Practical approaches to delivering pandemic impacted laboratory teaching

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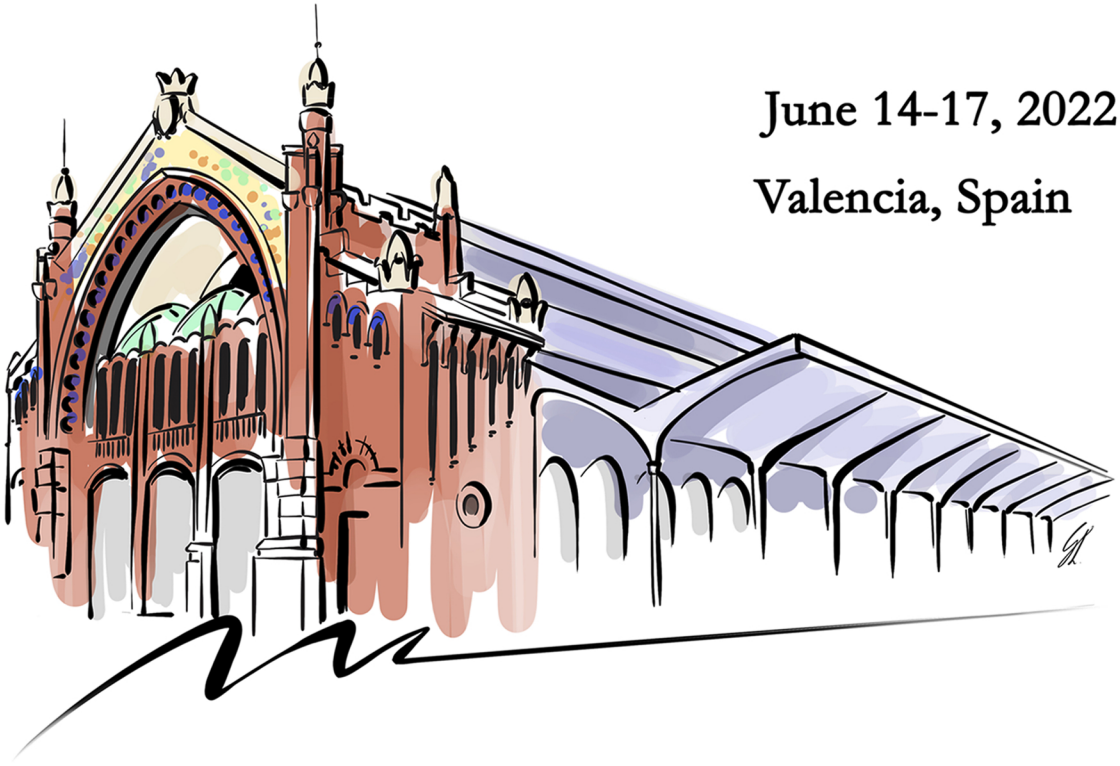
UNIVERSITAT POLITÈCNICA DE VALÈNCIA

HEAd '22

8th International Conference on Higher Education Advances



June 14-17, 2022

Valencia, Spain

ADE
FACULTAD DE ADMINISTRACIÓN Y DIRECCIÓN DE EMPRESAS. UPV

Departamento de Economía y Ciencias Sociales

Congress UPV
8th International Conference on Higher Education Advances (HEAd'22)

The contents of this publication have been evaluated by the Scientific Committee according to the procedure described in the preface. More information at http://www.headconf.org/

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Josep Domenech

Cover design by Gaia Leandri

Publisher

2022, Editorial Universitat Politècnica de València
Cno. de Vera, s/n.
46022 Valencia (SPAIN)
www.lalibreria.upv.es / Ref.: 6039_01_01_01

ISSN: 2603-5871
ISBN: 978-84-1396-003-6 (print version)
Print on-demand
DOI: http://dx.doi.org/10.4995/HEAD22.2022.15652

Preface

Josep Domenech
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Abstract

This is the preface for the eighth edition of the International Conference on Higher Education Advances (HEAd). The series of HEAd conferences has become a leading forum for researchers and practitioners to exchange ideas, experiences, and research results relating to the preparation of students and the organization of higher education systems. The eighth edition (HEAd'22) was celebrated between 15 and 17 June 2022 in Valencia, Spain, under a hybrid format: virtual and face-to-face simultaneously. This was the first time the delegates could meet in person after two years of remote participation due to the pandemic situation. This preface gives an overview of the aims, objectives, and scope of HEAd'22, as well as the main contents of the scientific program and the process followed in selecting the papers.

Keywords: *Higher education; innovative materials; educational technology; evaluation and assessment; globalization in education.*

1. Introduction to HEAd'22

This volume contains the selected papers of the Eighth International Conference on Higher Education Advances (HEAd'22), which was held in Valencia, Spain, from 15 to 17 June 2022. HEAd adapted to the evolving mobility restrictions related to the Covid-19 pandemic, and this eighth edition was held in a hybrid format: in-person and virtually, simultaneously. This made it the most complex edition in organizational terms, so far. The pandemic is teaching us that adaptation is key, as everything may change in a very short time period. The hybrid format is the response of the HEAd conference to the changing restrictions. Once again, the eighth edition was a great success of participation and consolidated the series of HEAd conferences as a leading forum for researchers and practitioners to exchange ideas, experiences, and research results relating to the preparation of students and the organization of higher education systems.

The selection of the papers for the scientific program was conducted by a team of 177 committee members representing 47 countries on all five continents. Following the call for papers, the conference received 270 full paper submissions with authors from 56 different countries. All the submitted papers were reviewed by at least two program committee members under a double-blind review process. Finally, 77 papers were accepted as full papers for oral presentation during regular sessions, representing an overall full paper acceptance rate of 28.5%. This selection ensures a high-quality program that is greatly valued by the research communities. Additionally, 52 submissions were accepted for short paper presentations and 34 for poster presentations, all of them receiving high review scores and published by UPV Press in this volume. The organization committee congratulates all the authors for having their papers accepted in the proceedings of such a competitive conference.

The contents of the program represent quite well the situation that global education is living by adapting to the mobility restrictions imposed during the Covid-19 pandemic. It is noteworthy that two of the most repeated topics are related to online and hybrid teaching. Skill and competency development was another current topic that attracted the interest of the scientific committee, together with the specificities of STEM education and the use of digital technology to support teaching. Emerging topics such as sustainability in education and gender studies also had their room in the program.

HEAd'22 also featured three keynote speakers that overviewed important and current topics: Cesar Ortega-Sanchez (Curtin University, Australia) talked about putting all the pieces together regarding student learning. The second keynote speech was delivered by José V. Benlloch-Dualde and Lenin Lemus (Universitat Politècnica de València, Spain) and dealt with a hot topic in higher education: Learning analytics or how to improve the teaching and learning processes from data.

The conference was supported and hosted by the Faculty of Business Administration and Management of the Universitat Politècnica de València, which has been recently ranked as the best technical university in Spain by the Academic Ranking of World Universities (ARWU) 2021.

The organizing committee would like to thank all of those who made this year's HEAd a great success. Specifically, thanks are indebted to the invited speakers, authors, scientific committee members, reviewers, session chairs, presenters, sponsors, supporters, and all the attendees. Our final words of gratitude must go to the Faculty of Business Administration and Management of the Universitat Politècnica de València for supporting, once again, the HEAd conference, making it possible to become a great event.

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Index

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14570

Integrating transversal skills into higher education in health and social care

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Abstract

International and national agencies have stated the need to shift the focus towards teaching-learning strategies that work on transversal skills throughout the training journey. It is especially relevant in health and social care, where these skills are usually taken for granted. These competencies are also essential in tackling gender inequities in health and social care, ensuring that the HE system does not prolong entrenched gender bias. To face these challenges, the ERASMUS+ project "ITSHEC - Integration of transversal skills into health and social care, higher education, and the curriculum" is developing practical tools to support opportunities to acquire and develop key competencies in different educational environments. The resources will address learning outcomes related to critical and creative thinking, interpersonal/socio-emotional and citizen-oriented skills and learning to learn.

Keywords: *Transversal skills; health and social care; teaching-learning strategies; learning outcomes.*

1. Introduction

The changing environment of today's societies requires constant transformation and adaptation, and professionals must continue learning to learn skills actively to adapt to changes and complexity. In the current situation and the future, the healthcare and social professions face the challenge of acting in complex and unpredictable problems: they are faced with an ever-ageing population, epidemiological transitions to chronicity, pandemic outbreaks (such as the currently ongoing Covid-19 pandemic), and increased social inequalities with the associated vulnerabilities, among other issues. Besides, Europe faces the global challenges of climate change and environmental degradation (green deal), digitalization while ensuring that technology serves the people, and inclusion and reduction of inequalities. All these challenges require professionals who can analyze situations using critical and creative thinking, make decisions when faced with large amounts of information and that involve the patient/user, and manage difficult (and mundane) situations with appropriate interpersonal and emotional skills. To meet these challenges, it's an important start to improve the training of healthcare and social services professionals in the area's transversal skills throughout their undergraduate and postgraduate training journeys.

It is the context of the ERASMUS+ project ITSHEC - Integration of transversal skills into health and social care, higher education and the curriculum, which aims to improve the training of healthcare and social services professionals in transversal skills throughout the undergraduate and postgraduate training journey. ITSHEC is a transnational cooperation project between higher education and pedagogical innovation institutions coordinated by The Universitat Pompeu Fabra (UPF) in Spain. The partner institutions are The ESIMar Nurse School of Barcelona, the Metropolia University of Finland, the Split University of Croatia and Immersium Studio (specialized in immersive education).

Based on recognizing the relevance of transversal skills in addressing the challenges of the future, this project is developing practical tools to support opportunities to acquire and develop key competencies in different educational environments: face-to-face training, simulation and e-virtual learning. Furthermore, it benefits future professionals, patients, and clients since professionals with these skills can offer better healthcare and social care based on a patient/user-centred approach. In this paper, we present one of the project's main products, a Methodological Guide that gathers the most appropriate and innovative teaching-learning strategies to support the development of transversal skills. It also includes a pedagogical framework and an evaluative framework for transversal skills.

2. Methodological Guide to Develop Transversal Skills

The Methodological Guide entitled "Learning strategies to promote transversal skills on health and social care studies" is the first product of this project. It has been created to offer

different strategies for developing students' transversal skills, specifically critical and creative thinking, interpersonal/socioemotional and citizen-oriented skills and learning to learn, particularly in healthcare and social care. The primary use of the methodological guide is to assist lecturers in planning, to integrate it into their teaching activity, and evaluating the improvement of transversal skills in undergraduate and postgraduate students.

2.1. Pedagogical Framework for Transversal Skills

One of the gaps identified in the European Higher Education Area (EHEA) is a lack of implementation of teaching-learning strategies to work on transversal skills throughout the overall educational continuum in healthcare and social care. This situation relates, among other factors, to the absence of a framework that defines the gradation of skills development: although there are numerous classifications and definitions, it is necessary to establish a gradation by levels that state the degrees of skills development and associated specific learning outcomes.

In this sense, the first part of this material is a Pedagogical Framework intended to support lecturers who strive to implement transversal skill training into their subjects, courses, and modules. Additionally, the guide aims to help plan the lessons, specific activities, and learning outcomes that intend to work on transversal skills. We have defined different dimensions for each skill with their respective learning outcomes, based on previous reports, studies, pedagogical references, and European qualifications frameworks, especially the European Qualifications Framework (EQF) and the Finnish National Framework for Qualifications Other Competence Modules (FiINQF).

We also present a level scale that seeks progressive and continuous integration of transversal skills training throughout the academic and professional journey (Bacigalupo et al., 2016). It also facilitates a student-centred approach as it allows the starting point for each student (individual level of development) to be assessed.

To illustrate what includes the Pedagogical Framework, "Table 1" shows the dimensions that have one of the transversal skills of the ITSHEC project (interpersonal/socioemotional) and the associated learning outcomes.

Table 1. Transversal knowledge, skills, and learning outcomes in ITSHEC.

Skills	Dimensions	Learning outcomes
Interpersonal /socioemotional	Communication	Able to express ideas clearly and fluently. Able to use precise and descriptive/content-specific vocabulary to enhance the topic or message. Able to share information in an organized and interesting way. Able to share an analysis of the main message to interpret, synthesize and/or evaluate the meaning of the content to draw a logical conclusion about the topic. Able to show empathy and use non-verbal communication and active listening.
	Reflection and responsibility	Able to self-reflect, evaluate one's own actions and emotions, and take responsibility for own actions. Has the ability to develop improved professional and social-emotional responsibilities. Able to perform tasks efficiently and carefully. Able to persevere in the face of difficulties.
	Relationships	Able to develop positive and emotionally safe interactions and co-create teamwork. Able to reflect and manage emotional and self-regulation and to show empathy in professional relationships.
	Partnership, network and cooperation	Able to work cooperatively with others: listens to others, incorporates what others say, encourages peers' participation, engages in group decision making, helps peers selfishly, and accomplishes shared goals. Able to act and cooperate with others autonomously under structured conditions and to take account of various social roles and emotions in various contexts Has the ability to build network and partnerships in changing interprofessional and disciplinary (projects) teams and innovate/reform it into a complex and unpredictable world.

Skills	Dimensions	Learning outcomes
		Able to develop leadership by understanding the needs of others and being aware of their feelings and thoughts; and facilitate collaborative and participatory problem-solving.
	Conflict management	Has the capacity to create a non-discrimination atmosphere and to handle demanding situations of conflict. Able to facilitate conflict resolution, remain calm under pressure and control emotions in conflict situations.
	Cultural sensitivity	Able to evaluate and develop one's cultural awareness. Has the knowledge, awareness and acceptance of other cultures and the willingness and capacity to understand people from different backgrounds and embrace diversity.

2.2. Teaching-learning methodologies and evaluation of Transversal Skills

The project team has conducted a detailed literature review to identify the principal learning methodologies used to work with transversal skills. From this previous review, we choose six methodologies that proved to be suitable for improving these skills, as well as methodological aspects to be considered when the objective of the training is to foster the development of students' transversal skills:

1. Problem-based learning is a widespread methodology in higher education that uses realistic problems as a starting point for the learning process. The main benefits of using PBL are that it promotes deep learning (Dolmans, 2015) and long-term knowledge acquisition (Schmidt, 2011). It is also an excellent context for developing transversal skills (Carrió, 2016; Rodriguez, 2019).

2. Roleplaying is an experiential teaching-learning strategy that encourages student participation by proposing different cases and scenarios in which the students must develop specific roles (different from their own). (Collins, 2004; Shearer and Davidhizar, 2003)

3. Virtual Reality environments allow students to be immersed in a highly realistic, vivential first-person learning experience that only requires a VR headset. As a result, VR environments are emerging as a fundamental learning methodology for distance and life-long education (Eckert and Mower, 2020).

4. Cooperative learning is a pedagogical practice that involves students working together to achieve goals that would otherwise not be performed or completed working alone. It is a recognized way to promote learning in different kinds of subject areas and develop transversal skills (Barkley et al., 2014).

5. Simulation in health sciences is defined as a tool that creates a situation or environment to allow people to experience a representation of a real health care situation for practice, learning, evaluation, testing or further investigation of human actions in a safe environment (McGaghie et al., 2010; Lopreiato et al., 2016).

6. Gamification uses game elements outside the context of a game (Bedwell et al., 2012) to improve and enhance students' learning outcomes (Landers, 2014). This methodology influences students' motivation levels, increasing their participation in activities and the acquisition and integration of learning outcomes (Fitz-Walter et al., 2011).

The guide also brings specific content about including a gender perspective in teaching and learning. We firmly understand that having transversal skills and related learning outcomes in the curriculum should involve a gender-sensitive approach. Gender mainstreaming is a fundamental aspect of the quality of the education provided, and this guide also seeks to encourage teaching with a gender perspective. A professional with gender equality skills requires commitment, methodological expertise, and specialist knowledge. In addition, it stimulates students' critical thinking capacity, providing them with new tools to identify social stereotypes, norms and roles related to gender. Therefore, the gender perspective should embed any learning activity that seeks to develop students' transversal skills (WHO, 2007; European Institute for Gender Equality, 2019).

Besides the contents mentioned above, the guide includes a methodological framework to evaluate the development of students' transversal skills. The evaluation framework consists of a multi-method approach that integrates multiple perspectives (student, teacher, peer-to-peer) and tools (rubrics, checklists, scales, evaluative argumentation, portfolio, among others). Furthermore, it explains how to plan, design, and use the different methods and tools for evaluating transversal skills. Including this evaluation framework in this guide is particularly relevant since it will facilitate the incorporation of the evaluation in the design of the training activities (Boud, 2020).

2.3. Student's perception of Transversal Skills

Finally, since in ITSHEC project cooperation and co-creation is elementary, this guide presents a final chapter with the results of seven focus groups with more than 30 students from different healthcare and social care degrees (medicine, nursing, dental medicine, human biology, social sciences, social work, etc.) and various European countries. The main

objective was to explore their engagement and preferential teaching-learning approaches and to adapt and optimize the educational content and methodologies.

The results indicate that students perceive that curricula and training programs for professionals have gaps in their approach to transversal skills: they are excessively centred on the transmission of knowledge per se rather than on the teaching-learning strategies, which are fragmented and limited to subjects and/or disciplines. This fragmentation is also present in professional practice in the health and social services, where there is not enough implementation of interdisciplinarity and the service-user/patient-centred approaches in everyday practice. It is also evident that the acquisition and development of transversal skills and the formal, structured knowledge obtainment for each area and discipline are fundamental during university studies. According to the students' perceptions, this transversal knowledge is essential for training effective professionals.

3. Conclusion

Higher education is a versatile process that offers students the possibility to develop their knowledge, abilities, and attitudes to participate actively in broader society, be active citizens, and develop successful professional careers. Therefore, the development of transversal skills should be a continuous, participatory, and dialogical process. In this sense, we need new teaching-learning approaches to address transversal skills. These approaches will require a change in the role of teachers, from being knowledge transmitters to being learning facilitators and a playful attitude on the part of students. It is essential to recognize the transversal skills as assessable learning objectives here. For this reason, it is necessary to introduce assessment strategies for these skills into the curricula, with clear and accessible guidelines for students, including student involvement in the assessment process (tools for self-assessment and peer evaluation). We assume that if lecturers employ more appropriate (adapted to target needs) training and assessment strategies, students could achieve a higher degree of development in critical thinking, interpersonal skills, and learning to learn.

References

Bacigalupo, M., Kampylis, P., Punie, Y., Van den Brande, G. (2016). EntreComp: The Entrepreneurship Competence Framework. *Luxembourg: Publication Office of the European Union,* 10, 593884.

Barkley, E., Cross, P. & Major, C. (2014) *Collaborative Learning Techniques: A Handbook for College Faculty*, 2nd Edition. Jossey-Bass.

Bedwell, W.L., Pavlas, D., Heyne, K., Lazzara, E.H., Salas, E. (2012). Toward a taxonomy linking game attributes to learning: An empirical study. *Simulation & Gaming*, 43(6),729-760. doi:10.1177/1046878112439444

Boud, D. (2020). Challenges in reforming higher education assessment: a perspective from afar. *Revista electrónica de investigación y evaluación educativa*, 26(1), art. 2m. http://doi.org/10.7203/relieve.26.1.17088

Carrió, M. Agell, L., Baños, J.E., Moyano, E., Larramona, P., Pérez, J. (2016). Benefits of using a hybrid problem based learning curriculum to improve long term learning acquisition. FEMS Microbiology Letters, 363, 1-7.

Collins, J. (2004) Education techniques for lifelong learning: giving a PowerPoint presentation: the art of communicating effectively. *Radiographics*, 24(4),1185-1192. doi: 10.1148/rg.244035179.

Dolmans, D., Loyens, S., Matcq, H. & Gijbels, D. (2015). Deep and surface learning in problem-based learning: a review of the literature. *Advances in health sciences education*. Doi: 10.1007/s10459-015-9645-6.

Eckert, D., Mower, A. (2020) *The effectiveness of virtual reality soft skills training in the enterprise: a study.* Retrieved from: https://www.pwc.com/us/vlearning.

Finnish National Agency for Education (2018). *Finnish National Framework for Qualifications* (FiNQF). Retrieved from: https://www.oph.fi/en/education-and-qualifications/qualifications-frameworks.

Fitz-Walter, Z, Tjondronegoro, D. & Wyeth, P. (2011) Orientation passport: using gamification to engage university students. In *Proceedings of the 23rd Australian Computer-Human Interaction Conference*, ACM, Australian National University, Canberra, ACT, 122-125. Doi: https://doi.org/10.1145/2071536.2071554

European Institute for Gender Equality (2019). *Gender mainstreaming and institutional transformation* [Internet]. Retrieved from: https://eige.europa.eu/gender-mainstreaming/toolkits/gender-institutional-transformation/gender-mainstreaming-and-institutional-transformation

WHO (2007). Integrating gender into the curricula for health professionals: Meeting Report. Geneva, Switzerland: Department of Gender, Women and Health, p. 3–32.

Landers, R. N. (2014). Developing a theory of gamified learning: Linking serious games and gamification of learning. *Simulation & gaming*, 45(6), 752-768. Doi: 10.1177/1046878114563660.

Lopreiato J O. (2016). *Healthcare Simulation Dictionary*. Rockville, MD: Agency for Healthcare Research and Quality. AHRQ Publication No. 16(17)-0043.

McGaghie, W.C., Issenberg, S.B., Petrusa, E.R., Scalese, R.J. (2010). A critical review of simulation-based medical education research: 2003-2009. *Medical education,* , 44(1), 50-63. doi: 10.1111/j.1365-2923.2009.03547.x.

Rodríguez, G., Pérez, N., Núñez, G., Baños, J. E., and Carrió, M. (2019). Developing creative and research skills through an open and interprofessional inquiry-based learning course. BMC medical education, 19(1), 134

Schmidt, H. G., Rotgans, J. I., & Yew, E. H. J. (2011). *The process of problem-based learning: What works and why. Medical Education*, 45(8), 792–806. https://doi.org/10.1111/j.1365-2923.2011.04035.x

Shearer, R., & Davidhizar, R. (2003). Using role play to develop cultural competence. *The Journal of nursing education*, 42(6), 273–276.

The European Qualifications Framework for Lifelong Learning (EQF). (2008) Luxembourg: Office for Official Publications of the European Communities. 2008. http://www.ehea.info/media.ehea.info/file/Framework_for_qualifications/69/0/EQF-LLL-2008_596690.pdf

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14463

Introduction to bioethics through mobilization of critical thinking skills

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Abstract

A course design to 'learn by doing' and to encourage critical thinking and reflective abilities, was initiated in the context of bioethics teaching. Critical thinking is a process that transcends disciplines, committing students to be actors of their learning. The course design combines formal teaching sequences, group work sequences and interactions (or exchanges between students). The students are confronted with authentic cases bringing values into conflict, which they will have to present. Using evaluation grids the students have designed, they can self-assess and assess their peers. They also benefit from teacher feedback between their oral presentations. The impact of the course design was assessed by analyzing student productions, using a questionnaire and performing group interviews. The data collected suggested that the students are particularly invested in their learning, while becoming aware of the objectives targeted by these teaching. Several strong points were raised and are discussed in this communication.

Keywords: *Critical thinking; bioethics; evaluation grid.*

1. Introduction

1.1. Context

The need for the development of a critical mind in students responds both to the demand for a society that upholds the values of democracy (Lecointre, 2018), and to a French ministerial injunction that defines critical mind as a set of attitudes and habits related to discernment, thinking and vigilance over one's judgments and those of others.

Students are exposed to a growing body of information and hoaxes, which requires the mobilization of a body of tools and knowledge to guide and to distinguish facts from interpretations, as well as truth from error. Managing this critical mass of information disrupts the relationship to knowledge: how to learn and how to teach in a context where there is immediate access to a multitude of content where knowledge, pseudo-knowledge, beliefs and opinions are mixed together?

Critical thinking training and the practice of critical thinking emerge as opportunities to explore tools and ways of working that can be appropriated by students and transferred to other areas. Critical thinking transcends disciplines: it engages students to be actors, to position themselves as citizens, through skills that implement both careers and personal lives.

The ethical issues linked to advances in medicine and biology are debated at regular intervals and are reflected in legislative texts, as for bioethics. This discipline has never been so fundamental for facing the challenges and issues that await us in the coming decades. We noticed a need among undergraduate students to understand ethical issues when working on raising awareness of the ethical dimensions of research protocols in animal experimentation (Bodart and Dupré, 2020). Critical thinking can be also seen as an important part of teaching ethics itself. It is, for example, included in the code of ethics of teachers who are members of the French-speaking pedagogical society (Prairat, 2006).

We recently aimed at clarifying with our students the ethical contexts of the knowledge taught, especially in the field of research in animal experimentation, genetic technologies, environmental threat, development of neurotechnologies, and aimed at stimulating their critical thinking. These concerns have led to the creation in 2020-2021 of two introductory bioethics modules, in the second (L2) and third (L3) years of the Bachelor mentioning in Cellular Biology and Physiology (LBCP). Such modules were also opened to L2 students mentioning in Biochemistry or in Biology of Organisms and Populations. These optional modules were included in the knowledge and skills block "Positioning yourself in a career / professional field". The objective of these lessons was to allow students to make well-argued and defended choices, as well as to become aware that the critical mind is part of an action, the learning of the mechanisms of which benefits both their professional orientation and to their personal life.

1.2. Nature of critical thinking and critical thinking training

Ennis (1987) defined specific capacities and attitudes characteristic of critical thinking while cognitive strategies were established by Paul, Binker, Martin & Adamson in 1989. Training in critical thinking had been noticeably studied by Boisvert, who offered conditions and illustrations of pedagogy in this area (Boivert, 2015). Critical thinking is characterized as a reflective process in which the propensity for self-correction is essential (Ennis, 1987; Lipman, 2003). According to McPeck (1981), critical thinking is best practiced when the student has in-depth knowledge in a particular field.

Three approaches have been reported for critical thinking training: (1) a general approach, which presents the elements of critical thinking separately from the subject of the teaching, (2) an infusion approach, where the students have the theoretical elements of the critical thinking provided as guides and where these elements are addressed in a context, (3) an approach by immersion, where the principles are not explicit but are developed implicitly during the lessons. The combination of an immersion approach and an infusion approach seemed to be the approach that exhibited the most positive effects to improve students' critical thinking skills (Abrami et al, 2015).

In the context of bioethics teachings, a combined approach has been therefore favored, (1) where the capacities relating to critical thinking have been clearly exposed to the students and (2) where the students are confronted with authentic cases, highlighting conflicts of values. The method chosen was based on group work, brainstorming activities, individual reflective activities, co-construction of evaluation grids, oral presentations and co-construction of knowledge.

1.3. Learning by doing

Our aim was therefore to develop and evaluate a teaching which encourages critical thinking and the capacities of the students to exert reflexivity on their thoughts, with the objective of increasing their capacities to argue from simple ethical lines. Therefore, the choice was made to drive the students in front of complex ethical situations, which they had to present and discuss the historical, scientific and ethical contexts. One has to note that these courses were for the majority of students their first contact with bioethics. The approach was to get them to manipulate concepts as well as to practice critical thinking and evaluate their practice. The method was presented as a process allowing to take a step back towards one's own beliefs, as well as to succeed in establishing the validity of certain facts or not. The methods used were also based on co-construction techniques and emphasized to the students the importance of group work.

These two modules were designed with strong inspiration from the Learning and Assessment Situations (LES), defined by Georges and Poumay (2020) to assess skills. Indeed, they are

based on four points : (1) students must be confronted with complex problems which require research, thinking and generate awareness (learning by doing); (2) the situations with which the students are confronted, must be close to the reality of professional life (situations with high authenticity) ; (3) learning and assessment should be combined so that the teacher can see students in action, and provide to the students the opportunity for self-assessment and constructive feedback; (4) an integrative dimension, which requires the use of knowledge from different fields. We also coherently articulate the three pillars of pedagogical alignment in the construction of these two teaching modules: objectives, method and evaluation (Biggs, 2003).

2. Courses design

The courses of this module have been developed in two ways, according to time constraints imposed by the Bachelor mention architecture and referred hereafter as L2 for second year courses and L3 for third year courses. Due to the Covid situation, the teaching were performed at distance during the year 2021The teaching in L2 consisted of 4 courses of 1.5 hours each, and three practical teaching sessions (volume = 10 hours). The scheme of the teaching sessions is depicted in figure 1 for L2 students .

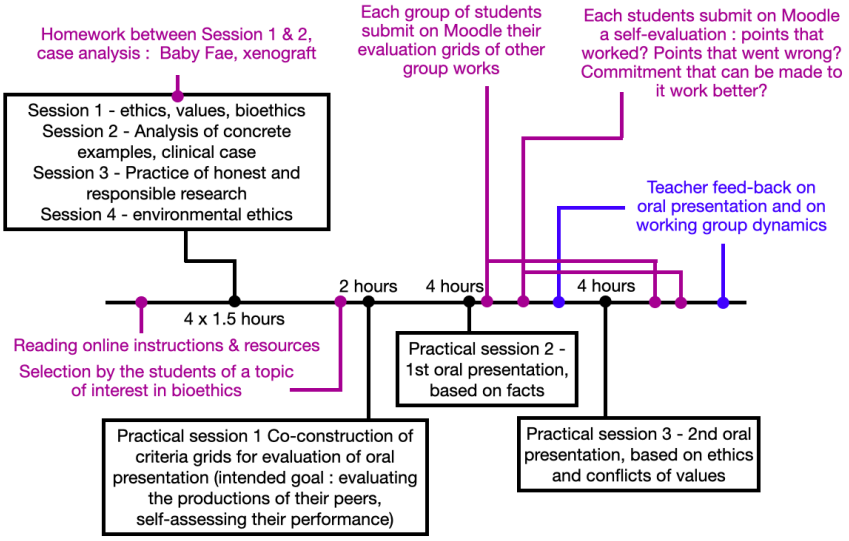

Figure 1. Overall scheme of teachings. Sessions performed with the teacher are indicated in black. Activities that shall be performed by the students are indicated in purple. Activities performed by the teacher are indicated in blue.

The first course aimed to present the module: definition of ethics, main currents of thought in ethics, notion of moral dilemma, notion of values and definition of the perimeter of bioethics. The second course was devoted to discuss a case analysis (xenograft of a baboon heart into a newborn, referred as Baby Fae case (Cifarelli, 1985)) and moral dilemmas related to scientific misconduct (i.e. fraudulent link between vaccine & autism; Flaherty, 2012). The third and fourth courses dealt respectively with the practice of honest and responsible research, and environmental ethics. In L3, topics related to environmental ethics were not directly addressed with the students due to time constraint and due to the consideration of their specialization and specific interest areas in cell biology and physiology.

Asynchronously, the students formed working groups and selected themes to work on: 4 themes had to be chosen from 6 themes proposed by groups of 16 students. The practical lessons were divided into three sessions of 2, 4 and 4 hours respectively.

The first practical session was scripted as follows: (1) presentation of instructions (15 min), examples of tables and expectations; group work, determination of criteria and descriptors (1 h), (3) pooling of the grids produced and discussion (45 min in L2, 30 min in L3).

The first practical session was devoted to creating an evaluation grid (criteria grid). The purpose of this evaluation grid is to be used by students to evaluate the presentations made during the second and third practical work sessions. It was explained that the creation of this grid aims to encourage their critical thinking, so that they can take a critical and reasoned look at any oral presentation, and be able to support discussions at the end of the presentations. Two examples of evaluation grids were provided; the constituent elements of a grid were discussed: criteria, performance levels and descriptors. Based on the work of Ennis (1987) and Paul, Binker, Martin & Adamson (1989), several tables have been provided so that students can identify criteria specific to critical thinking. During this practical session, students were told that they will be assessed on the evaluation grid created and how they will use this grid, as well as on the two oral presentations. Each grid created by the students was submitted on the Learning Management System Moodle (institutional and online pedagogic platform used by the University of Lille) within 24 hours after the session. This grid was not considered final until the end of the third practical session, when it was used for the evaluation of the oral presentations of the other groups.

The other two practical sessions were scripted as follows: (1) oral presentation + question-and-answer phase (15 min + 15 min; 4 groups maximum per session), (2) break (15 min, L2 only), (3) discussion phase where each group evaluated, according to their co-created grids, the presentations of the peers (30 min), (4) individual self-assessment phase on the group work (15 min for L2, carried out asynchronously for L3), and (5) a pooling phase (15 minutes per group). The assessment and self-assessment sheets were submitted on the Learning Management System Moodle after the session.

Between practical sessions 2 and 3, the teacher provided feedback on several lines, emphasizing areas for improvement in (1) group production and (2) group work.

3. Evaluation

We performed an evaluation of the courses. The objective of such evaluation was to improve the teaching: since 2021 was the first year of completion of this teaching, it was therefore necessary to optimize the teaching design. The evaluation system was made up of the following elements:

- An analysis of students' evaluation grid productions by the teachers. The evaluation grids constructed by the students were analyzed (Figure 2). Teacher's evaluation grid of this work includes 6 criteria, which evaluate the criteria chosen by the students, as well as the description of the expected performance levels : (1) clarity of criteria, (2) independence of criteria, (3) expression and clarification of strategies, aptitudes and capacities specific to critical thinking (4) clarity of descriptors, (5) differentiation of the levels of performance, (6) use of the grid by students (support for metacognition). One has to note also that four performance levels have been established and described: insufficient, acceptable, good and very good.

- A questionnaire. An anonymous questionnaire was carried out using the LimeSurvey software. The same questionnaire was submitted to both L2 and L3 students. It was made up of 23 closed questions and 3 open questions. The closed questions were organized according to 5 categories: (1) general appreciation, (2) lessons, (3) animation of the lesson and interactions, (4) activities and (5) evaluation. The open-ended questions focused on the relevance of teaching in their training, on the three strengths of teaching and the last question invited students to provide suggestions for improving teaching.

- Group interviews. In addition to the questionnaire, two collective interviews with L2 students were carried out. The objective of the interviews was (1) to question the students on the contributions of the teaching to the building of their career, and (2) to address the connections between the objectives of the teaching and the way in which the courses are dispensed. These interviews were designed to deepen and / or clarify the data collected by the questionnaire.

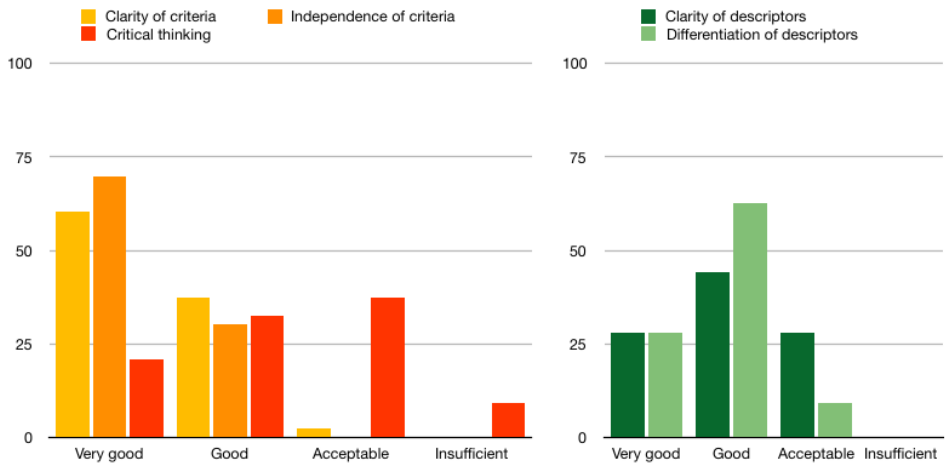

Figure 2. Analysis of co-created grids of evaluation. 43 grids were analyzed immediately after their co-construction by the students. Metacognition criteria and use of the evaluation grids by the students was assessed at the end of the teaching, and was not included in this figure.

4. Results and discussion

The lessons were built as mixed approaches. The students were confronted with authentic cases bringing into conflict ethical values which they will have to explicit. Using the evaluation grids they have designed, students were able to self-assess and assess oral presentations of their peers. They also benefited from teacher feedback between their oral presentations during practical sessions 2 and 3.

The student productions (oral presentations) drove us to conclude that students correctly understood the different currents of thought in bioethics and were able to produce materials that transcribe their ability to argue and develop simple ethical links. L2 students apprehended in a globally satisfactory way the exercise of co-building of the grids of criteria (Figure 2). L2 and L3 students exhibited performance levels that were distributed in a similar manner. Drafting clear and independent criteria did not raised major difficulties. One group out of four had difficulties to handle the use of critical thinking criteria in their evaluation grids.

By relying on the results and observations from questionnaires, interviews and analysis of student productions, several teaching strengths emerged: (1) students felt involved in their teaching, due to the development and maintenance of interactivity with them, and among themselves; 20 students (out of 40, L3) identified the interactions and discussion phase as strengths for this teaching, (2) the aims of the module had been understood by the students; the teaching clarified their vision of science, and their representation of bioethics, which no

longer appeared as abstract (L2: 6 students out 12 who answered the poll; L3: 19 students out of 40 expressed this idea), (3) the feedback provided, as well as the peer review, allowed the students to evolve and see themselves progressing through mobilization of critical thinking skills: respectively 16.6% and 20% of the L2 and L3 students who answered the questionnaire acknowledged the importance of this feedback. The 4 dimensions relating to Learning and Assessment Situations (Georges and Poumay, 2020) noticeably appeared in the students' feedbacks: a complex situation that mobilizes a critical mind, a situation close to professional reality, self-assessment and constructive feedback, and interdisciplinarity. We also surprisingly observed that 1 out of 4 students (either in L2 or L3 students' responses) stressed the importance of the teacher's involvement and attitude.

According to interviews and questionnaires, the importance of interactions was stressed by the students: "I wouldn't have gone this far on my own". Several strengths of this teaching were underlined by students: (1) interactions between students and teacher are considered (formative evaluations), (2) feedback from self-evaluations, which build a space to act together in a positive and constructive manner, (3) group work (diversity is perceived as an advantage and this joint action between teaching actors, teachers and students, could be analyzed with reference to the work of Sensevy (2011)), (4) creation of "a space for free and respectful speech", where "knowing how to listen to others" and "being listened to" (posture of the teacher) are essential. Therefore, we would like to stress that the tensioning of the teacher's posture is therefore important in a professional practice which aims to promote interactivity.

Several areas for improvement have emerged: (1) modification of the courses in order to increase interactivity and that students can have a better quality interaction space, (2) vigilance on the clarity of instructions and insistence on their understanding by all students, (3) the reformulation of certain thematic proposals, since the relevance or feasibility of a few topics were raised by several students, (4) an optimization of the time management between two presentations, allowing the teachers to improve the quality of the feedback and enabling the students to integrate the provided feedbacks, (5) the addition of a feedback on the evaluation grid that they produced, in order to reassure them or to guide them to improve on criteria or descriptors.

The conclusions of the course evaluations lead us to several observations, including that the students appreciated to develop their critical thinking: "it was not simply a question of sitting down and listening to a list of problems, but of thinking through ourselves, to deepen the reflection instead of learning something by heart." Students became aware of their ability to evaluate not only their own performance but also the one of their peers. Teaching support and self-assessment tools could be easily transferred to other teachings.

Acknowlegments

The authors would like to thank Yanele Poteaux, Céline Meurice and Aurélie Dupré (service de conseil et d'accompagnement à la pédagogie, Direction Innovation Pédagogique de l'Université de Lille) for their pedagogical assistances and fruitful discussions.

References

Abrami, P. C., Bernard, R. M., Borokhovski, E., Wade, A., Surkes, M., Tamim, R., Zhang, D. A. (2008). *Instructional interventions affecting critical thinking skills and dispositions: A stage one meta-analysis*. Review of Educational Research, 78, 1102–1134.doi.org/10.3102/0034654308326084

Bodart J.F., Dupré A., (2020) *Animal experimentation in transgenesis : evaluating course design in large classrooms*. FEBS Open Bio 10(6). doi.org/10.1002/2211-5463.12846

Boisvert J. (2015) *Pensée critique : définition, illustration et applications.* Revue québécoise de psychologie, 36 (1), 3-33.

Cifarelli P. S. (1985). *Baby fae.* West J Med 1985 Mar;142(3):401-2.

Ennis, R. H. (1987). *A taxonomy of critical thinking dispositions and skills.* In Baron, J., Sternberg, R. (Eds.), *Teaching thinking skills: Theory and practice* (pp. 9–26). New York, NY: W. H. Freeman.

Flaherty D.K. (2012) *The vaccine-autism connection: a public health crisis caused by unethical medical practices and fraudulent science.* Ann Pharmacother. 45(10):1302-4.doi: 10.1345/aph.1Q318.

Georges, F et Poumay, M. (2020). *Créer des SAE - Guide de soutien à la création de situations d'apprentissage et d'évaluation en contexte d'APC*. ADIUT (Eds) http://hdl.handle.net/2268/254034

Lecointre G. (2018) *Savoirs, opinions, croyances, une réponse laïque et didactique aux contestations de la science en classe*, Belin Eds.

Lipman, M. (2003) *Thinking in education*. New York : Cambridge University Press.

McPeck J.E. (1981) *Critical thinking ad education*. New York, NY: St. Martin's press.

Paul, R., Binker, A., Martin, D., & Adamson, K. (1989). *Critical thinking handbook : High school (a guide for redesigning instruction).* Foundation for Critical Thinking. ISBN-0-944583-03-2

Prairat E. (2009), *De la déontologie enseignante*, Paris cedex 14: Presses Universitaires de France.

Sensevy S. (2011) *Le sens du Savoir. Eléments pour une théorie de l'action conjointe en didactique.* De Boeck. Bloom, B. S. (1956). *Taxonomy of Educational Objectives.* New York: David McKay.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14674

Learning of Pharmacogenetics in human medicine students through PBL and ICTs

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Abstract

Objective: To describe the learning achievement after training in pharmacogenetics based on PBL and ICT and its persistence four years later in human medicine students of a public university in Peru. Materials and Methods: 160 students who received training on the pharmacogenetics of warfarin applying PBL and ICT were evaluated. The instrument was based on a clinical problem applied immediately after training and 4 years later. Results: Results of the first evaluation indicated a good analytical resolution of the problem with argumentation in the genetic conditions of the patient. The evaluation after four years showed that 89% of the students continued at higher levels of learning. Conclusion: It was shown that the use of a meaningful learning methodology with PBL and ICT can make knowledge last and serve in the future for decision-making in the selection of medication.

Keywords:*Pharmacogenetics, Warfarin, Problem-Based Learning, Students, Medical.*

1. Introduction

Pharmacogenetics is a discipline that allows determining an optimal drug for a patient according to their genetic characteristics (Valdes & Yin, 2016). The genetic variability of each individual has relevance for dosage and treatment (Bishop, 2018). Currently, more than 30 drugs used for the central nervous system contain pharmacogenetic information on the product label, which refers to genetic variation in drug metabolism (Bishop, 2018).

Warfarin is an oral anticoagulant, the most prescribed for the diagnosis of thromboembolism (Shendre, Dillon, Limdi, 2018). However, its great variability between patients complicates its treatment with this drug (Alawan, Voils, Hartzema, 2017). Research has identified genetic factors that influence warfarin dosage, the most significant being single nucleotide polymorphisms in CYP2C9 (major drug-metabolizing enzyme) and VKORC1 (warfarin-inhibited target protein) (Shendre et al., 2018)

Medical education in Pharmacogenetics is still incipient. A cross-sectional study surveyed 900 medical students, finding that the average score of knowledge about the topic is low, even though there was a positive attitude towards pharmacogenetics (Zawiah, et al., 2021). In another investigation, the main barriers that the students identified in the implementation of genomic medicine and pharmacogenomics were the lack of training (59.7%) and lack of clinical practice guidelines (58.7%) (Rahma, et al., 2020)

The present study was carried out with the objective of determining the persistence of learning of the pharmacogenetics of the warfarin polymorphism in a population of human medicine students, through the use of Information and Communication Technologies (ICT) and Problem-Based Learning (PBL).

2. Materials and methods

Longitudinal study that evaluates the knowledge achieved after a training in pharmacogenetics based on PBL and ICT and its persistence four years later. The study population consisted of 160 third-year students from the Human Medicine School of the Universidad Nacional Mayor de San Marcos enrolled in 2014.

The training consisted of 10 hours (synchronous and asynchronous) of collaborative work. Different didactic materials were designed such as 1) Online guides for students and teachers, 2) Collaborative work strategies, 3) Creation of a virtual classroom where the material to be used and discussion forums were available, 4) Elaboration of a problem case related to polymorphism of metabolization of Warfarin and 5) Preparation of digital evaluation forms. In addition, other ICTs used were: search for information in databases and video viewing to review extraction techniques of DNA, PCR amplification and use of electrophoresis.

The students were divided into 16 teams, each led by a student and a teacher to discuss the genetic polymorphisms that altered the dosage of Warfarin, then present the findings and suggest an appropriate treatment. Participation in the study was voluntary, confidential, and had no influence on the grades of the subjects that the students were taking. The work was approved by the Ethics Committee of the Faculty of Human Medicine, UNMSM.

The instrument for measuring knowledge was based on solving the clinical problem: "Evaluation of CYP 2C9 and VKORC1 Polymorphism for Warfarin Administration"[1]. The instrument consisted of 4 open questions in google form and lasted 30 minutes. The evaluation of the answers was carried out by the teachers using a competency evaluation matrix with a score from 1 to 20, which was then categorized into 4 levels: Excellent, Very good, good and disapproved. (see table 1)

Table 1: Competency evaluation matrix.

Area	Competence	Score
Cognitive and procedural	Identify the problem of polymorphisms	1-5
	Explain the biotransformation of Warfarin	1-5
	It explains the results of the polymorphisms found and their relationship with therapeutic efficacy.	1-5
	Establishes therapeutic strategies, analyzes the main pharmacological groups for their safety and efficacy, showing polymorphisms and selects doses.	1-5
Attitudinal	Teamwork,	1-5
	Clear, precise exposure.	1-5
	Resolution of doubts with critical analysis	1-5

Source: Elaboration of the authors

The first measurement was carried out immediately after the end of the training, where in addition to the measurement of knowledge, other indicators of the learning process were measured, such as the creation of mental maps, co-evaluation among students of the same group (score from 1 to 20) and a self-evaluation. following the Bloom scale (score from 1 to 20)

[1] Available at https://drive.google.com/file/d/1oYqeOboS5ztvbqokFq74iRmGrWgkUT0O/view

Table 2: Co-evaluation matrix.

Values	Top Score.	Description
Commitment	4	Commitment to individual and collective self-learning with all team members through collaborative work.
Puntuality	2	Punctuality in the scheduled meetings and with the delivery of the work assumed.
Responsibility in the entrusted work	4	Responsibility for individual work and work with the team, towards the achievement of comprehensive learning.
Team Contributions	4	Contributions in synthesis of the reviews carried out based on indexed sources.
Ethical considerations of collaborative work	3	Ethical considerations in individual and team work, respect, assertive dialogue, avoid plagiarism, solidarity and altruism.
Reflections made	3	Reflections made for the construction of knowledge, self-assessment, co-assessment and the achievement of metacognition (how much did you learn about the subject, how does this knowledge demonstrate).
Total	20	

Source: Elaboration of the authors

The second measurement was made 4 years later. The same students were contacted and only the instrument was applied to measure knowledge based on the same clinical problem of the use of Warfarin. The qualification was carried out by the same teachers of the first measurement.

3. Results

All 160 enrolled students completed the Pharmacogenetics training and participated in the final evaluation. During the knowledge evaluation that was carried out immediately after the training, the elaboration of mental maps was also requested to reinforce the learning process. Each group developed a mental map evidencing the resolution of the problem with arguments based on the patient's genetic conditions, the drug analyzed, and the risks (safety) or benefit (efficacy).

The average of the qualification of knowledge on Pharmacogenetics obtained in the first measurement was 17.1 ± 1.2 points, where 67% of the students achieved the Excellent learning level, 22% achieved the "Very good" level, 8% achieved the "Good" level and 3% achieved a "Poor" level. Additionally, a co-evaluation between peers and a self-evaluation were carried out, obtaining average grades of 16.5 ± 1.7 and 6.6 ± 1.6, respectively. The scores of these two evaluations did not present a statistically significant difference with the knowledge score given by the teachers ($p<0.01$).

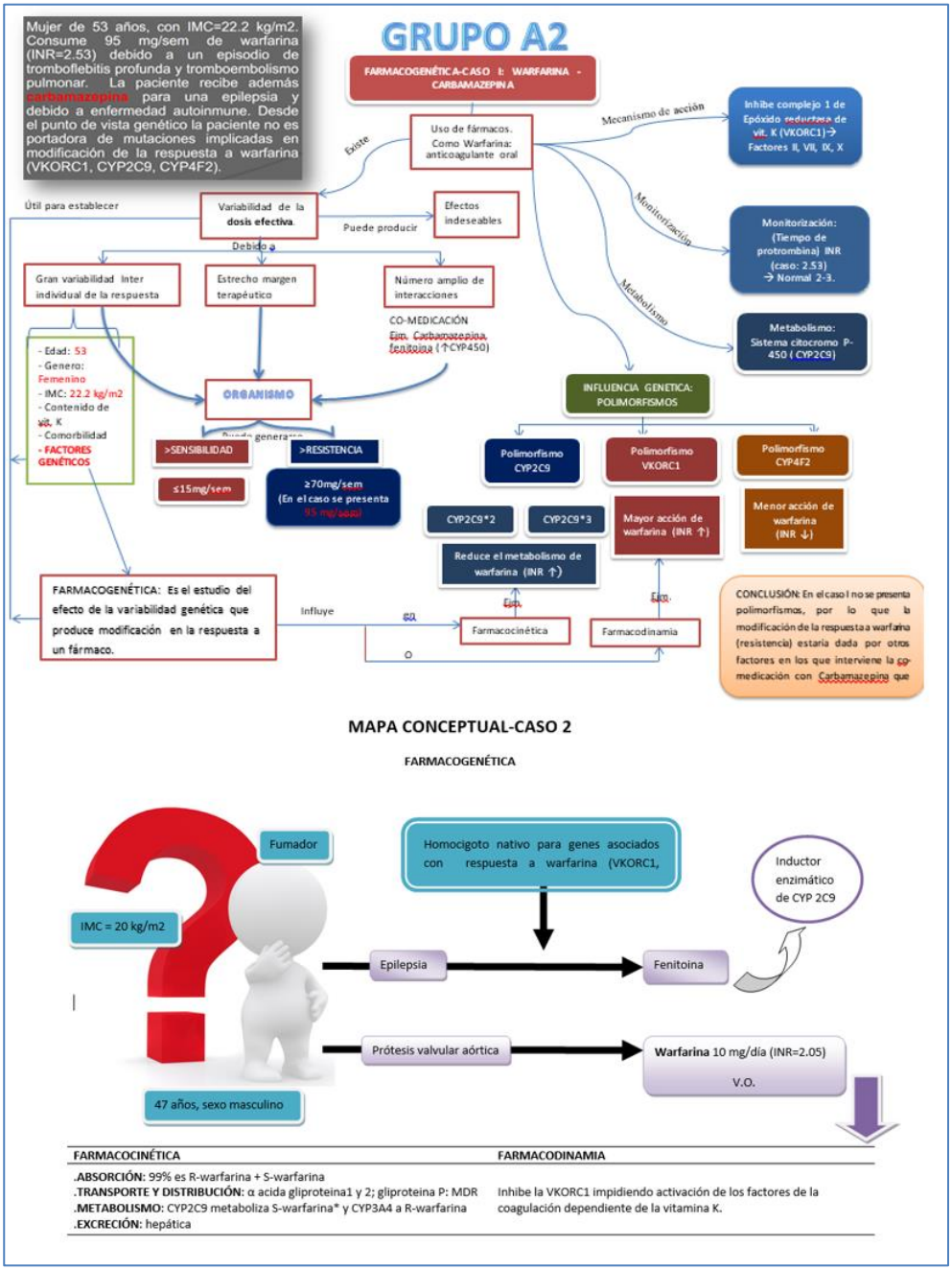

Figure 1. Example of the analysis performed by the students to solve the proposed case.

The second measurement was made 4 years later to 134 students who accepted or were available to take the evaluation. The average knowledge score on Pharmacogenetics was 17.2 ± 4.1 points, where 63% of the students achieved the Excellent learning level, 22% achieved the "Very good" level, and 12% achieved the "Good" level. and 3% achieved a “Poor” level.

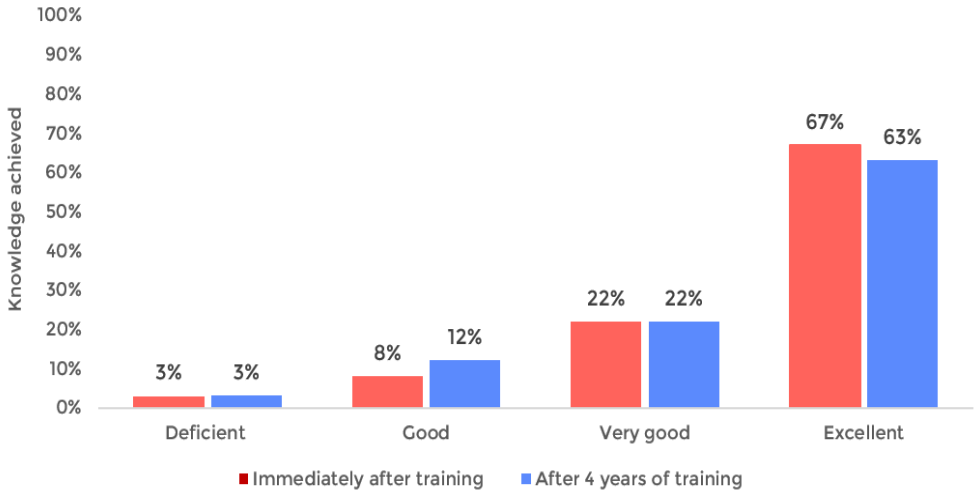

Figure 2. Knowledge achieved in pharmacogenetics, comparison of the year 2014 and 2018. Source: Elaboration of the authors

No significant difference was found between the first and second measurements. Of the 142 students who qualified with superior levels of learning in the first measurement (Excellent and Very Good), 80.3% continued with superior levels of learning four years later.

4. Discussion

According to Schunk (1997) defines learning as "a lasting change in behavior or the ability to behave in a given way as a result of practice or other forms of experience", when analyzing this concept three important elements are identified: 1. It is a change from the traditional lecture given by the teacher (2012), to a presentation built by the students themselves (2014) 2. Implies the development of a capacity to conduct oneself; it means that the person who learns acquires skills, and develops abilities. 3.It is a result of responsible self-learning practice. When analyzing the results over time, in 2014 the students raised what they know and do not know to solve the problem. The non-statistical difference between the results of the co-evaluation, hetero-evaluation and Bloom scale suggests an adequate reliability and validity of the assessments, for which it is justifiable to carry out a basically cognitive evaluation in the second moment of the investigation. In 2018, the students were already aware of the genetic polymorphism that patients present in their metabolism of warfarin, and the decisions to be made in the face of this problem.

In this constructivist scenario of individual and collective learning, among the factors to be highlighted are discipline, responsibility and the repetition of processes to acquire knowledge. This learning is complemented by collaboration and interaction between peers.

During the first stage, the investment of time is equivalent to 100 hours of collective work; which resembles the process of scientific research. These hours of work invested are evidenced by the results of the second stage, where all students received passing grades (considering that four years had passed since the intervention).

The learning model for warfarin metabolism indicates that we are working with the drug with the greatest impact in the treatment of thrombosis, as stated by Zambon, C.F., Pengo, V., Moz, S. et al. (2018),, this author has shown that therapeutic failures obey the patient even more than the drug and can be predicted knowing the INR results in the first 19 days of treatment and adjusting the dose.

Our teaching proposal has been developing since 2014, which includes methodologies such as PBL, which includes the resolution of public health problems Galindo Cárdenas, L. A., & Col. (2011); Aguilar, M.E., & Col. (2011)., Lermanda, C. (2016).In pharmacology, the problems elaborated deal with drugs recognized as essential by the WHO, in this way the students are prepared for the reasoned prescription of drugs with ethical responsibility.

Currently we continue to develop virtual and face-to-face teaching models. We are sure that in 2022 we will use the B-learning modality and also e-learning in all subjects, which have contributed to the development of meta-cognitive skills in students.

5. Conclusion

Cognitive ability is persistent over time using the methodology described in the Pharmacogenetics learning process. It was shown that the use of a meaningful learning methodology with PBL and ICT can make knowledge last and serve in the future for decision-making in the selection of medication.

References

Aguilar, M.E.U, Hamui-Sutton, A., Figueiras, S.C., Fortoul Van der Goes, T.I., & Guevara-Guzmán, R. (2011). Impact of problem-based learning on the cognitive processes of medical students. Medical Gazette of Mexico, 147(5), 385-393.

Alalwan, AA., Voils, SA. & Hartzema, AG. (2017). Trends in utilization of warfarin and direct oral anticoagulants in older adult patients with atrial fibrillation. Am J Health Syst Pharm;74(16):1237-44. doi: 10.2146/ajhp160756.

Bishop, J.R. (2018). Pharmacogenetics. Handb Clin Neurol;147:59-73. doi: 10.1016/B978-0-444-63233-3.00006-3.

Galindo Cárdenas, L.A, Arango Rave, M.E., Díaz Hernández, D.P., Villegas Múnera, E.M., Aguirre Muñoz, C.E., Kambourova, M., & Jaramillo Marín, P.A. (2011). How problem-based learning (PBL) transforms the educational meanings of the Medicine program at the University of Antioquia? Iatreia, 24(3). http://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S0121-07932011000300011.

Lermanda, C. (2016). Problem-based learning (PBL): a pedagogical experience in medicine. REXE-Journal of Studies and Experiences in Education, 6(11), 127-143.

Rahma, A.T., Elsheik, M., Elbarazi, I., Ali, B.R., Patrinos, G.P., Kazim. M.A., et al (2020). Knowledge and Attitudes of Medical and Health Science Students in the United Arab Emirates toward Genomic Medicine and Pharmacogenomics: A Cross-Sectional Study. J Pers Med;10(4):191. doi: 10.3390/jpm10040191.

Schunk D.H. (1997). Learning theories. Mexico: Prentice-Hall Hispanoamericana.

Shendre, A., Dillon. C., Limdi, N.A. (2018). Pharmacogenetics of warfarin dosing in patients of African and European ancestry. Pharmacogenomics;19(17):1357-71. doi: 10.2217/pgs-2018-0146

Valdes, R Jr., Yin, D.T. (2016). Fundamentals of Pharmacogenetics in Personalized, Precision Medicine. Clin Lab Med;36(3):447-59. doi: 10.1016/j.cll.2016.05.006.

Zambon, CF, Pengo, V., Moz, S. et al (2018) Pharmacokinetic and pharmacodynamic re-evaluation of a genetic-guided warfarin trial. Eur J Clin Pharmacol 74: 571. https://doi.org/10.1007/s00228-018-2422-8

Zawiah, M., Yousef, AM., Al-Ashwal, FY., Abduljbaar, R., Al-Jamei, S., Hayat Khan. A., Alkhawaldeh, B (2021). Pharmacogenetics: a perspective and preparedness of Pharm-D and medical students in Jordan. Pharmacogenet Genomics;31(6):125-32. doi: 10.1097/FPC.0000000000000430

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14675

Contemporary pharmacology teaching methods in the Covid-19 era at Umm Al-Qura University

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Abstract

Globally, Covid-19 has created unparalleled challenges at all levels of education. In view of this, Umm Al-Qura University (UQU) introduced electronic learning in education as a measure to limit the pandemic's effects. In this study, a comparative, cross-sectional approach was taken to explore the use of electronic learning as an active teaching model. The Blackboard was utilized to aid knowledge retention and transform pharmacological knowledge from theoretical to practical knowledge. The study was conducted between January 2020 and April 2021 with 415 pharmacy students. Students felt that content saturation and traditional lectures were critical obstacles for active teaching. Meanwhile, integrated active intellectual teaching methods, including flipped classrooms and practical video simulations, facilitated students' engagement. As contemporary teaching methods are required in modern education, UQU has sought to empower excellence in education and transform the teaching of pharmacology during the pandemic.

Keywords: *Pharmacology; contemporary teaching; instructional strategies; electronic learning; Blackboard; Covid-19.*

1. Introduction

Effectively implementing innovative technology in the field of classical education is a modern day challenge. However, this is important because new educational models that use electronic learning (e-learning) can develop skills and competencies, as well as enhance student engagement and promote interactive learning (Brouwers, Makarski, and Levinson, 2010). Existing research on information technology shows that the acquisition of knowledge is linked to technical developments that pass on information (e.g. multimedia technologies). Thus, incorporating such methods in education facilitates the shift from externally controlled to self-directed learning (Hutten, Stiegmaier, and Rauchegger, 2020). Given this background, educational institutions are faced with the question of how to best incorporate technology into their course design.

This existing challenge was further complicated by the Covid-19 pandemic, which created challenges at all levels of education (Hoofman and Secord, 2021). When the pandemic began in 2020, the Saudi government announced that all education would continue on a remote basis (News, 2020), which forced educational institutions to rapidly shift their teaching methods. The aim of this study is to explore the uses of e-learning as a contemporary teaching model and to analyze the barriers and strategies associated with its adoption. To this end, one such institution, the Saudi Umm Al-Qura University (UQU), will be taken as a case study.

2. Method

2.1. Ethical considerations and study design

The study was approved by the Scientific Research Ethics Committee at UQU (Institutional Review Board number: HAPO-02-K-012-2022-02-972). A comparative cross-sectional approach was used to examine the use of e-learning as an active teaching model. Participants were undergraduate (second-, third-, and fourth-year) Doctor of Pharmacy students that were registered at UQU pharmacy college. Participants were provided an informed consent form that they signed prior to taking part in the study.

2.2. Pharmacology course design

During the pandemic, the pharmacology curriculum was adapted into an online teaching course made up of four modules: pharma I (drug neuropharmacology, including effects at the cellular and molecular level on the central and peripheral nervous system); pharma II (cardiovascular pharmacology of drugs used in the treatment of cardiovascular diseases); pharma III (basic and clinical toxicology, including the effects of drug toxicity on experimental and clinical levels); and pharma IV (oncological pharmacotherapy, which are drugs that slow or block cell growth and are most often associated with cancer; and antimicrobial pharmacology, which are drugs used to treat bacterial diseases). Each module

contained 12 chapters. To ensure that the students concentrated on their studies, the teaching content in each chapter was divided into several theoretical and practical classes lasting approximately 60–90 minutes each. This structure addressed the course's intended learning outcomes (ILOs) (knowledge, skills, and values), with the aim of guiding students through active high-impact teaching.

2.3. Contemporary teaching strategies

Several creative teaching approaches were employed to teach the pharmacology course on a remote basis. The aim of these strategies was to take the online course from a low-impact traditional level (that of teacher-centered "teach in front of a computer screen" and student-centered "stay at home and take the course passively online") to a high-impact modern level by applying integrated methods of active intellectual teaching. These integrated teaching strategies included taking a pharmacotherapeutic approach by drug class and sub-class; problem-based learning case studies; practical video simulations; flipped classrooms; and gamification in pharmacology science group activities.

2.4. Contemporary assessment strategies

To assess the effectiveness of pharmacology teaching as an educational outcome, various questions were posed by UQU faculty members at the end of each module. These questions evaluated different pharmacological teaching methods, while also focusing on the students' interests and knowledge during each theoretical class. Five kinds of questions were posed: open-ended (questions that promoted student interactive discussion); closed-ended (questions used to focus thinking on a particular pharmacological drug interaction); rhetorical (questions that reinforced a therapeutic idea or emphasized a point); managerial (Blackboard polling questions that kept the pharmacology classroom operations moving); and essay questions (asking for pharmacological information, such as descriptive, evaluative, and comparative points of view).

2.5. Study survey

The survey, which was adapted from a questionnaire used to get students' feedback at the end of each semester, was hosted by the UQU WebEx research platform. Participants were given summary evidence of e-learning's impact on education, and they used a four-point Likert scale to address the following: their satisfaction with UQU's integration of knowledge management and e-learning; the most concerning learning barriers; and the best strategies to mitigate said barriers. The study followed the Checklist for Standards for Quality Improvement Reporting Excellence for Education (Greg *et al.,* 2019).

2.6. Statistical analysis

Descriptive statistics were used to summarize the responses. For categorical variables, responses to "Yes/No" or multiple-choice questions were calculated using numbers (n [%]). Regression models were used to explore the relationship between demographic factors and responses using t-tests, mean differences of continuous data, and chi-square tests for dichotomous or ordinal data. A two-side hypothesis testing was then carried out at the 5% significance level. The Blackboard and Webex research platforms were used to produce graphical outputs and perform statistical analyses.

3. Result

The study was conducted between January 2020 and April 2021. Four hundred and fifteen undergraduate pharmacy students participated with a total of eight groups in each academic year (four female and four male subgroups, ranging from 15 to 17 students each). The length of each pharmacology module was 16 weeks (12 academic weeks and 4 examinations). Six high-impact instructional strategies were identified: the strategy of high relevance, high-quality engagement, effective assessment, effective feedback, adequate support, and the preparation of contingency plans. They are presented below to emphasize how instructors used e-learning technology to improve pharmacology teaching experiences.

3.1. High relevance between e-learning instructional plan design and student education

The Blackboard was used as a comprehensive digital learning tool. Its Collaborate Ally function elaborated the course's lesson plan design seamlessly, thereby bridging the gap between theoretical and practical classes. This helped the faculty to take control of the digital course contents and make ILOs more accessible to students in an integrated way. The Blackboard's Collaborate Synchronous function was also used to engage students and encourage the development of professional skills.

3.2. E-learning and high-quality engagement

The Blackboard, Mediasite, and WebEx platforms were used to facilitate collaborative and group activities. The Blackboard Analytics was utilized to support pharmacology knowledge retention. While the Mediasite was used to deliver practical videos to simulate active teaching, WebEx was used for asynchronous and synchronous communication (web-audio-video meetings on how to do scientific pharmacology presentations using flipped classrooms etc.). In this way, the platforms offered a well-rounded learning experience by ensuring that all enrolled students could realize their potential and actively collaborate during their classes.

3.3. E-learning and effective assessment of student education

The Blackboard was regularly adjusted to ask various types of questions at the end of each pharmacology module chapter to assess teaching and learning outcomes. Its assessment and accreditation functions helped the lecturers simplify assessments and improve problem-based learning and flipped classrooms (in contrast to traditional lectures, which are often perceived by students as being boring and dry). The average percentage difference of students per activity interactions was 85%; course rating, activity assessment, and access to pharma II module contents were highly valued at 100%. Figures 1 and 2 detail the course activities of one student, who spent the most time studying the course contents (more than 50 hours, which was above the course average of 10% of the grade center scores in the pharma II module).

3.4. E-learning and adequate study support provided by UQU faculty

The students' weekly marks and feedback reports allowed the UQU faculty to intervene early and keep them on track for success. Furthermore, the Blackboard helped staff predict and identify at-risk students and therefore eliminate their achievement gaps, making it possible to overcome learning and progress barriers. The module activities grade matrix identified active students with the highest grade interactions (i.e. those who scored an A^{+}, 100-95, or an A, 94-90), as well as inactive students with the lowest grades (those who scored a B, which less than 80%), as shown in Figure 3.

The linear regression model explained 3.1% of the variance in students' scores, which was statistically significant at α=0.05. The scores were positively associated with their accessibility to pharmacology courses such that, for each additional accessibility to the course activities, the natural log of accessibility was predicted to increase by 0.002 units; this association was statistically significant (P = 0.001) with more than 85% of the grading scores (Figure 4).

3.5. E-learning and effective feedback of UQU students

The survey findings show that e-learning deepened knowledge and skills in experimental operations that used a cumulative e-learning based assessment (Figure 5). Overall, 333 (80.2%) students were satisfied with the integration of pharmacological knowledge management and e-learning, and only 102 (24.5%) were dissatisfied with the lack of practical pharmacological classes involving animals. Additionally, 232 responders (55.9%) and 183 responders (44.1%) rated traditional courses and content saturations as being important barriers to active teaching, respectively. Conversely, 224 responders (54.0%), 150 responders (36.1%), and 140 responders (33.7%) rated the therapeutic teaching strategies by drug classes, practical video simulation, problem-based learning case studies, and flipped classrooms as important innovative strategies to overcome passive teaching, respectively.

Number of items				
Percentage difference	Department average	Course items Available	Total	Element
	4.5	3	7	Evaluation
	12.1	81	81	Content
	12.0	0	12	Tool
Percentage difference	Department average	Course item average		Activities
	7.2	14		Access operations
	247.1	485		Minutes
	43.9	135		Interactions
	1.0	8		Rating and assessments
Percentage difference	Department average	Course item average		Item reached percentage
	(%76) 3.4	(%80) 5.6		Evaluation
	(%30) 3.6	(%10) 7.7		Content
	(%8) 1.0	(%8) 1.0		Tool

%100 %0 %100-

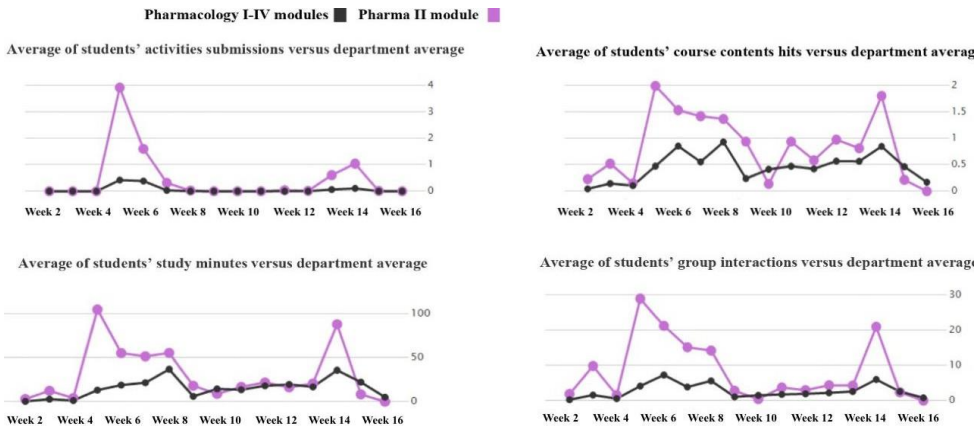

Figure 1. The course activities and assessments overview for pharma II module versus all pharma modules (I-IV).

Figure 2. The course activities and assessments overview per student in pharma II module versus all pharma modules (I-IV) with the highest marks

3.6. Contingency plan to manage unexpected technical obstacles to e-learning

Due to the sudden emergence of Covid-19 and the subsequent shift to remote learning, most UQU faculty members and students faced the challenge of overcoming poor e-learning management experience. To enable this, UQU launched a digital library for training and an online forum to teach faculty and students how to use e-learning programs. Furthermore, UQU technology support teams from the Deanship of E-learning and Distance Education (from the University Vice Presidency for Educational Affairs) offered regular courses to support UQU faculty and students (UQU, 2020).

4. Discussion and Conclusion

Pharmacology teaching is in a state of constant reform. This is especially important in the Covid-19 era, where education faced new challenges. In the interest of promoting UQU in international university rankings, university officials made an effort to empower its students, transform the teaching of pharmacology, and apply integrated methods of teaching. The initial implementation of e-learning using the Blackboard was highly successful and time-efficient during the pandemic. This study recommend six instructional strategies for high-impact teaching practice in pharmacology to ensure that pharmacy students effectively engage and collaborate in the transition to high-impact education.

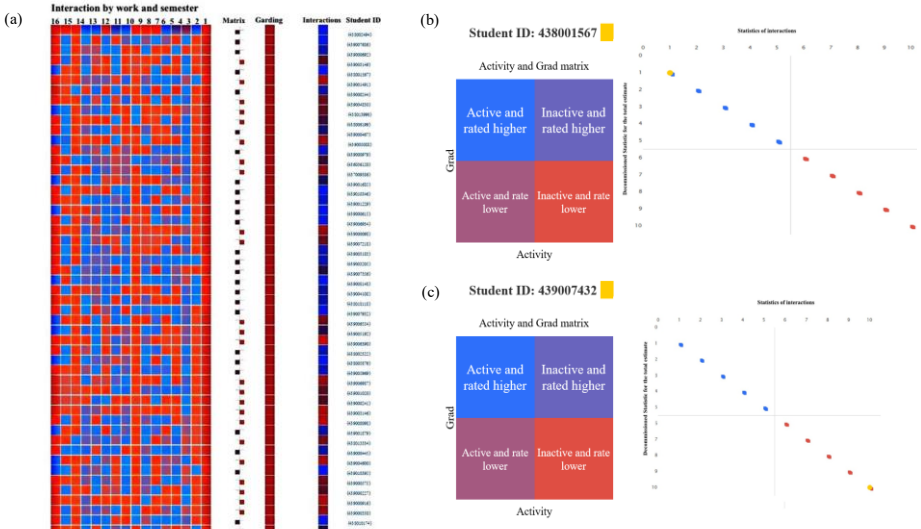

Figure 3. (a) Module activities grade matrix of students enrolled to pharma II course. (b) Grade matrix of active student with A^+ and A highest grade. (c) Grade matrix of inactive student with lowest grade less than B grade.

This was evidenced by pharmacy students' formal feedback on the effectiveness and efficiency of the desired ILOs for this structural course. However, the majority of pharmacy students considered the lack of active practical involvement and spending more time in-class (compared with practical studying outside the classroom) to be important barriers, which may affect their learning effectiveness. Based on this, it appears that students' challenges did not come from technical obstacles, but from difficulties such as their own learning attitude, which may include a lack of self-discipline or a good learning environment at home. Therefore, the quantity, difficulty, speed of learning, and length of teaching content should match the academic readiness and online learning behaviour of students. Constructivist didactics try to optimize individuals' acquisition of knowledge by fostering active thinking and providing an optimal learning environment. Cognitivist theory advocates acquiring a balance between self-directed (student-centred) and externally directed (teacher-centred) instructions (Berzbach,

2004). For this purpose, this study utilized e-learning in education with a development of social competences that fostered learning in small groups. The use of contemporary teaching strategies such as high-quality engagement (learning with peers in small groups using asynchronous or synchronous communication), cognitivist didactics (evidence-based learning, practical video simulations, and personal interpretations), effective assessment, and supportive feedback, ameliorates pharmacy students' experiences. Such strategies help pharmacy students develop their own effective learning strategies, including critical thinking and problem-solving. Hence, gaining knowledge is not an external process (as in cognitive science), but is internally driven (self-directed learning).

Although the results of using e-learning in pharmacology are promising, there are still unresolved questions including how to measure the success of e-learning in the short- and long-term. If one accepts that constructivist learning is best suited for e-learning, a conceptual problem arises, since traditional examinations have a strong basis in cognitive learning theory. To address this, pharmacologists and pharmacists must collaborate with educational professionals to develop suitable modes of evaluation.

Model	B	Std. Error	Beta	*t*-test	Sig.	95% confidence interval for B (upper – lower bound)
Constant	5.189	0.040		129.516	0.000	5.110 – 5.268
Accessibility	0.002	0.001	0.163	3.112	0.001	0.001 – 0.004

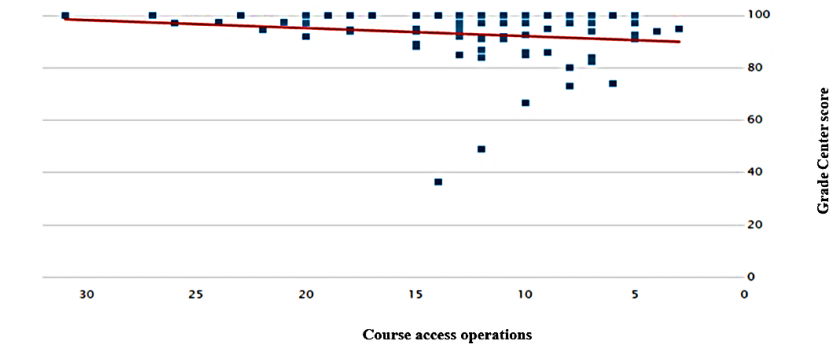

Figure 4. The grading distributions and access to pharma II course module versus all pharma modules (I-IV)

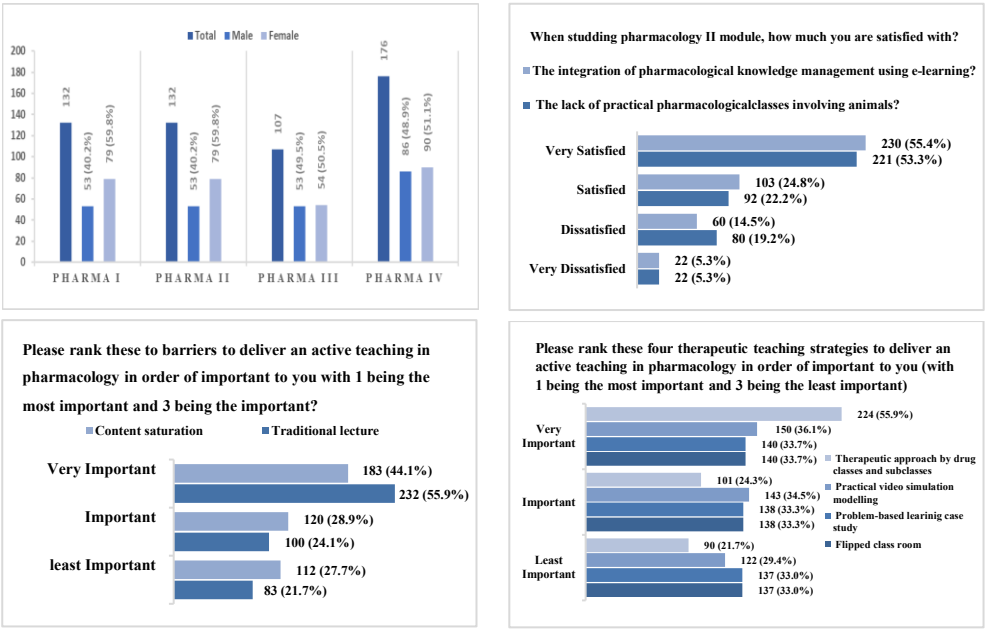

Figure 5. Participants survey results of pharma modules (I-IV)

References

Berzbach, F. Die Ethikfalle. Pädagogische Theorierezeption am Beispiel des Konstruktivismus; Bertelsmann: Bielefeld, Germany, 2004. (in German)

Brouwers, M.C., Makarski, J., Levinson, A.J. A randomized trial to evaluate e-learning interventions designed to improve learner's performance, satisfaction, and self-efficacy with the AGREE II. *Implement. Sci.* 2010, *5*, 29.

Greg, O., Armstrong, G., Dolansky, M., Singh, M., & Louise, D. (2019). SQUIRE-EDU (Standards for QUality Improvement Reporting Excellence in Education): Publication Guidelines for Educational Improvement. *Academic Medicine, 94*(10), 1461-1470. doi:10.1097/ACM.0000000000002750

Hoofman, J., & Secord, E. (2021). The effect of COVID-19 on education. *Pediatr. Clin. North Am., 68*(5), 1071–1079. doi:10.1016/j.pcl.2021.05.009

Hutten, H., Stiegmaier, W., Rauchegger, G. KISS—A new approach to self-controlled e-learning of selected chapters in medical engineering and other fields at bachelor and master course level. *Med. Eng. Phys.* 2005, *27*, 611–616.

News, A. (2020). Students in Saudi Arabia to continue remote learning in September. Retrieved from https://www.arabnews.com/node/1719946/saudi-arabia

UQU, D. (2020). The digital training library on the e-Learning system. Retrieved from https://uqu.edu.sa/en/elearn/DigitalTrainingLibrary

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14521

A case study comparing the flipped hybrid classroom and traditional classroom in a post-graduate chemical pathology module

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Abstract

This case study compared student performance and experiences in a flipped hybrid classroom (FHC) and a traditional classroom (TC) in a post-graduate chemical pathology programme.

Nine students participated in the study. The final summative grades based on clinical case vignettes assessing high cognitive domains were 55.83% (±26.94) and 60.61% (±36.02) for the FHC and TC, respectively. Students obtained higher scores in the synthesis domain in the FHC compared to the TC. In contrast, higher scores were obtained in evaluating pathophysiology and biochemical test results in the TC. The thematic analysis of the open-ended questions identified three themes: (1) flipping is fun and informative; (2) TC is better with a bit of flip; and (3) we know what we like.

This study showed that the TC showed slightly better summative assessment performance, and that students are positive about flipped approaches but have their own preferences.

Keywords: *Flipped classroom; hybrid classroom; flipped hybrid classroom; traditional classroom; chemical pathology.*

1. Introduction

Chemical pathology is a specialist branch of medicine that involves the biochemical investigation of bodily fluids to help manage disease in patients. The biochemical tests require analysis and interpretation in conjunction with associated clinical information. Post-graduate studies in chemical pathology attract graduates from the basic biological sciences and medicine. At the University of Pretoria, South Africa, the Bachelor of Science Honours (BSc.Hons) degree introduces science graduates with biological science majors to chemical pathology. Clinical case vignettes teach knowledge of disease states and interpretation of biochemical tests. Case-based study is challenging for science graduates as they lack fundamental knowledge of clinical sciences. Therefore, alternative approaches to teaching chemical pathology may benefit their academic performance and learning experience.

2. Literature review

The flipped classroom inverts the traditional classroom (TC) by moving the lecture and self-study activities to out-of-class activities. Flipping can take many forms, and the format and definition of the flipped classroom are varied. The flipped classroom encourages the four phases of experiential learning: active experimentation, concrete experience, reflective observations and abstract conceptualisation (Kolb & Kolb, 2005), and may benefit an active construction of knowledge. Notably, the flipped classroom supports peer-peer and student-instructor interaction and facilitates problem-solving during the in-class activity (Kennedy, 2013). Also, flipped teaching models are claimed to afford flexible learning environments, improve in-class engagement with instructors, and develop critical thinking domains required in problem-solving (Kennedy, 2013).

Criticisms of the flipped class are high resource investment in developing teaching material, the need for new technology and instructor skillsets, and the need for students to develop active and self-directed learning skills. In addition, there are limited studies that rigorously compare TC to the flipped classroom, especially using performance outcomes (DeLozier & Rhodes, 2017; Kennedy, 2013), so its value in teaching and learning is questioned.

The use of e-technologies to engage students during out-of-class activities is attractive as various evolving platforms and computer software can be used to achieve learning objectives. Electronic technologies can be utilised in distinct areas of medical education such as electronic learning (online learning or e-learning), electronic teaching and electronic assessment (Ellaway & Masters, 2008). E-learning may encourage flexible (synchronously or asynchronously), engaging, learner-centred and interactive learning experiences (Ellaway & Masters, 2008).

Hybrid learning is a pedagogical approach that combines face-to-face instruction with computer-mediated instruction, for example, e-learning methodologies (Scida & Saury, 2006). Multiple modes of hybrid delivery exist with various mixtures and approaches to optimise learning goals.

Research demonstrates that classrooms utilising flipped and hybrid methods create rich learning experiences with favourable student preferences (Smith, 2021). The flipped hybrid classroom (FHC) has been applied in biochemistry teaching (Singh & Arya, 2020), which is the foundation of chemical pathology, but student performance was not assessed in that study.

Our study compared student performance and experiences between TC and a pilot FHC in endocrinology study units in the chemical pathology BSc.Hons programme at the University of Pretoria.

3. Methods

This study utilised a quasi-experimental cross-sectional case study design at a single centre. Two endocrinology study units in the BSc.Hons were taught to nine students, either by FHC (adrenal endocrinology) or TC (reproductive endocrinology). Each study unit spanned ten days.

Lecture notes were uploaded to the LMS after the delivery of a 90-minute lecture which explored core content knowledge and case vignettes. Students were encouraged to follow up on problematic concepts with the lecturer via email.

A three-stage FHC model was used and consisted of pre-class, in-class and post-class stages. The pre-class stage required students to complete all preparative activities and formative online assessment (with feedback) to access the 90-minutes in-class session and the summative assessment. Formative assessments were not scored, and unlimited testing attempts were permitted.

The pre-class stage consisted of various online activities (e-tivities) and teaching material uploaded to the LMS six days before the contact session. The e-tivities consisted of (1) PowerPoint™ slide presentation; (2) flashcards with questions and summaries designed on Cram™ with conceptual image and textual feedback; (3) word puzzles designed on Crossword Compiler 11™ interrogating essential biochemistry concepts; (4) a short five-minute "Conceptual Nugget" video on dynamic tests, self-created on an iPad and edited on the Apple Movies application; (5) a 10-minute video on an adrenal disease case study with formative assessment inserted in the video using EdPuzzle™; (6) an online case vignette on adrenal tumour with the discussion threads moderated by the instructor via the Blackboard™ LMS discussion tool; and (7) freeware webinar segments that explored screening tests in adrenal disease.

Conceptual problems that arose from engagement with all online preparative material and formative assessments were explored and clarified during the 90-minute in-class contact session. Furthermore, all students participated in consolidating problem concepts during a three-day post-class asynchronous consolidation session via the online discussion board.

A case study methodology used two sources of data: student performance and an online questionnaire. Student performance was assessed via an end-of-module, written, face-to-face assessment that used clinical case-based vignettes that evaluated high-order thinking. Students were required to integrate clinical history, physical examination findings, and laboratory results to diagnose and interpret biochemical tests and pathophysiology.

An online questionnaire was administered via Qualtrics^{XM} after each study unit. The questionnaire was based on the course experience questionnaire instrument (Ramsden, 1991). The questionnaire was validated by experts and consisted of eight open- and seven closed-ended items, which used a five-point Likert scale. The summative examinations results were captured on an Excel™ spreadsheet. All quantitative scores were descriptively analysed and expressed as percentages (± standard deviation). Two researchers manually coded the open-response questionnaire items and used an inductive process to generate themes.

The study adhered to the principles of the Declaration of Helsinki and received ethical clearance from the Faculty of Health Sciences Research Ethics Committee at the University of Pretoria (ethics clearance certificate number 737/2019).

5. Results

Nine students completed the FHC questionnaire, and seven completed the TC questionnaire.

The final summative average scores were 55.83% (±26.94) and 60.61% (±36.02) for the FHC and TC, respectively. Students obtained higher scores in the synthesis domain of diagnostic questions in the FHC (80% ±34.96) than TC (60.00 ±51.63). In contrast, higher scores were obtained in analysis, interpretation and evaluation cognitive domains of biochemical tests and pathophysiology knowledge categories in the TC (66.33% ±32.24) than FHC (53.00% ± 29.07). In general, the standard deviation was wide across all scoring categories and reflected the sample group size and the abnormal distribution of the data.

The results from the questionnaire showed that most participants agreed that both FHC and TC improved analytical (FHC: 88.89%, N=8; TC: 82.71%, N=6) and problem-solving skillsets (FHC: 88.89, N=8; TC: 82.71%, N=6). The FHC showed stronger agreement on enhancing written communication skills (FHC: 88.89%, N=8; TC: 57.14%, N= 4). More participants agreed that the FHC improved their ability to plan their study (FHC: 44.44%, N=4 TC (63.43%, N=5). Also, more participants (88.89%, N=8) agreed that their self-confidence to solve clinical cases in laboratory medicine was enhanced by the FHC study

unit compared to the TC (71.43%, N=5). Most (FHC: 88.89%, N=8; TC: 85.72%, N= 6) agreed that lecturer was good (FHC: 88.89%, N=8, TC: 85.71%, N=6) and were satisfied with the overall quality of both module approaches (FHC: 77.78, N=7; TC: 85.72, N=6).

Thematic analysis of open-ended questionnaire items identified three themes.

Theme 1: Flipping is fun and informative

Participants emphasised personal enjoyment of the flipped e-tivities and could emphasise a wide range of potential academic benefits. Notable inclusions were: class preparation, engagement with the material, enhancing memory retention and testing their understanding. One student articulated the utility of focussing their attention on crucial information through formative assessment provided by online e-tivities.

> "*The electronic activities were set up in such a way, that reading was still required but, in my opinion, reading was made easier because one would read to specifically find the answer to complete the electronic activity*." (P4)

Participants found video material the most helpful, particularly webinar and EdPuzzle™ videos. They also named the online discussion board and the CRAM™ flashcards as useful for engagement, memorisation, and preparation for an in-class activity. Interestingly, participants considered the PowerPoint didactic lecture the least favourite online activity because "*The [lecture] material was a bit overwhelming, but the contact lecture gave a clearer of what was required*" (P3). But the view on the lecture notes was not necessarily shared but considered "*comprehensive and easy to follow*" (P1).

Participants emphasised that the in-class interaction with the lecturer was needed to support the flipped activities as "*face-to-face interaction with lecturer provides opportunities to ask questions when you missed something*." (P2). Poor internet connectivity was a barrier for some accessing the e-tivities – but the e-tivities were considered fun and worthwhile despite this challenge.

Theme 2: TC is better with a bit of flip

Participants attending the TC included reading the prescribed chapters from the textbook or independently sourcing out other learning materials on the topic as part of their preparation. Some participants engaged with the textbook, which was "*very informative*" and provided a "*foundation*" for the lecture (P5). Participants understood the material "*much better in the lecture*" (P9) if they had prepared ahead of class.

Theme 3: We know what we like

Participants were keen on a combined approach due to the perceived benefits: "*I actually prefer a combination of a traditional lecture with some additional activities. I find it beneficial to go through the lecture notes and do some extra reading before the lecture as*

that enables me to listen with understanding and make notes where I may not have understood. I also, however, found it interesting to do the additional activities." (P1)

Other advantages of the combination of FHC and TC identified unique and overlapping features of each classroom approach. For example, preparation outside class would prepare them to ask questions during the lecture. The TC permitted participants to focus better on relevant issues without distraction by diverse activities that appeared to divide their attention across learning objectives. The contact session was identified as: "*... helpful because I was able to ask questions and get clarity of concepts I did not understand while I was reviewing the work alone*" (P5).

The introduction of e-tivities was resisted by those who had "… become accustomed to the traditional lecture format. I am not really a fan of electronic learning." (P8); and traditional lectures made it possible "… *to follow the lecture clearly" (*P7). Participants were very confident when stating their preferences: "*Although flipped classroom electronic activities is a more fun/enjoyable form of learning, I believe the best way to build knowledge and study is with traditional lecture format and reading*" (P6).

6. Discussion

This study compared student performance and experiences between TC and FHC in an endocrinology module in a BSc.Hons programme in chemical pathology. Studies that compare the flipped classroom to the TC are limited, particularly those regarding objective student performance. In our study, the TC summative scores were slightly higher than the FHC. Similar studies in health sciences have shown equivalent, inferior or improved performance (DeLozier & Rhodes, 2017).

In this study, participant experiences were generally positive and similar to other studies (Bishop, 2013). Participants reported that their analytical and problem-solving skills had improved (both FHC and TC), and as a result, they felt confident in solving case-based clinical cases. The ability to evoke higher-order cognitive thinking (Bloom, 1956) and develop critical thinking is vital in higher education to develop a "deep knowledge" of subject matter (John Biggs, 2011). However, the research is unclear whether a flipped model supports the development of critical thinking skills (van Vliet, Winnips, & Brouwer, 2015) or shows no improvement in critical thinking (Hwang & Oh, 2021). The student experiences in our study support improved analysis and problem-solving of clinical case vignettes by both TC and FHC modes.

It is also noteworthy that some participants attending the TC also prepared ahead of the lecture - an informal flipped approach. Participants motivated that preparation ahead of the in-class session improved their in-class engagement in both TC and FHC. In contrast, results of a pharmacotherapy course showed that students spent little time preparing for traditional

lectures without in-class accountability (DeJongh, Lemoine, Buckley, & Traynor, 2018). Therefore, the FHC in our study provided an expansion of an already existing informal student practice of pre-class preparation by providing scaffolded online activities and formative assessments.

Our study findings identified that video case-based teaching and webinars were the most preferred mode of e-tivity. The combination of the flipped classroom strategy and EdPuzzle™ has improved students' participation in learning activities and achievement in writing (Hidayat & Praseno, 2021). The preference for a combination of TC (with online activities) or solely TC emphasises students' needs for personal engagement with the lecturer. Bishop (2013) also identified student preference for in-person lectures compared to video lectures and interactive in-class activities compared to lectures. The unique contribution of the lecturer to resolve conceptual problems aligns with Vygotsky's concept of the zone of proximal development that identifies the supportive role of teachers in advancing students' learning (Vygotsky & Cole, 1978). In summary, this study supports online video e-tivities coupled with instructor in-person or online support to encourage multi-dimensional thinking (John Biggs & Collis, 1989) demanded by case-based study.

A limitation of this study is the small number of participants, which was unavoidable as this is a niched small group enrolment programme.

7. Conclusion

A comparison between the performance and experiences of the FHC and TC in small-group post-graduate chemical pathology module identified slightly higher summative scores in the TC method and positive learning experiences in both formats. In addition, the role of contact sessions and lecturer support was regarded as essential for learning. Any change to this programme needs more data to determine the optimal lesson plan. Future studies can investigate further novel combinations of elements from TC and FHC models to achieve the optimal balance for teaching and assessing chemical pathology.

References

Biggs, J. (2011). *Teaching for quality learning at university : what the student does*. [Philadelphia, Pa.]; Maidenhead, Berkshire, England; New York: McGraw-Hill/Society for Research into Higher Education ; Open University Press.

Biggs, J., & Collis, K. (1989). Towards a Model of School-based Curriculum Development and Assessment Using the SOLO Taxonomy. *Australian Journal of Education, 33*(2), 151-163. doi:10.1177/168781408903300205

Bishop, J. V., M.A. (2013). *The Flipped Classroom: A Survey of the Research*. Paper presented at the 2013 ASEE Annual Conference & Exposition, Atlanta, Georgia. https://peer.asee.org/22585

Bloom, B. S. (1956). Taxonomy of educational objectives. Vol. 1: Cognitive domain. *New York: McKay, 20*(24), 1.

DeJongh, B., Lemoine, N., Buckley, E., & Traynor, L. (2018). Student preparation time for traditional lecture versus team-based learning in a pharmacotherapy course. *Curr Pharm Teach Learn, 10*(3), 360-366. doi:10.1016/j.cptl.2017.11.009

DeLozier, S. J., & Rhodes, M. G. (2017). Flipped classrooms: A review of key ideas and recommendations for practice. *Educational Psychology Review, 29*(1), 141-151. doi:10.1007/s10648-015-9356-9

Ellaway, R., & Masters, K. (2008). AMEE Guide 32: e-Learning in medical education Part 1: Learning, teaching and assessment. *Med Teach, 30*(5), 455-473. doi:10.1080/01421590802108331

Hidayat, L. E., & Praseno, M. D. (2021). Improving Students' Writing Participation and Achievement in an Edpuzzle-Assisted Flipped Classroom. *EDUCAFL : Journal of Education of English as Foreign Language; Vol 4, No 1 (2021): EDUCAFLDO - 10.21776/ub.educafl.2021.004.01.01*. Retrieved from https://educafl.ub.ac.id/index.php/educafl/article/view/172

Hwang, Y., & Oh, J. (2021). The effects of flipped learning approaches in anatomy class. *Sustainability (Switzerland), 13*(24). doi:10.3390/su132413724

Kennedy, C. J. (2013). Update on the Flipped Classroom. *Useful resources on MedEd.* Retrieved from https://www.amee.org/getattachment/AMEE-Initiatives/MedEdWorld/Flipped-Classroom-leaflet-v3.pdf

Kolb, A. Y., & Kolb, D. A. (2005). Learning Styles and Learning Spaces: Enhancing Experiential Learning in Higher Education. *Academy of Management Learning & Education, 4*(2), 193-212. Retrieved from http://www.jstor.org/stable/40214287

Ramsden, P. (1991). A performance indicator of teaching quality in higher education: The Course Experience Questionnaire. *Studies in Higher Education, 16*(2), 129-150. doi:10.1080/03075079112331382944

Scida, E. E., & Saury, R. E. (2006). Hybrid Courses and Their Impact on Student and Classroom Performance: A Case Study at the University of Virginia. *CALICO Journal, 23*(3), 517-531.

Singh, S., & Arya, A. (2020). A hybrid flipped-classroom approach for online teaching of biochemistry in developing countries during Covid-19 crisis. *Biochemistry and Molecular Biology Education, 48*(5), 502-503. doi:https://doi.org/10.1002/bmb.21418

Smith, K. D. (2021). Is it face time or structure and accountability that matter? Moving from a flipped to a flipped/hybrid classroom. *Journal of Applied Research in Higher Education, 13*(2), 609-621. doi:10.1108/JARHE-08-2019-0229

van Vliet, E. A., Winnips, J. C., & Brouwer, N. (2015). Flipped-Class Pedagogy Enhances Student Metacognition and Collaborative-Learning Strategies in Higher Education But Effect Does Not Persist. *CBE Life Sci Educ, 14*(3). doi:10.1187/cbe.14-09-0141

Vygotsky, L. S., & Cole, M. (1978). *Mind in society: Development of higher psychological processes*: Harvard university press.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14286

Designing a Novel Interprofessional and Inter-University Education Session for Healthcare Trainees to Improve Interprofessional Practice

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Abstract

Interprofessional education is widely acknowledged as critical for training successful clinicians, however logistical challenges often interfere with its implementation. The aim of this paper is to describe the procedures developed to enable students in different health professional programs in different geographic regions within the same country to learn about each other's professions and apply this knowledge to optimize outcomes for patients.

Principles from the Rehabilitation Treatment Specification System and Universal Design for Learning were combined to design an efficient and effective virtual approach to achieving interprofessional knowledge and collaborative skill outcomes. Application of these principles resulted in a 3-stage approach combining synchronous and asynchronous learning as well as didactic and problem-based learning. This paper describes the design and implementation for speech-language pathology and pharmacy students learning about swallowing disorders, but the procedures are applicable to a broad range of professions and academic content when interprofessional education is the goal.

Keywords: *Interprofessional education; virtual learning; health professions education; problem-based learning; speech-language pathology; pharmacy.*

1. Introduction

To address the complexity of modern healthcare, it is no longer acceptable to educate health professionals in silos. Adverse patient outcomes and increased health expenditures are a result of fractured health systems, miscommunication, and poor collaboration among health professionals (World Health Organization [WHO], 2010). The "Framework for Action on Interprofessional Education & Collaborative Practice" (WHO, 2010) emphasizes the importance of implementing innovative approaches to teaching and highlights how interprofessional education (IPE) allows students to develop the appropriate skills to become "collaborative practice-ready" healthcare providers. While there are many published collections of IPE competencies (e.g., Canadian Interprofessional Health Collaborative [CIHC], 2010; Interprofessional Education Collaboration [IPEC], 2016), there are two overarching objectives reflected in all: 1) learning about other professions to know when to collaborate and 2) learning with other professions to know how to collaborate.

IPE requires progressively complex learning activities to be contextually relevant, interactive, experiential, and reflective (D'Eon, 2005; McKee, D'Eon, & Trinder, 2013). Outcomes of IPE that meet these criteria include shared leadership, collaboration, communication, and respect for the roles and responsibilities of other health professionals (IPEC, 2016; Guraya & Barr, 2018; van Diggele, Roberts, Burgess & Mellis, 2020). However, logistical challenges such as scheduling and coordinated planning limit the feasibility of implementation (Ward, Zagoloff, Rieck & Robiner 2018), resulting in missed opportunities for meaningful interprofessional training that would enhance the quality of patient care, especially for patients with complex presentations.

One example of a complex medical condition where interprofessional training could enhance efficiency and effectiveness of patient care is swallowing difficulties, also known as dysphagia. Several studies have suggested that at least 40% of patients in acute care present with dysphagia (e.g., Altman, Yu & Schaefer, 2010; Crary, Humphrey, Carnaby-Mann, Sambandam, Miller, & Silliman, 2013; Peñalva-Arigita, Prats, Lecha, Sansano, & Vila, 2019). If poorly managed, dysphagia can lead to malnutrition, pneumonia and, in some cases, mortality (Carrión, Cabré, Monteis, Roca, Palomera, Serra-Prat, Rofes, & Clavé, 2015; Clavé, Rofes, Carrión, Ortega, Cabré, Serra-Prat, & Arreola, 2012), as well as increased hospital costs, length of stay, and risk of readmission (Attrill, White, Murray, Hammond, & Doeltgen, 2018; Patel, Krishnaswami, Steger, Conover, Vaezi, Ciucci, & Francis, 2018). Through interprofessional collaboration, speech-language pathologists ensure patients are swallowing safely and efficiently, occupational therapists ensure patients have the fine motor skills to self-feed, and dietitians ensure patients are receiving the nutrients they require to thrive. Importantly, pharmacists can also ensure optimal patient outcomes, given their expertise in pharmaceutics, pharmacology, pharmacokinetics, and medication management strategies. Unfortunately, collaboration between pharmacy and speech-language pathology

students is limited. There are just 12 speech-language pathology and 10 pharmacy programs across all of Canada, with only half being co-located in the same university.

In the fall of 2021, the Pharmacy program at the University of Manitoba in Winnipeg, Manitoba (Canada) partnered with the Speech-Language Pathology (SLP) program at McMaster University in Hamilton, Ontario (Canada) to design and carry out a novel interprofessional and inter-university event. McMaster University does not have a Pharmacy program and the University of Manitoba does not have an SLP program. The goal of the event was to teach students about dysphagia, drug delivery, and the impact they may have on one another. The aim of this paper is to describe the procedures developed to enable students in pharmacy and speech-language pathology programs in different geographic regions to learn about each other's professions and apply this knowledge to optimize outcomes for patients with dysphagia. The IPE event was named "A Tough Pill to Swallow: Dysphagia Management for SLP and Pharmacy Students." While this paper explains the creation of an IPE event specific to pharmacy and speech-language pathology students, the procedures described are applicable to a broad range of professions and academic content when interprofessional education is the goal.

2. Methods - Defining Interprofessional Learner Outcomes

The four authors, two faculty from each program, met to discuss the limitations in current instructional content on dysphagia and medication delivery effects, as well as optimal timing of providing this content. Both primary goals of interprofessional training (learning about the other profession to know when to collaborate and learning with the other profession to know how to collaborate) were deemed important to include. For the SLP program, the optimal timing was identified as early in the final year of the two-year Master of Science program, when students had learned how to assess and treat dysphagia but were just embarking on applying this knowledge in more advanced contexts. For the Pharmacy program, the optimal timing was identified as early in the third year of the four-year Doctor of Pharmacy program, when students have knowledge on the pharmacodynamic and pharmacokinetic drug properties and clinical skills for complex application-based learning. Course schedules were compared to find a week agreeable to each program.

Learner outcomes were categorized as Knowledge Outcomes when they achieved learning about dysphagia, medication delivery, and the roles of each profession. In contrast, Skill Outcomes involved collaborating to enhance care for a patient with dysphagia. Both sets of outcomes were defined in behavioural terms and were equally applicable to students in both programs. The Knowledge Outcomes were to describe various dysphagia management recommendations, describe various methods of medication delivery, explain how delivery methods impact drug effectiveness, and explain how diet texture modification and

medication delivery methods impact each other. The Skill Outcomes were to identify opportunities for and benefits of collaboration between SLP and Pharmacy to optimize a given patient's health and wellbeing, prepare medical chart notes (one for each profession) for a given patient describing the analysis and recommendations that reflect the result of collaborative decision-making, and describe the group process skills required to achieve effective information sharing and problem-solving in patient care discussions.

3. Methods - Mapping Instructional Methods onto Learner Outcomes

Principles from the Rehabilitation Treatment Specification System (RTSS; Hart, Dijkers, Whyte, Turkstra, Zanca, Packel, Van Stan, Ferraro, & Chen, 2019) were used to map the instructional methods onto target learner outcomes. The RTSS emphasizes the importance of instructional "ingredients" matching the desired learning outcomes, such that if changes in Knowledge are required, ingredients include descriptions and explanations, whereas if changes in Skill are required, ingredients include practice. Therefore, didactic instructional methods were selected to achieve the Knowledge Outcomes while problem-based learning methods (Neufeld & Barrows, 1974) were selected to achieve the Skill Outcomes.

In addition, principles from Universal Design for Learning (Center for Applied Special Technology [CAST], 2018) were used to ensure a sufficient variety of instructional approaches were included to support students with varied learning preferences in accessing knowledge via different routes (e.g., didactic vs problem-based) and in having different modalities through which to share their knowledge (e.g., written vs spoken).

The University of Manitoba and McMaster University are separated by more than 2,000 kilometres and one time zone. Fortunately, the coronavirus pandemic had vastly increased the accessibility of and comfort with virtual learning, so the IPE event was completed 100% virtually on the Zoom platform. There were three distinct stages to the IPE event, each one progressively building upon knowledge and skill. Approximately two weeks before the IPE event, students were provided a handout describing the requirements at each stage.

3.1. Stage 1: Profession-Specific Content Delivered Asynchronously

Recognizing that each professional group needed an introduction to the basics of the other's knowledge on the topics of dysphagia and medication delivery effects, a 30-minute recorded lecture was prepared for each student group. The Pharmacy program prepared a lecture for the SLP students on the role of a pharmacist, the pharmacist's scope of practice in Canada, and collaboration opportunities. The SLP program prepared a lecture for the pharmacy students that provided an introduction to normal swallowing and the role of speech-language pathologists in dysphagia management. Both lectures were posted on each university's

respective Learning Management System one week before the IPE event so that students could watch them asynchronously at times that suited their schedules.

During this time, the programs pre-arranged the 82 students into ten groups, with the group composition ratio based on the relative number of students in each program.

3.2. Stage 2: Interprofessional Content Delivered Synchronously

A 1.5-hour synchronous interprofessional lecture was delivered virtually for all students. Instructors from the SLP and Pharmacy programs collaborated on preparing the content. This lecture built upon the knowledge delivered within the asynchronous lectures, with a focus on the role of each profession when managing patients diagnosed with dysphagia, and included relevant research to support evidence-based practice. Highlights from SLP included swallowing assessments, diet texture modification recommendations, and a review of thickened fluids. Pharmacy discussed types of medication dosage forms and their characteristics, emphasized how product manipulation could alter drug delivery and affect patient safety, and proposed a step-by-step process to assess medication management in the patient with dysphagia. The Knowledge Outcomes were reviewed at the end of the didactic portion and students were encouraged to ask questions to ensure the outcomes were achieved.

Upon completion of the lecture and question/answer period, problem-based learning cases were released to the students. Two cases were prepared, with five of the groups assigned to each case. Each profession was assigned homework relating to the case to complete prior to Stage 3. The SLP students were required to interpret the dysphagia assessment results and generate recommendations for appropriate diet modifications and the Pharmacy students were required to review the medication list and consider strategies which could be implemented to ensure appropriate drug delivery for different diet texture constraints.

3.3. Stage 3: Small Group, Problem-Based Learning

Each of the two cases reflected a different patient population and clinical needs but followed the same template: description of the patient and reason for admission, medical history, pre-admission medications, new medications since admission, and dysphagia assessment results. Both Case A and Case B asked the interprofessional student groups to achieve the same Skill Outcomes, described earlier.

This stage of the IPE event occurred two days after the didactic component. On arrival to the virtual classroom, students were sorted into their small groups and given one hour to discuss the case and document their Skill Outcomes on a shared Google Doc. One Google Doc was prepared for each case, with separate sections for each group to document their results, allowing students with the same case to benefit from other groups' learning. Students were encouraged to use the Help function in the virtual classroom to ask for an instructor to join their group if they had questions, but instructors also rotated through the groups to check in

on their progress. Just over halfway through the small group time, each group was informed of which of the learner outcome results they would be required to present to the large group.

One hour was then allocated for the ten groups to join together as a large group. Four groups (two per case) were assigned to share their findings for the first Skill Outcome (collaboration opportunities). Another four groups were assigned to discuss the second Skill Outcome (chart notes). The two remaining groups (one for each case) spoke to the final Skill Outcome (group process skills). All groups elected representatives from each profession to share their learning to ensure both perspectives were highlighted. Instructors provided input as needed. A final question and answer segment and concluding remarks wrapped up the large group session.

Upon completion of this final segment of the IPE event, informal feedback was solicited to determine student perceptions and learnings from the IPE event. The instructors then met to discuss feedback and plan for the refinement of activities for the following year.

4. Results and Discussion

The design and implementation procedures for "A Tough Pill to Swallow: Dysphagia Management for SLP and Pharmacy Students" were feasible and resulted in positive feedback from students. The instructors recommend the RTSS- (Hart et al. 2019) and CAST-inspired (CAST, 2018) procedures described in this paper for any programs wishing to collaborate on implementing a virtual IPE event. The procedures were time-efficient during both the development and implementation phases. They also resulted in effective and efficient achievement of all desired Knowledge and Skill Outcomes. This was evidenced via the students' written work documented in the Google Docs, their oral presentations to the large group at the end of the small group discussions, and the feedback provided immediately post IPE event (van Diggele et al., 2020).

Feedback from the students suggested that they enjoyed the structure of the event, including the staged process and multiple learning modalities (e.g., synchronous and asynchronous components; individual, small group, and large group activities; didactic and problem-based components). Many students described the significance of the learning event as they prepared to embark upon their careers, commenting that they had not understood the critical importance of collaboration between SLP and pharmacy prior to the event. Students also indicated that they now felt comfortable reaching out to initiate collaboration with the other profession and that they understood the tremendous value even a short conversation could have on ensuring optimal management of their patients' health and wellbeing.

Some suggestions were made to further improve the event for subsequent years. Students recommended a smaller group size to ease interaction in the virtual platform. They also indicated a preference for each group to have its own Google Doc, rather than its own section

within one larger Google Doc, to reduce distraction while documenting their outcomes. Finally, refinements to how information was shared in the large group were suggested to improve the clarity of discussion across the two cases. The instructors additionally decided to review the content provided across each of the three stages, in the context of what was observed from the group discussions and presentations, to ensure duplication is minimized while progressive scaffolding of content is reinforced. With feasibility of the methods confirmed, the next iteration of this IPE event will use the extended version of Kirkpatrick's classic educational outcomes model (Reeves, Fletcher, Barr, Birch, Boet, Davies, McFadyen, Rivera, & Kitto, 2016) to develop a pre- and post-online survey of perceptions of IPE and implementation of collaboration skills, as well as any differences between the undergraduate Pharmacy and graduate SLP student experiences.

5. Conclusion

This paper describes procedures developed to enable students in different health professional programs in different geographic regions within the same country to learn about each other's professions and apply this knowledge to optimize outcomes for patients. A series of procedures to address typical logistical challenges, such as time and space issues, while adhering to effective pedagogical approaches, were also presented. A 3-stage approach involving synchronous and asynchronous learning, as well as problem-based learning, increased engagement by allowing students with varied learning preferences to fully participate, and provided multiple opportunities for the instructors to confirm attainment of all Knowledge and Skill Outcomes. A limitation of these procedures is that formal feedback was not solicited from the students. However, this same model can be applied across disciplines to demonstrate and highlight the importance of interprofessional collaboration. Future research will capture formal pre- and post-data to evaluate changes in interprofessional knowledge and skill.

References

Altman, K. W., Yu, G. P., & Schaefer, S. D. (2010). Consequence of dysphagia in the hospitalized patient: impact on prognosis and hospital resources. *Archives of Otolaryngology–Head & Neck Surgery, 136(8),* 784-789.

Attrill, S., White, S., Murray, J., Hammond, S., & Doeltgen, S. (2018). Impact of oropharyngeal dysphagia on healthcare cost and length of stay in hospital: A systematic review. *BMC Health Services Research*, *18*(1), 594. doi.org/10.1186/s12913-018-3376-3

Canadian Interprofessional Health Collaborative. (2010). A national interprofessional competency framework. Vancouver, BC: Author. Retrieved from http://www.cihc-cpis.com/publications1.html.

Carrión, S., Cabré, M., Monteis, R., Roca, M., Palomera, E., Serra-Prat, M., Rofes, L., & Clavé, P. (2015). Oropharyngeal dysphagia is a prevalent risk factor for malnutrition in a cohort of older patients admitted with an acute disease to a general hospital. *Clinical Nutrition*, *34*(3), 436–442. doi.org/10.1016/j.clnu.2014.04.014

Clavé, P., Rofes, L., Carrión, S., Ortega, O., Cabré, M., Serra-Prat, M., & Arreola, V. (2012). Pathophysiology, relevance and natural history of oropharyngeal dysphagia among older people. In *Stepping Stones to Living Well with Dysphagia* (Vol. 72, pp. 57–66). Karger Publishers.

Center for Applied Special Technology. (2018). Universal design for learning guidelines. Wakefield, MA: Author. Retrieved from http://udlguidelines.cast.org.

Crary, M. A., Humphrey, J. L., Carnaby-Mann, G., Sambandam, R., Miller, L., & Silliman, S. (2013). Dysphagia, nutrition, and hydration in ischemic stroke patients at admission and discharge from acute care. *Dysphagia, 28(1),* 69-76.

D'Eon, M. (2005). A blueprint for interprofessional learning. *Journal of Interprofessional Care, 19(Suppl. 1)*, 49-59. doi.org/10.1080/13561820512331350227

Guraya, S. Y., & Barr, H. (2018). The effectiveness of interprofessional education in healthcare: A systematic review and meta-analysis. *Kaohsiung Journal of Medical Sciences,* 34, 160-165. doi.org/10.1016/j.kjms.2017.12.009

Hart, T., Dijkers, M. P., Whyte, J., Turkstra, L. S., Zanca, J. M., Packel, A., Van Stan, J. H., Ferrero, M., & Chen, C. (2019). A theory-driven system for the specification of rehabilitation treatments. *Archives of Physical Medicine and Rehabilitation, 100(1),* 172-180.

Interprofessional Educational Collaborative. (2016). Core competencies for interprofessional collaborative practice: 2016 update. Washington, DC: Author. Retrieved from https://www.ipecollaborative.org/ipec-core-competencies.

McKee, N., D'Eon, M., & Trinder, K. (2013). Problem-based learning for inter-professional education: evidence from an inter-professional PBL module on palliative care. *Canadian Medical Education Journal*, *4*(1), e35–e48. doi.org/10.36834/cmej.36602

Neufeld, V.R., & Barrows, H.S. (1974). The "McMaster Philosophy": An approach to medical education. *Journal of Medical Education, 49(11)*, 1040-1050.

Patel, D. A., Krishnaswami, S., Steger, E., Conover, E., Vaezi, M. F., Ciucci, M. R., & Francis, D. O. (2018). Economic and survival burden of dysphagia among inpatients in the United States. *Diseases of the Esophagus: Official Journal of the International Society for Diseases of the Esophagus*, *31*(1), 1–7. doi.org/10.1093/dote/dox131

Peñalva-Arigita, A., Prats, R., Lecha, M., Sansano, A., & Vila, L. (2019). Prevalence of dysphagia in a regional hospital setting: Acute care hospital and a geriatric sociosanitary care hospital: A cross-sectional study. *Clinical Nutrition ESPEN, 33,* 86-90.

Reeves, S., Fletcher, S., Barr, H., Birch, I., Boet, S., Davies, N., McFadyen, A., Rivera, J., & Kitto, S. (2016). A BEME systematic review of the effects of interprofessional education: BEME Guide No. 39. *Medical Teacher*, *38*(7), 656–668. doi.org/10.3109/0142159X.2016.1173663

Van Diggele, C., Roberts, C., Burgess, A., & Mellis, C. (2020). Interprofessional education: tips for design and implementation. *BMC Medical Education*, 20(suppl 2):455. doi.org/10.1186/s12909-020-02286-z

Ward, W., Zagoloff, A., Rieck, C., & Robiner, W. (2018). Interprofessional education: Opportunities and challenges for psychology. *Journal of Clinical Psychology in Medical Settings, 25*, 250-266. doi.org/10.1007/s10880-017-9538-3

World Health Organization. (2010). Framework for action on interprofessional education and collaborative practice. Geneva, Switzerland: Author. Retrieved from: https://www.who.int/publications/i/item/framework-for-action-on-interprofessional-education-collaborative-practice.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14597

Embedded Course Level Assessment for Effective Assessment of Program Learning Outcomes

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Abstract

Learning outcomes assessment is an effective academic quality assurance tool that enables educators to review and enhance the alignment between planned, delivered, and experienced curricula. Accurately assessing what students know and are able to do after completing a learning module is the first step to decide on the strategies to implement and the proper actions to take in order to ensure the continuous improvement of the student learning experience. This paper introduces a simple process for effectively assessing the intended program learning outcomes using assessment data collected at the course level. The process takes advantages of the assessment instruments used regularly by course instructors to assess their students in the classroom. This would help the program collect effective assessment data, while reducing the assessment load and not overwhelming faculty with extra assessment tasks.

Keywords: *Assessment, continuous improvement, learning outcomes, curriculum alignment.*

1. Introduction

Educating the next generation of students and preparing them for the job market has always been the core business of higher education institutions. With the emergence of the fourth industrial revolution and the ubiquity of internet technologies and applications, higher education institutions are currently facing several novel challenges. Four of these major challenges have been identified recently by the World Economic Forum as the increasing need for life-long learning; the evolving needs and expectations of students; the emerging technologies and business models; and the transition towards a "skills over degrees" model (Østergaard & Nordlund, 2019). Other major challenges include global competition, the increasing social and geographical diversity of the student body, and the reduction in state and federal funding.

While addressing the above challenges, higher education institutions are still required to provide quality education and to prepare students with the required skills and competencies to deal with an extremely dynamic job market. Nevertheless, several shortcomings have been identified by a recent study conducted by IBM's Institute for Business Value. The study surveyed the opinion of industry and academic leaders on the contemporary issues confronting higher education. The results of the study published by Forbes magazine (Morrison, 2015) indicated that only 43% out of the 1,000 industry and academia leaders surveyed felt that higher education gave students the skills they needed to join the job market. Moreover, only 41% believed that higher education met the industry needs.

Therefore, there is currently a considerable pressure from governments and academic accreditation agencies on higher education institutions to improve the effectiveness of their teaching practices to overcome the above challenges and shortcomings. For instance, the Australian Vice Chancellors' Committee stated in its guidelines for effective university teaching that "the promotion of effective teaching should be a matter of highest priority for each university and that each institution needs to develop a coherent set of policies and practices which demonstrate that the institution values above all else the education of its students and the contributions that academic staff make to the enhancement of student learning" (Aylett & Gregory, 1996). Teaching effectiveness, continuous improvement, and the ability of students to achieve their intended learning outcomes are also of utmost importance for several institutional and academic accreditation agencies including WASC, SACS, ABET, and AACSB, among others.

For a higher education institution to successfully promote effective teaching, its policies and procedures should define what effective teaching is, and how it can be measured and improved. Measuring teaching effectiveness in higher education environments, however, is not as easy as measuring research and service effectiveness. Evidence of research and service activities are usually public in nature, which makes them easier to locate and evaluate.

Teaching activities, on the other hand, take place behind closed doors, where only students and their instructors are usually involved. Hence, many universities rely on tools such as students' evaluation of teaching, peer evaluation of teaching, and course portfolios to collect evidence regarding the extent to which teaching and learning has taken place (Aylett & Gregory, 1996; Buckridge, 2008; Cerbin, 1994; De Rijdt et al., 2006; Melland & Volden, 1996; Shao et al., 2007). Other evaluation tools such as achievement of learning outcomes, teaching related publications, and teaching awards are also mentioned in literature (Berk, 2005).

Among the tools mentioned above, Learning Outcomes Assessment (LOA) provide educators with an effective tool to review and enhance the alignment between the planned, delivered and experienced curriculum. LOA processes could be used for obtaining reliable information to answer the following questions:

- Are students achieving the intended outcomes?
- Are they learning the required skills to succeed in this field or profession?
- Is the program continuously improving the students learning experience?
- Should the curriculum or the teaching strategies be modified?
- Are there other techniques or additional resources that would help students learn more effectively?

Answering the above questions would help educators decide on the proper actions to take and the strategies to implement in order to ensure the continuous improvement of the student learning experience, and the achievement of the intended learning outcomes.

This paper introduces a simple process for effectively assessing the intended program learning outcomes using assessment data collected at the course level. The process takes advantages of the assessment instruments used regularly by course instructors to assess their students in the classroom. This would help the program collect effective assessment data, while reducing the assessment load and not overwhelming faculty with extra assessment tasks. The remaining of the paper is organized as follows: Outcome-based teaching mode and its alignment maps are introduced in Section 2. The proposed PLO assessment method using the calculated CLOs assessment results is introduced in Section 3, followed by discussion remarks in Section 4.

2. Alignment Maps in Outcomes-Based Curriculum

Designing a program that addresses the above challenges starts by a careful definition of the intended program learning outcomes (PLOs) that describe the knowledge, skills, and competencies the students should have or be able to demonstrate upon the successful completion of the program requirements. The defined outcomes should provide students with

competencies and skills that are current and relevant to the 21st century competitive job market. They should be also aligned with the program and the college goals/objectives.

Abate et al. (2003) consider the development of PLOs as the foundation of building an outcomes-based curriculum. Once the PLOs are defined and approved, curriculum and learning strategies are developed to support their achievement. As such, the curriculum development is student centric and guided by what the student will be able to do at the end of each module rather than simply using modules content and subject areas as the guidelines (Thomas et al., 2015). Developed curricula should demonstrate through curriculum alignment that offered courses, learning activities, and assessment methods provide students with enough opportunities to achieve the intended PLOs at the introductory, developed, and mastery levels.

Curriculum alignment is an essential element of the curriculum development as it assures that the students have different opportunities to achieve the intended outcomes by graduation. It is also used to identify curriculum gaps and redundancy and to ensure that that appropriate assessment tools are used to assess each outcome. At the top level, a curriculum map is used to show how the offered courses contribute to the achievement of each PLO. This map is important as it clearly identify where PLOs are weakly, appropriately, or excessively covered by the offered curriculum. If a weak coverage is identified for a PLO (i.e., curriculum gap), the offered curriculum must be reconsidered to enhance its coverage.

Since each course could contribute to several PLOs at different levels, a second and more detailed map is needed to show how the alignment between the course learning outcomes (CLOs) and the PLOs. The CLOs must contribute to the achievement of the program PLOs, while each course does that to a different degree and in a different way. Thus, individual courses serve different purposes, and it is the collective learning across all courses that enables the student to achieve the overall PLOs. Extra caution is paid to the alignment of the CLO blooms taxonomy cognitive level with the PLO proficiency level.

In addition to the above two alignment maps, another map is needed to align the course topical outlines (CTOs) with the CLOs. This map is essential to assure that the offered topics are aligned with the blooms taxonomy cognitive level specified by the CLO. It is also important for closing the assessment loop, as it can be used to accurately identify the topics contributing to a specific CLO. Hence, allows course coordinators to design effective remedial actions targeting the areas of weaknesses. Each CLO must be covered by at least one CTO.

3. Assess PLOs Using CLOs Assessment Data

Since quality and excellence in education are important to all aspects of society, focus has been placed upon the assessment strategies to assure that programs are continuously improving and accomplishing their missions. Programs are expected to assess the defined outcomes regularly through a periodic assessment plan (Huba & Freed, 1999; Kuh & Ewell, 2010). The aim of the assessment plan is to provide programs with the required evidence for making informed changes in the curriculum to improve student performance. During each cycle, multiple assessment tools are used to measure the students' attainment of the intended outcomes at the end of the learning module. The collected assessment data are analyzed and compared against predefined targets to determine which outcomes the students have attained and which ones need improvement. Remedial actions are then recommended to address any revealed deficiencies, and the assessment loop is closed after the recommended remedial actions are implemented, and their impact are measured. To ensure the effectiveness of the assessment plan, another map is used to align the assessment instruments selected by the program with the each CLO and PLO

The first step in the assessment plan is to identify the most appropriate assessment methods that will be used to assess each outcome. An appropriate assessment method should be able to measure the competency addressed by the outcome effectively and accurately. It is essential that the selected assessment tool and the outcome belong to the same blooms taxonomy level. For instance, Blooms Taxonomy level one questions such as describe or explain are inappropriate to assess a higher cognitive level such as analysis, or design.

To streamline the assessment process at the course and program level, an online learning outcomes management system has been recently developed and deployed at (*removed for blind review*). The system provides programs with a user-friendly interface to build the different alignment maps mentioned above. Faculty use the system throughout the academic semester to submit the assessment data collected using regular course level assessment tools (e.g., tests, quizzes, projects, etc.). Once the assessment data for of tool t is submitted for CLO 'c', the system calculate the attainment level ($A_{t,c}$) as the percentage of students scored $\geq th_c$, where th_c is the predefined attainment threshold for tool t. If multiple tools are used to assess the same CLO, the system allows the course instructor to assign a weight ($W_{t,c}$) for each 't' when used to assess CLO 'c'. By the end of the semester, the system calculates the attainment result for CLO 'c' as:

$$A_c = \frac{\sum_t A_{t,c} \times w_{t,c}}{\sum_t w_{t,c}} \qquad (1)$$

If multiple sections are offered for a given course, after calculating the achievement score of each section, the system advances the status of the course workflow to "calculate the course assessment score" and calculates the overall attainment score of the CLO as

$$A_c = \frac{\sum_s A_{c,s} \times n_s}{\sum_s n_s} \quad (2)$$

The system also uses the CLO attainment results regularly calculated at the end of each semester as a direct assessment tool to calculate the PLOs attainment level. Out of the list of courses aligned with a PLO, the system identifies the courses aligned at the mastery level. The CLOs/PLOS alignment map is then used to identify the CLOs of the mastery level courses aligned with the PLO. The attainment results of the identified CLOs are then aggregated using a weighted average formula to calculate the attainment result for the PLO.

$$A_{p,CLO} = \frac{\sum_C A_c \times n_c \times W_c}{\sum_C n_c \times W_c} \quad (3)$$

Where n_c is the number of students measured for CLO '*c'*, and W_c is the weight assigned to the CLO. The system allows the program to assign different weights to different CLOs, as some CLOs might contribute by different weights to the attainment of the PLOs. This weight is part of CLOS/PLOS alignment map. The PLO attainment results are analyzed by comparing the calculated attainment results with target attainment threshold, and the attainment results calculated by other tools such as graduation projects, capstone courses.

4. Discussion

The learning outcomes assessment system was deployed starting Fall 2018. It has been used since then to streamline the assessment processes at the course and program level. Table 1 shows the assessment statistics for the 2020-2021 academic year. It shows that 11960 CLOs are defined in the system for 2415 active courses. While 626 PLOs are defined for 90 academic programs. Out of the 11960 CLOs, 4509 are aligned with 546 PLOs. The 148 unaligned With regard to the assessment efforts in AY2021, out of the 1678 courses selected for assessment, 1535 courses were assessed successfully (91.5%). In terms of CLOs, 7428 CLOs where assessed out of the planned 7950 CLOs. Figure 1 shows the CLO assessment statistics for the last five semesters. It shows a steady increase in the number of percentage of assessed CLOs each semester. Out of the 5778 CLOs offered in Fall 2021, 5539 were assessed successfully (96%)

At the program level, 322 PLOs were planned for assessment, out of which 297 were assessed successfully (92%). Out of the 297 assessed PLOs, CLO assessment results were used to

Table 1. Assessment Statistics for 2020-2021 Academic Year

	PLOs	Aligned PLOs	Course	CLOs	Aligned CLOs
Active	626	599	2415	11960	4509
Planned	322	296	1678	7950	2170
Assessed	297	284	1535	7428	2063

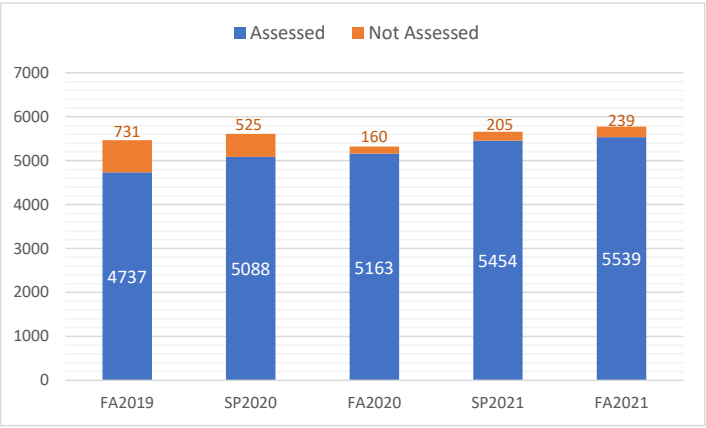

Figure 1. CLO Assessment Status

assess 284 PLOs. CLOs assessment results were the only assessment tool used to assess 163 out of the 297 assessed PLOs, while other assessment tools (e.g., capstone, graduation projects, internship experience, and exit exams) were used to assess 134 PLOs.

Although programs are strongly encouraged to utilize multiple tools to assess PLOs, the above statistics show clearly that more than 54% of the programs still rely on the assessment results collected at the course level as the only tool for PLO assessment. This is meanly because some programs are still not clear on how to utilize the extremely useful data collected from capstone courses, graduation projects, and internship experience for PLO assessment. To overcome this issue, starting the 2021-2022 academic year, a new feature was added to the learning outcomes assessment management system that allows programs to define assessment rubrics for individual PLOs and embed them at the course level. At the beginning of each semester, each program decides on the rubrics to be uses, and selects the courses where the data for the rubric will be collected. The course instructor is required to evaluate his/her students based on the provided rubric and submit the data to the system.

References

Abate, M. A., Stamatakis, M. K., & Haggett, R. R. (2003). Excellence in Curriculum Development and Assessment. *American Journal of Pharmaceutical Education*, *67*(1/4), 478–500.

Aylett, R., & Gregory, K. (1996). *Evaluating Teacher Quality in Higher Education*. Psychology Press.

Berk, R. (2005). Survey of 12 Strategies to Measure Teaching Effectiveness. *International Journal of Teaching and Learning in Higher Education*, *17*(1), 48–62.

Buckridge, M. (2008). Teaching portfolios: Their role in teaching and learning policy. *International Journal for Academic Development*, *13*(2), 117–127.

Cerbin, W. (1994). The Course Portfolio as a Tool for Continuous Improvement of Teaching and Learning. *Journal on Excellence in College Teaching*, *5*(1), 95–105.

De Rijdt, C., Tiquet, E., Dochy, F., & Devolder, M. (2006). Teaching portfolios in higher education and their effects: An explorative study. *Teaching and Teacher Education*, *22*(8), 1084–1093.

Edgerton, R., Hutchings, P., & Quinlan, K. (1995). *The Teaching Portfolio: Capturing the Scholarship in Teaching*. American Association for Higher Education.

Fong, R. W., Lee, J. C., Chang, C., Zhang, Z., Ngai, A. C., & Lim, C. P. (2014). Digital teaching portfolio in higher education: Examining colleagues' perceptions to inform implementation strategies. *The Internet and Higher Education*, *20*, 60–68.

Huba, M. E., & Freed, J. E. (1999). *Learner-Centered Assessment on College Campuses: Shifting the Focus from Teaching to Learning* (1st edition). Pearson.

Kuh, G. D., & Ewell, P. T. (2010). The State of Learning Outcomes Assessment in the United States. *Higher Education Management and Policy*, *22*(1), 1–20. https://doi.org/10.1787/hemp-22-5ks5dlhqbfr1

Melland, H. I., & Volden, C. M. (1996). Teaching Portfolios for Faculty Evaluation. *Nurse Educator*, *21*(2), 35–38.

Morrison, N. (2015). *Higher Education "Is Failing Students And Employers."* Forbes. https://www.forbes.com/sites/nickmorrison/2015/07/09/higher-education-is-failing-students-and-employers/

Østergaard, S. F., & Nordlund, A. G. (2019, December 20). *The 4 biggest challenges to our higher education model – and what to do about them*. World Economic Forum. https://www.weforum.org/agenda/2019/12/fourth-industrial-revolution-higher-education-challenges/

Schneckenberg, D. (2009). Understanding the real barriers to technology-enhanced innovation in higher education. *Educational Research*, *51*(4), 411–424. https://doi.org/10.1080/00131880903354741

Shao, L. P., Anderson, L. P., & Newsome, M. (2007). Evaluating teaching effectiveness: Where we are and where we should be. *Assessment & Evaluation in Higher Education*, *32*(3), 355–371.

Tartwijk, J. V., Driessen, E., Vleuten, C. V. D., & Stokking, K. (2007). Factors Influencing the Successful Introduction of Portfolios. *Quality in Higher Education*, *13*(1), 69–79. https://doi.org/10.1080/13538320701272813

Thomas, P. A., Kern, D. E., Hughes, M. T., & Chen, B. Y. (2015). *Curriculum development for medical education: A six-step approach*. Johns Hopkins University Press. https://jhu.pure.elsevier.com/en/publications/curriculum-development-for-medical-education-a-six-step-approach

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14700

A Systematic Review of Strategies to Develop Students' Cognitive Presence in Online Courses

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Abstract

This systematic review synthesizes research on strategies used to promote cognitive presence in online courses to identify trends from two decades (2000 to 2020) of scholarship. From initial search of 181 studies, a total of 14 articles published in peer-reviewed journals were reviewed. Results show that all of the studies were carried out in higher education with majority in the United States within the field of Education. Case-based and debate strategies were used the most to promote cognitive presence followed by structured, problem-based, and roles. For the patterns of students' cognitive presence, the majority of student discussions fell into exploration and integration phases with a small percentage within triggering and resolution phases. The study concludes that instructional strategies combined with effective instructional design elements can help learners engage in purposeful collaborative inquiry while progressing through all four phases of cognitive presence to achieve higher level learning outcomes.

Keywords: *Cognitive Presence; instructional strategies; systematic review.*

1. Introduction

Cognitive presence is defined as "the extent to which learners are able to construct and confirm meaning through sustained reflection and discourse" (Garrison et al., 2001, p. 11). It is the core element of the Community of Inquiry (CoI) framework that guides the design and implementation of online learning environments through a social-constructivist approach to learning (Garrison, 2017). CoI assumes that learning occurs at the intersection of the three presences–social presence, teaching presence, and cognitive presence (Garrison et al., 2001). Cognitive presence represents the means to support and maintain a purposeful learning community (Garrison, 2017). It is operationalized through the Practical Inquiry Model (PIM) based on phases of Dewey's (1933) reflective thinking and a collaborative inquiry process (Garrison et al., 2001). The PIM provides practical ways to evaluate the nature and quality of critical reflection and discourse in a community of inquiry through following (Garrison, 2017) following four phases: (1) Triggering: Identifying a problem or an issue through initiating the inquiry process; (2) Exploration: Searching for relevant information and offering explanation; (3) Integration: Interpreting and constructing possible solution to make decisions; (4) Resolution: Providing or defending potential solutions by means of practical applications.

According to Garrison (2017), "much research is needed to fully appreciate the inquiry process (cognitive presence) that occurs in a shared learning environment." Given that scholars have explored a variety of strategies to establish cognitive presence and to achieve higher-level learning (Chen et al., 2019; Olesova et al., 2016; Sadaf & Olesova, 2017), a synthesis review of effective strategies in order for instructors to make well informed decisions based on research-based practices is vitally needed (Sadaf, et al., 2021). While there are a few systematic reviews conducted on critical thinking and discussion strategies in general, there are no systematic reviews on the strategies to promote cognitive presence in online courses. Therefore, the purpose of this review is to gain deeper understanding of the current research by reviewing recent articles published between 2000 and 2020. Following questions guided our study:

1. What are the characteristics of the reviewed studies?
2. What are the patterns of students' cognitive presence phases in the reviewed studies?
3. What instructional strategies are used to promote cognitive presence in online courses?
4. What guidelines exist in the literature with regards to the strategies that promote cognitive presence in online learning?

2. Methods

We used the five-step systematic review process described in the U.S. Department of Education, Institute of Education Sciences, What Works Clearinghouse Procedures and Standards Handbook, Version 4.0 (2017). The five steps included (a) developing the review protocol, (b) identifying relevant literature, (c) screening studies, (d) reviewing articles, and (e) reporting findings.

2.1. Data Sources and Search Strategies

Five databases were searched using the search terms "Cognitive Presence" and "Online learning" for published articles between the years 2000 to 2020 using both the Title, Keyword and Abstract search function. The five databases searched included Academic Search Complete, ERIC Library, Information Science & Technology, PsycINFO and Science Direct. From the initial search, 181 articles resulted. These articles were screened both at the title level, abstract level, and full text level based on the inclusion and exclusion criteria. This resulted in 14 articles which were coded for the systematic review.

2.2. Inclusion and Exclusion Criteria

To be included in this systematic review, each study met the following screening criteria: Focus of the article (Cognitive Presence and Online Learning), publication date (2000 to 2020), publication type (original research from peer reviewed journals), research method (both quantitative and qualitative methods including an identifiable methods section and presentation of results), language (journal article was written in English) and focus on instructional strategies used to promote cognitive presence. A research study was excluded if it did not meet one or more of the criteria to be included.

2.3. Data Coding and Analysis

A review protocol for coding was developed in Microsoft Excel. Items were coded for article description, research design, data collection methods, data analysis methods, research topic focus, and cognitive presence phase included in the review protocol. Two graduate students reviewed and coded each of the articles independently, and then the first author verified the codes. Consensus was reached by resolving any disagreements over discussions. Descriptive statistics were generated to show the patterns and frequency of the variables of interest. Narrative data for research focus and instructional strategy were analyzed using content analysis to identify categorical themes.

3. Results

3.1. Characteristics of Reviewed Studies

The educational setting for all 14 studies was higher education. Most of the studies were conducted in the United States (n=8, 57.1%), two in Canada, and one each in Australia, Netherlands, Spain, and one in both UK and Hongkong. Education was the most common subject (n=7, 50%), followed by two each in Engineering, Health, Human Sciences, and one in multiple subjects. The participants in six of the studies were undergraduate students, six were graduate students, and two included both undergraduate and graduate. Most studies (n=9, 64.3%) used quantitative research design. All 14 studies used online discussion transcripts as the data collection method and content analysis of discussion to analyze data.

3.2. Patterns of Students' Cognitive Presence

Overall, the majority of the studies categorized students' posts as exploration (42%) and integration (31%), with smaller percentages as triggering (15%) and resolution (8%). Six studies coded messages that did not fit any of the four phases of cognitive presence as "other." Most of the studies placed the majority of student posts in the exploration, three studies finding the most messages in the integration phase, and only one study classified the majority of student posts in the triggering phase.

Table 1. Percentage Distribution of Cognitive Presence Phases in Studies

Authors	Main Strategy	Sub-Strategies	T	E	I	R	O
Chen et al., 2019	Peer Facilitation	Guided	11	54	29	1	5
Darabi et al., 2011	Multiple Strategies	Case-based, structured, scaffolding, debate, roles	6	42	41	10	
de Leng et al., 2009	Problem-based	PIM Structured	16	41	27	8	8
Gašević et al., 2015	Roles	Scaffolding	18	39	29	6	8
Gibbs, 2006	Multiple Strategies	Debate, Invited expert	31	33	28	2	6
Kanuka et al., 2007	Multiple Strategies	Debate, Invited expert, problem-based, reflection, WebQuest	11	53	26	10	
Morueta et al., 2016	Multiple Strategies	Case-based, WebQuest, conventional	21	52	26	1	
Oh et al., 2018	Peer & Instructor Facilitation	Case-based, debate	-	-	-	-	
Olesova et al., 2016	Roles	debate, case-based, reflection, problem-based	2	22	74	2	
Oriogun & Cave, 2008	Problem-based	Roles	23	21	17	19	20
Redmond, 2014	Reflection		3	49	15	33	
Richardson & Ice, 2010	Multiple Strategies	Case-based, debate, conventional	-	-	-	-	
Sadaf & Olesova, 2017	Case-Based	PIM Structured	17	51	28	4	
Wang & Chen, 2008	Multiple Strategies	PIM Structured, peer facilitation	22	41	31	0	6
Mean			15	42	31	8	

3.3. Instructional Strategies

The most commonly used strategies to facilitate cognitive presence were case-based strategies (n = 6) and debate (n = 6). These were followed by the PIM structured, problem-based strategies, and roles. Among the less researched instructional strategies were conventional, scaffolding, and inquiry-based represented (see Table 2).

Table 2. Instructional Strategies Used in Cognitive Presence Studies (n=14)

Instructional strategies	#	Studies
Case-based	6	Oh et al. (2018), Sadaf & Olesova (2017), Olesova et al. (2016), Morueta et al. (2016), Darabi et al. (2011), Richardson & Ice (2010)
Debate	6	Oh et al. (2018), Olesova et al. (2016), Darabi et al. (2011), Richardson & Ice (2010), Kanuka et al. (2007), Gibbs (2006)
PIM structured	4	Sadaf & Olesova (2017), Darabi et al. (2011), de Leng et al. (2009), Wang & Chen (2008)
Problem-based	4	Olesova et al. (2016), de Leng et al. (2009), Oriogun & Cave (2008), Kanuka et al. (2007)
Roles	4	Olesova et al. (2016), Gašević et al. (2015), Darabi et al. (2011), Oriogun & Cave (2008)
Peer facilitation	3	Chen et al. (2019), Oh et al. (2018), Wang & Chen (2008)
Reflection	3	Olesova et al. (2016), Redmond (2014), Kanuka et al. (2007)
Conventional	2	Morueta et al. (2016), Richardson & Ice (2010)
Invited expert	2	Kanuka et al. (2007), Gibbs (2007)
Scaffolding	2	Gašević et al. (2015), Darabi et al. (2011)
WebQuest	2	Morueta et al. (2016), Kanuka et al. (2007)

3.4. Guidelines

There is considerable agreement among the articles surveyed on guidelines and best practices for facilitating cognitive presence in online learning (see table 3). Half of the studies recommended that tasks for the strategies should be structured and designed to intentionally guide students through the phases of cognitive presence. Others suggested to provide open-ended strategies, assign roles within discussion, provide additional scaffolding, and design questions that promote progression through the phases of cognitive presence.

Table 3. Guidelines for promoting cognitive presence in online courses

Guidelines and implications	#	Studies
Design tasks to intentionally guide students through the phases of cognitive presence	8	Oh et al. (2018), Sadaf & Olesova (2017), Olesova et al. (2016), Morueta et al. (2016), Redmond (2014), Darabi et al. (2011), Oriogun & Cave (2008), Kanuka et al. (2007)
Provide open-ended strategies conducive for a high level of cognitive presence	3	Morueta et al. (2016), Wang & Chen (2008), Gibbs (2006)
Assign roles with clear guidelines within discussion	3	Olesova et al. (2016), Gašević et al. (2015), Kanuka et al. (2007)
Provide additional scaffolding to help learners achieve the next level	4	Olesova et al. (2016), Darabi et al. (2011), Richardson & Ice (2010), Gašević et al. (2015)
Design initial discussion questions that promote progression through stages of cognitive presence	3	Sadaf & Olesova (2017), Olesova et al. (2016), Richardson & Ice (2010)
Provide pre-structured threads to guide the learner within the model of practical inquiry	3	Sadaf & Olesova (2017), Darabi et al. (2011), Wang & Chen (2008)

4. Discussion and implications

This systematic review revealed several interesting trends regarding the empirical research on the strategies to promote cognitive presence in online learning published between 2000 through 2020. Results revealed that all of the studies were conducted in higher education and almost half of them within the United States. Among four disciplines, a majority of the studies were conducted in Education. This suggests the need to expand research on in other countries and in a variety of disciplines.

In terms of research methodology, quantitative research methods were used the most with discussion transcripts as the main data source and content analysis as the data analysis method. This corresponds previous systematic reviews on cognitive presence in online learning (Sadaf et al., 2021). Less use of mixed-methods and qualitative research methods points to the need to conduct more research using both mixed-methods and qualitative methods that can help accurately understand strategies to promote cognitive presence in different learning modes.

This review shows that the majority of cognitive presence messages fell into exploration and integration phases with a small percentage within triggering and resolution phases. A possible explanation is that the level of cognitive presence achieved is associated with the learning objectives of the strategies. Scholars have concluded that instructional strategies must be employed to allow learners to collaborate in a meaningful critical discourse helping them attain higher-level cognitive presence (Garrison, 2017; Sadaf & Olesova, 2017).

Analysis of the 14 studies revealed that different instructional strategies had different learning outcome in terms to cognitive presence phases. For example, the PIM structured strategy used in Sadaf & Olesova's study reached resolution phase and Darabi et al., (2011) did not. Sadaf & Olesova concluded that students reaching resolution phase was due to that the nature of the task and the wording of the discussion questions. This shows the importance of other elements of design in addition to just using an instructional strategy.

The following six key themes of guidelines emerged from this systematic review that may have implications for developing cognitive presence in online discussions:

1. Task design and structure of the discussion play the most critical role in promoting higher levels of cognitive presence. Structure provided in the early stages of discussion activities can transition to more open activities later on, since the less structured the learning task, the more interaction and cohesion will occur (Morueta et al., 2016).
2. Use open-ended strategies with tasks that are conducive for a high level of cognitive presence are important. For example, case-based and inquiry-based discussion tasks lead to greater cognitive participation (Moruetta et al., 2016; Sadaf & Olesova, 2017).
3. Assign roles for students within an online discussion to raise levels of cognitive presence among learners (Gašević et al., 2015; Olesova et al., 2016). Scripted roles in discussions can improve cognitive presence, in particular guiding students through the integration phase with intentional question design (Olesova et al., 2016), and highly structured, planned, confrontational activities (Kanuka et al., 2007).
4. Provide scaffolding to help learners achieve the next level of cognitive presence. The instructor's role as a facilitator of discourse among students includes moderating and shaping the direction of the discourse by modeling appropriate contributions and challenging students' ideas (Garrison & Cleveland-Innes, 2005), monitoring the discussion process and intervening when necessary (Wang & Chen, 2008), and guiding learners in the process of knowledge building (Morueta et al., 2016).
5. Design discussion questions with the specific intent of guiding students through the phases of cognitive presence (Olesova et al., 2016; Sadaf & Olesova, 2017). For example, explicitly asking students to provide a rationale for their solutions or giving them an authentic task such as a case to solve followed by the PIM questions can promote cognitive presence in online discussions (Sadaf & Olesova, 2017).
6. Design pre-structured threads to guide the learner to achieve progression through the phases of cognitive presence (Darabi et al., 2011; Wang & Chen, 2008). The instructor should provide pre-structured threads based on the model of practical inquiry to guide the learner starting with triggering events leading the discussion towards integration and resolution (Darabi et al., 2011; Sadaf & Olesova, 2017).

References

Chen, Y., Lei, J., & Cheng, J. (2019). What if online students take on the responsibility: students' cognitive presence and peer facilitation techniques. *Online Learning*, *23*(1), 37-61.

Clearinghouse, W. W. (2017). Procedures handbook (version 4.0). *Washington, DC: Institute of Educational Sciences, US Department of Education. Retrieved from https://ies.ed.gov/ncee/wwc/Docs/referenceresources/wwc_standards_handbook_v4.pdf*

Darabi, A., Arrastia, M. C., Nelson, D. W., Cornille, T., & Liang, X. (2011). Cognitive presence in asynchronous online learning: A comparison of four discussion strategies. *Journal of Computer Assisted Learning*, *27*(3), 216-227.

Dewey, J. 1933. *How we think: A restatement of the relation of reflective thinking to the educative process*. Boston: D.C. Heath and Company.

Garrison, D. R., & Cleveland-Innes, M. (2005). Facilitating cognitive presence in online learning: Interaction is not enough. *The American journal of distance education, 19*(3), 133-148.

Garrison, D. R., Anderson, T., & Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education*, *15*(1), 7-23.

Garrison, D. (2017). *E-learning in the 21st century: A community of inquiry framework for research and practice* (3rd ed.). London: Routledge/Taylor and Francis.

Gašević, D., Adesope, O., Joksimović, S., & Kovanović, V. (2015). Externally-facilitated regulation scaffolding and role assignment to develop cognitive presence in asynchronous online discussions. *The Internet and Higher Education, 24*, 53-65.

Kanuka, H., Rourke, L., & Laflamme, E. (2007). The influence of instructional methods on the quality of online discussion. *British Journal of Educational Technology, 38*(2), 260-271.

Morueta, R. T., López, P. M., Gómez, Á. H., & Harris, V. W. (2016). Exploring social and cognitive presences in communities of inquiry to perform higher cognitive tasks. *The Internet and Higher Education*, *31*, 122-131.

Oh, E. G., Huang, W. H. D., Mehdiabadi, A. H., & Ju, B. (2018). Facilitating critical thinking in asynchronous online discussion: comparison between peer-and instructor-redirection. *Journal of Computing in Higher Education*, *30*(3), 489-509.

Olesova, L., Slavin, M., & Lim, J. (2016). Exploring the effect of scripted roles on cognitive presence in asynchronous online discussions. *Online Learning*, *20*(4), 34-53.

Oriogun, P. K., & Cave, D. (2008). Using code-recode to detect critical thinking aspects of asynchronous small group CMC collaborative learning. *Journal of Interactive Online Learning, 7*(3), 208-226.

Redmond, P. (2014). Reflection as an indicator of cognitive presence. *E-Learning and Digital Media*, *11*(1), 46-58.

Richardson, J. C., & Ice, P. (2010). Investigating students' level of critical thinking across instructional strategies in online discussions. *The Internet and Higher Education*, *13*(1-2), 52-59.

Sadaf, A., & Olesova, L. (2017). Enhancing cognitive presence in online case discussions with questions based on the practical inquiry model. *American Journal of Distance Education*, *31*(1), 56-69.

Sadaf, A., Wu, T., & Martin, F. (2021). Cognitive presence in online learning: a systematic review of empirical research from 2000 to 2019. *Computers and Education Open*, *2*, 100050.

Wang, Y. M., & Chen, V. D. T. (2008). Essential elements in designing online discussions to promote cognitive presence: A practical experience. *Journal of Asynchronous Learning Networks*, *12*, 157-177.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14450

A Framework for Facilitating Acquisition and Improvement of Negotiation Skills by Business Students

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Abstract

In this paper, we present a framework for facilitating the acquisition and improvement of a certain type of skill critical for success in business management: negotiation skill. We then proceed to provide evidence of the effectiveness of our framework, with data from a large public university's business program. We examined the performance of negotiators in dyads on negotiation exercises. Results indicate that the framework we used for training was associated with "getting to yes," as well as the quality of negotiated agreements, when comparing a randomly selected sample of trained business student dyads with a separate, comparable sample of dyads without formal training.

Keywords: *Negotiation; training; business students; integrative behavior.*

1. Introduction

Negotiation has been defined as a process in which two or more parties seek agreement on what each shall give to, and take from, the other (Rubin & Brown, 1975). Done well, the process can lead to high-quality agreements and positive relations. Done poorly, low quality agreements result, and relationships suffer. Fisher and Ury (1981) claimed that too often negotiators arrive at less-than optimal agreements, damage relationships, and create barriers to working together successfully. They advocated for a "win-win" negotiating approach in which the parties sought to uncover the true interests (rather than stated positions) of each other, and creatively devise options in which both could satisfy true interests (rather than seeking to divide a "fixed pie'). Barry & Friedman (1998: 348) defined integrative bargaining situations as "non-zero sum encounters in which there is the possibility for joint gain from the negotiation." In other words, integrative or "win-win" bargaining allows negotiators to increase the size of the pie by generating alternatives that satisfy the underlying interests of the two parties. Alternatively, distributive bargaining is characterized by attempts by one or both parties to capture value under the assumption that the total to be gained is zero-sum; what one party gains, the other party must give up. In practice, business educators have learned, training students to seek to increase the size of the pie so that all get more – rather than try to get the biggest piece of a smaller pie – is a challenge in business schools.

2. Training Framework

While numerous approaches have been developed to teach negotiation skills (lectures, case studies, observation of others, videos, etc.), one useful technique is the role-playing exercise. Exercises serve at least three purposes: 1) they reveal students' naïve theories of negotiation, which can later be contrasted with evidence from the research and the experiences of experts; 2) they provide an opportunity to practice new skills; and 3) they illustrate the application of underlying principles and themes. We developed 3 negotiation exercises that incorporate some distributive and some integrative aspects. The exercises permit the generation of creative alternatives that potentially satisfy both parties' underlying interests, allowing for a win-win deal. Moreover, they permit crafting solutions that meet one party's needs at low cost to the other. The goals of our training were for students to acquire and/or improve negotiation skills, particularly in integrative bargaining situations. Evidence of learning

should be found in (1) the number of students who actually arrived at a negotiated agreement in situation where integrative bargaining is possible, and (2) the quality of those agreements.

2.1. Step 1

Step 1 involved students completing a conflict management preference questionnaire and two personality self-assessments. At this point, students were not provided with any feedback.

2.2. Step 2

Step 2 placed students in dyads to negotiate with only minimal instructions, using the "Sasha Greatvoice" exercise (all exercises and surveys are available from the authors upon request). The "Sasha Greatvoice" exercise provides an opportunity to generate joint gains: an opera singer who is experimenting with a new sound and an empty calendar negotiates with the manager of a newly opened, small opera house with a very small budget.

2.3. Step 3

Upon completion of the timed (17-minute) exercise, students indicated if they had come to an agreement, and if so, jotted down a "Statement of Negotiated Agreement" and initialed it.

2.4. Step 4

Students individually and confidentially indicated their satisfaction with the results of the exercise, rated their own and the other party's style as exhibited in the negotiation, and assessed the other party's behavior. (Rating forms available from the authors upon request.)

2.5. Step 5

The instructors then debriefed the exercise, and introduced the first principles of negotiation. Considerable class time was spent on the debriefing. Reilly (2005) described a debriefing of an emotionally-charged negotiation exercise with students. While a PowerPoint presentation with the professor's suggestions might serve to convey information about how one establishes rapport in negotiation, Reilly found that real learning occurred when, in the debriefing, students described "the specific behaviors […that] led to the creation of a safe, rapport-filled environment where all information could be shared" (Reilly, 2005: 306).

In the debriefing, students reported to the class how the process went and what (if anything) they had agreed, and answered follow-up questions. The instructors' role was to use the students' experiences to introduce principles of negotiation to the class. In this debriefing, students learned what deals other dyads had reached, and sometimes concluded that their agreements were poor compared to others.' Typically, the debriefing emphasized bargaining over interests, not positions, and looking for creative ways to increase the potential area of agreement, rather than focusing exclusively on price. Dyads who had focused primarily on

money for a certain number of concerts became aware that they may have missed opportunities for joint gains through creative thinking, when compared with what other dyads had achieved. Following the debriefing, to exemplify how price obsession can get in the way of a quality agreement, instructors played a YouTube video with a Jaguar commercial featuring the artist Sting singing "Desert Rose." Reportedly, Sting agreed to do the commercial for no fee in order to boost sales of his music, a new sound poorly received, initially, by the market.

2.6. Step 6

Student teams prepared and delivered a presentation on one of six persuasion techniques: (1) Appeal to Authority, (2) Reciprocity, (3) Social Validation, (4) Liking, (5) Need for Consistency, and (6) Scarcity (Cialdini, 2001). This step had a dual purpose: developing team presentation skills, and acquiring knowledge of techniques that could be useful in negotiation.

2.7. Step 7

Instructors gave a lecture on conflict management preferences, accompanied by a handout to each student with his/her scores on each of five styles: competing, compromising, avoiding, accommodating, and collaborating (Thomas, 1976). Students' scores were compared with percentile scores from our database of nearly 7,000 business students, a comparison with mean scores from the student's country of origin, and a team conflict profile with data from all team members. Students were asked to reflect upon their results, and consider whether – and under what circumstances – their preference for dealing with conflict would facilitate or hinder negotiating. Shell (2001: 156) remarked: "Knowledge of bargaining styles is critical to negotiation success and ought to occupy a central place in negotiation training. Such knowledge helps student gain perspective on their own actions, interpret others' behavior, and use feedback more constructively."

2.8. Step 8

We assigned practitioner-friendly readings on negotiation which students completed prior to the next class.

2.9. Step 9

We lectured on principles of win-win negotiations, including: (a) establishing a goal for the negotiation; (b) determining one's BATNA (Best Alternative to the Negotiated Agreement) and estimating the other side's BATNA; (c) focusing on underlying interests, not positions; (d) being creative so as to generate options for mutual gain, that is, increasing the size of the pie; (e) using objective criteria, standards and benchmarks; (f) staying rationally focused on

the issue; (g) not making price the sole or primary content of the negotiation; (h) listening actively and asking many questions; etc.

2.10. Step 10

We put students in a new dyad for a second exercise: "Standard Airlines and Superior Aviation," which allowed for joint gains and avoiding a lawsuit over a trademark violation in a dispute between Southwest Airlines and Stevens Aviation.

2.11. Steps 11, 12, and 13

The next steps were identical to steps 3, 4, and 5 respectively. In the post-exercise debriefing, the instructors attempted to reinforce principles of win-win negotiations in response to the students' agreements. The debriefing was followed by the short YouTube video "Malice in Dallas," in which the CEOs of Southwest Airlines and Stevens Aviation arm-wrestled to settle a trademark dispute, a humorous way to emphasize that creative solutions can be found to meet underlying interests and create joint gain, and once again to emphasize that price does not have to be the primary content of a negotiation.

2.12. Step 14

New dyads were formed for the third negotiation exercise, "Urban Fire Department." In this exercise, the fire chief negotiates a pay increase with a recently promoted rising star, who happens to be a member of an under-represented group. Both parties are interested in increasing the diversity of the fire department, but may want to go about it in different ways. The introduction of a third exercise was done to allow students to improve skills in integrative bargaining. Thompson (1990) found that as negotiators completed more transactions, they reached more integrative agreements.

2.13. Steps 15, 16, and 17

The final steps in our training framework were parallel to Steps 3, 4, and 5 respectively. The three debriefing sessions (Steps 5, 13, and 17) were likely when the most learning occurred. Nadler et al. (2003: 537) found that experience alone is insufficient: "Contrary to popular intuition, simply having experience – in the absence of information revelation, principles, observation, or drawing analogies to other cases – is largely ineffective."

3. Method

We randomly assigned 168 business students in the same program to either a training or a no-training group (84 students each). Chi-square and t-tests of differences detected no significant differences between the groups on gender composition, age, level of education, grade point average, and country of origin. We therefore had 42 dyads each for the first (pre-

training), second (post-training), and third negotiation exercises. We examined the effectiveness of the training framework by looking at the data from the second exercise. Although the data from the third exercise revealed similar results to the second exercise, we have excluded these data from the present paper.

Agreement was reported by dyads in the "Statement of Negotiated Agreement" form. Satisfaction was calculated as the average of the dyad members' ratings on a single item, "How satisfied were you with the outcomes of the negotiation?" The quality of agreement was determined by three independent raters looking at the "Statement." Raters were consistent: $\mathbf{AD_{M(J)}}$ ranged from 0 to 1 (M= 0.26) (Burke & Dunlap, 2002), and $\mathbf{r^*_{wg(J)}}$ scores ranged from 0.71 to 0.96 (M=0.87), above the 0.7 suggested by Biemann et al. (2012).

4. Evidence of Effectiveness

We were interested in three potential outcomes. The first outcome was the percentage of dyads who got to an agreement in the time allotted, and the degree to which both parties were satisfied with the agreement reached. Pre-test (Exercise 1, Experimental group) to post-test (Exercise 2, Experimental group) revealed significant increases in the percentage of students who arrived at a deal as well as the quality of the agreements reached. Nonetheless, in order to examine the effectiveness of our framework, we needed to compare the results of the Experimental group after training (Exercise 2) with the Control group that had not undergone training but had some experience (also Exercise 2). We expected that training would enhance the quality of the negotiated agreements. We defined high-quality agreements as being characterized by four aspects. First, high-quality agreements include creative, non-standard ways to meet the interests of the parties and allow for or joint gains. Second, high-quality agreements fully meet the underlying interests of both parties (rather than being one-sided). Third, while the commercial transaction (price for a service) should be covered, it would not be the sole or dominant aspect of the deal. Fourth, high-quality agreements are practical, realistic, and easy to monitor compliance.

4.1. Agreement

We found that 32 dyads (76%) achieved a negotiated agreement in the control group while 40 (95%) did so in the experimental group for the second exercise. The Chi-square test reviewed a significant difference between the two groups ($\chi^{2}{}^{2}_{(1,\ N\ =\ 82)} = 6.22$, $p = .013$). Because agreement is a dichotomous categorical variable, we used logistic regression to calculate the odds of reaching agreement given training, controlling for average age of the dyad, age gap between negotiators, same country, and same sex. Training correctly predicted 88.3% of agreement with a significant effect (Cox and Snell $R^2 = .199$, $p = .004$; $B_{training}=2.53$, $p = .005$). Compared to those without training, dyads with training were 25% more likely to reach agreement.

4.2. Satisfaction

Using a one-tailed t-test, we found that dyad satisfaction with the negotiation was significantly higher in the experimental group (M= 4.10, SD=.906) than in the control group; $t_{(82)}$=1.75, p =.042. However, when controlling for age, age gap, same country, and same gender, we failed to find that training predicted satisfaction. Although the change in R^2 of .07 was significant (p = .020), the equation with training and the control variables overall did not predict satisfaction (R^2 = .14, $F_{(5, 71)}$ = 2.22, p = .061; β_{training} =.27, p = .020).

Quality of Negotiated Agreements. We tested whether or not the quality of the agreements could be attributed to the training. Independent-samples t-test were conducted to compare the quality of agreements in the control and experimental groups. We found significant differences in the scores for Creativity (Exp.M =2.86, SD=.980; Contr.M =1.96, SD=.994; $t_{(70)}$ =3.84, p < .001), Win-Win (Exp.M=2.83, SD=1.004; Contr.M=2.17, SD=.973, $t_{(70)}$= 2.78, p = .007); Price Prominence (Exp.M =3.35, SD=1.150; Contr.M=2.18, SD=.958; $t_{(70)}$ = 4.63, p < .001), Practicality (Exp.M =2.75, SD=1.032; Contr.M=1.89, SD=.870; $t_{(70)}$=3.78, p < .001), and Overall Quality (Exp.M =11.79, SD=3.559; Contr.M=8.20, SD=3.195; $t_{(70)}$=4.45, p < .001). These results indicated that training explained the difference in the quality of the negotiated agreement as we measured it.

We controlled for alternative explanations with multiple regression tests of the effect of training on quality controlling for average age, age gap, same country, and same gender. Training explained differences in 3 of the 4 measures of quality, as well as overall quality. Training predicted Overall Quality (R^2 = .26, $F_{(5, 59)}$ = 4.16, p = .003.; β_{training} = .51, p < .001), Creativity (R^2 = .23, $F_{(5, 59)}$ = 3.55, p = .007; β_{training} = .48, p < .001), Price Prominence (R^2 =.27, $F_{(5, 59)}$ = 4.42, p = .002.; β_{training} = .523, p < .000) and Practicality (R^2 = .18, $F_{(5, 59)}$ = 2.64, p =.032.; β_{training} = .434, p = .001), but not Win-win scores.

5. Conclusion

This paper describes an approach to facilitating the learning of negotiation skills by business students. We provide evidence that our training framework helped student dyads "get to yes" and achieve high-quality agreements. Agreements after training, as rated by our judges, were of significantly higher quality overall and for three of four measures: Creativity, Price prominence, and Practicality. It was not established that training explained improvement in Win-win outcomes (one measure of quality), nor in students' satisfaction with results. We interpret that to mean that our framework facilitated students' improvement in three of the aspects of quality we measured, but not in avoiding lopsided agreements wherein one party got a better deal than the other. Additional practice, feedback, and reflection may have been needed to transfer principles learned in one context to another context in order to improve "Win-win" outcomes. Moreover, in order to reach a win-win outcome, both parties may need

to frame the situation as one with integrative potential; if one or both negotiators characterize the situation as distributive, a win-win solution will not likely be reached.

In the debriefing, students were able to hear what other dyads had achieved and compare others' results to their own. Dyads who were obsessed with tangibles (price for services), learned that some colleagues had managed to go beyond price and meet both parties' interests. Dyads who saw that other classmates had generated more options thus "expanded the pie" learned that allowing creative ideas into the negotiation can improve the outcome. Dyads who arrived at agreements that might be difficult to implement and/or monitor compliance learned to pay more attention to the practicality of their solutions.

References

Barry, B. & Friedman, R.A. (1998). Bargainer characteristics in distributive and integrative negotiation. *Journal of Personality and Social Psychology, 74*: 345-359.

Biemann, T., Cole, M.S. & Voelpel, S. (2012). Within-group agreement: On the use (and misuse) of rWG and rWG(J) in leadership research and some best practice guidelines. *Leadership Quarterly, 23*: 66-80.

Burke, M.J. & Dunlap, W.P. (2002). Estimating interrater agreement with the average deviation index. *Organizational Research Methods, 5*: 159-172.

Cialdini, R. (2001). The science of persuasion, *Scientific American, 284*: 76-81.

Fisher, R. & Ury, W. (1981). *Getting to yes: Negotiating agreement without giving in*. New York: Penguin.

Nadler, J., Thompson, L. & Van Boven, L. (2003). Learning negotiation skills: Four models of knowledge creation and transfer. *Management Science, 49:* 529–540.

Rubin, J.Z. & B.R. Brown (1975), *The Social Psychology of Bargaining and Negotiation*, New York: Academic Press.

Reilly, P. (2005). Teaching law students how to feel: Using negotiations training to increase emotional intelligence. *Negotiation Journal, 21*(2): pp. 301-314.

Shell, G.R. (2001). Teaching ideas: Bargaining styles and negotiation: The Thomas-Kilmann conflict mode instrument in negotiation training. *Negotiation Journal, 17*: 155-174.

Thomas, K. (1976). Conflict and conflict management. In Dunnette, M. (Ed) *The handbook of industrial and organizational psychology* (pp. 889-935). Chicago: Rand McNally.

Thompson, L. (1990). The influence of experience on negotiation performance. *Journal of Experimental Social Psychology, 26*: 528-544.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14665

Co-created model of social innovation that promotes social impact in Vocational Training Institutions

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Abstract

Higher Education Institutions (HEI) have a fundamental role in generating positive social impact in the communities to which they belong. However, it is necessary to restructure the perspectives with which they are working, evolving from a rigid and welfare model, to a collaborative and co-creation one.

This paper aims to explore from theory and practice, how an Institutional model of social innovation can be designed involving stakeholders in the process. This will make it possible to realize that the incorporation of co-creation as a central element in the construction of a model is beneficial for the communities and generates greater and better results within society.

Keywords: *Social Innovation; co-creative solutions; social impact; Vocational Training Institutions.*

1. Introduction

Higher Education Institutions (HEI) are complex systems, with a defined trajectory, and with a momentum difficult to change. However, changing the current way of interacting with their communities can ignite a new source of solutions to the most pressing social and ecological problems. Several international and national level agreements aim to improve the current relationship between HEI and communities, but it is a space that still requires new models, intra-innovations and frameworks to materialize the change. This is particularly interesting and urgent in the Vocational Education Training sector in Latinoamérica, where also the HEI plays a role of contributing to economic equality, social inclusion and to the continuing training of the population.

This paper explores the co-creation process of a new educational model to accelerate the co-creation of solutions to urgent problems of disadvantaged communities in Chile. This model was co-created during the years 2020 and 2021, in the middle of the COVID-19 pandemic, which also gives the opportunity to better contextualize the Vocational Education Training (VET) and its role in society after this global crisis. Together with presenting the process behind the emergence of this model, the paper discusses the main threats and challenges that an approach like this can present. Perhaps a comprehensive understanding of new education models in the VET sector in the continent can help HEI to improve the strategies to help the society to be better prepared to the increasing threats related to climate change, democracy deterioration and economic inequality.

2. Context and problem

In 2016, UNESCO presented a strategy for Vocational Training Institutions that supports the 2030 Agenda for Sustainable Development, and which was agreed by the 193 Member States of the United Nations. Within it is the promotion and guarantee of and inclusive, equitable, quality education that provides learning opportunities for all people, establishing priority areas of action: Promotion of youth employment and entrepreneurship, promotion of equality and the equivalence of genders and and finally facilitate the transition towards sustainable economies and societies, proposing the key role played by HEI to promote ecological skills (UNESCO, 2016)

In Chile, the Ministry of Education has the “Strategic Transversal Dimensions in Vocational Training Institutions”, highlighting different areas of work: Quality, Territorial Development, Gender equity, Inclusion and Sustainability (Ministry of Education of Chile, 2020)

Similarly, the National Accreditation Commission of Chile (CNA) - a public and autonomous body whose purpose is to verify and promote the quality of HEI in Chile and their programs

- presents a "Guide for External Evaluation" in matters of Institutional Accreditation for Vocational Training Institutions, where content innovation plays the role of updating study plans. Likewise, from the Public Engagement, all Vocational Training Institutions must take into account the results and impacts of their programs (CNA, 2022).

Based on the foregoing, Social Innovation (SI) emerges as a response, which has different definitions but most theorists agree that its main axis is the search for common good, which protects people already the families of the abuses of all superior instance, of centralization, bureaucratization, welfare, among others (Martínez, 2015). To do this, Higher Education Institutions must implement and facilitate the creation of multiple initiatives, catalyzing learning from different disciplines in the face of the same problem (Gatica, Soto & Vela, 2015). Likewise, it is interesting to observe how social innovation initiatives have been organized in the form of laboratories or centers of social change within HEI. In this sense, in 2009, at the World Conference on Higher Education (WCHE), a call was made to contribute to the equitable development of universities through innovation and social responsibility (Martínez, 2015).

However, there are still barriers against institutional innovations, the most important being, according to Mulgan, Tucker and Sanders (2007): Efficiency (fear that the system will worsen in the short term), Minds (fear of changing assumptions, values and norms), Relationships (fear of losing relationships or contacts) and Interest (fear of changing status or learned mechanisms), the latter being the one most strongly linked to collaborative work between Institutions and their community. Despite this, there are HEI that wish to contribute to improving their strategies in order to better and more effectively face the social, economic and ecological challenges that afflict them.

This is the case of Santo Tomás Institution, in Chile, with 21 branches and more than 80 thousand students (University, Professional Institute and Technical Training Center), which has an Organization for Public Engagement Direction whose mission is to increase the contribution of the Institution to the most vulnerable communities in Chile. And that, now, is open to the emergence of a new policy based on Social Innovation, which is complex and diversified, and which hopes to open new opportunities for other houses of study, installing in them models and policies that improve, through cooperation and novelty, the conditions of the Institution and their environments.

3. Co-creation of a social innovation model that accelerates the social impact of Vocational Training Institutions

For both Gillwald (2016) and Mulgan (2016), the concept of Social Innovation is linked to the novelty of a solution to a problem, always looking for new mechanisms that remedy conflicts, in a better way and with a greater scope than previous solutions. Added to this, SI

assumes that novelty must change the basic routines of a society, its flows of authority, resources and belief systems (Westley, Antadze, Riddell, Robinson & Geobey, 2014). A change reflected by a less vertical and more horizontal work strategy, and where the central point is co-creation or co-production with all the levels and agents involved in the Institution (Voorberg, Bekkers, & Tummers, 2014).

Given the definitions of social innovation, the question is then how to install a set of policies, activities and capacities that support the emergence of more social innovations, and that these derive in addition to the teaching and innovation work of HEI.

The search for a model, for an educational innovation for social change, should tend to position all the levels involved as agents of change in the face of the problems that develop in their environment, thus contributing to their training as human capital and strengthening their social cohesion (Martínez, 2015). This would generate a reaction, both in their environment and in the Institution itself, forcing all those involved to adapt to a model of co-creating solutions to future crises or emergencies. In the case of Vocational Training Institutions, this model of promoting innovation would accelerate an impact both collectively and individually: In the first case, the SI would cause different entities within the institutions to generate the same multidisciplinary solution to a common problem. While, in the second case, all the professionals involved in the co-creation social innovation model will have the necessary experience to carry out SI in their respective individual projects.

4. Methodology

Between 2020 and 2021, an information survey was carried out with teachers, administrators and authorities of the Santo Tomás Institution, with the objective of designing and implementing a collaborative and co-constructed SI strategy. This stakeholder mapping consisted of semi-structured interviews with authorities from different institutions (University of the Basque Country, Universidad Minuto de Dios and Fundación Colunga), which have already designed an IS strategy, in order to learn about and use their experience as a frame of reference in the Santo Tomas Institution. In addition, two exploratory and diagnostic workshops were held, one with the authorities and teachers of the Santo Tomás Institution, and the other with its academics and officials. The next step was to ask a series of questions (open and closed) to different institutional entities to assess their knowledge about SI. Finally, the implementation of the Strategy was carried out through different meetings -in order to validate the IS Institutional Strategy and the different products that were part of it- implementing courses related to IS in the Institution.

5. Results and findings

Thanks to the co-creative diagnosis process at the Santo Tomás Institution, Social Innovation was defined as: "The collective search for new solutions aimed at solving social challenges with special emphasis on improving the quality of life of vulnerable communities. These new solutions can be a product, a service, a process, a practice or a management model that must be bidirectional, co-created, measurable and should aspire to generate permanent changes in society".

In this way, the definition would be in line with the essential elements in which all IS projects are framed: Co-creation, this being collective, bidirectional and pointing to the need to work collaboratively, thus generating multidisciplinary solutions to social challenges and environmental issues faced by the communities that are related to the Santo Tomás Institutions. Impact, that is, understanding of how the solutions affect, directly or indirectly, at a social, environmental and economic level. Novelty, where it is essential to implement and recognize the most innovative solutions which are also linked to sustainability, where every project must be lasting and continuous, allowing its model to prevail over time, aspiring to scale and, ultimately, to change the system in which it is framed.

In the case of the Santo Tomás Technical Training Center (CFTST), its Institutional Strategy for Social Innovation aimed to strengthen the connection and impact of the institution in the community. In this way, the implementation of SI as a strategic axis in the CFTST was based on sustaining a training framework for students, and also a plan for institutional change towards a culture that promotes co-creation. In this way, the Strategy would successfully insert itself into the Institution in a permeable manner, that is, it is impacted and has an impact on its environment, in constant feedback with the community and community partners and in balance with external requirements.

One of the projects carried out by this Institution around social innovation is "OdontoClean", a project that aims to generate information of clinical and practical importance for the patient and their families, and to be able to deliver it to those who have the greatest difficulty in reaching or get it. In this way, they work co-creatively with these people, generating support networks to solve the problem and generate a positive impact on the communities.

A Strategy for Institutional Change that would also be supported over time by a Change Team, in charge of being the interlocutor between institutional policy and work in the territory. Also having the role of promoting a culture of SI from the spaces that exist within the institution as well as the creation of new spaces necessary for its operation.

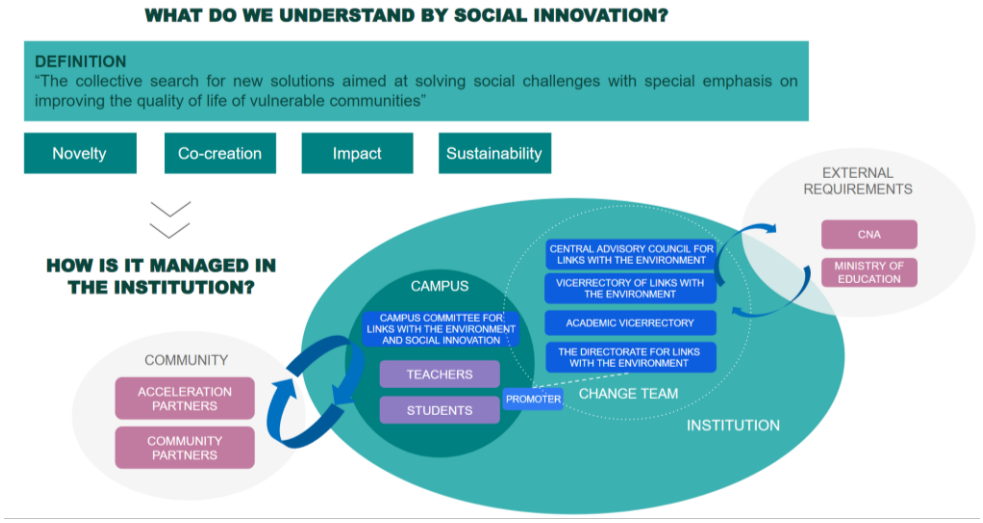

Figure 1. Institutional model of Social Innovation. Source: Own elaboration based on institutional model.

Within the implementations, different employability skills can be mentioned, through SI, in all students, teachers and collaborators of the Santo Tomás Institution, which would be divided into Curricular, Extra or Co-curricular and the Continuing Education program. Processes measured by indicators of Inputs, Results and Impacts.

In the case of the actions to be followed by the Strategy, these were measures in the short term (0 to 1 year), medium (1 to 3 years) and long term (3 to 5 years), divided into those focused on the Training of Students and Linkage and those focused on Institutionalization, Governance and Operations:

For the Training of Students and Bonding, the short-term actions focused on the introduction of the re-design and implementation of a class of social innovation called TDP, a. For the medium term, they focused on the integration and updating of knowledge in IS in all careers. While for the long term, a definitive inclusion of IS in all careers would be mandatory, thus consolidating the CFTST as a leading institution in Chile (and/or Latin America) in IS.

At the same time, for the Institutionalization, Governance and Operations group, short-term actions focused on the formation of the Change Team regarding the Strategy. For the medium term, work began on the inclusion of other venues in the SI, thus allowing the multidisciplinary exchange proposed by the Strategy. And finally, for the long term, it would be expected to generate the first studies on the multidirectional impact between the Strategy, the Institution, the students and the territory, based on competences in Vocational Training Institutions in Chile, Times Higher Education Report.

Although the Strategy generates an impact in the territory by the different institutional actors, it also trains students so that once they work in their respective disciplines, they can generate an impact in their own communities. In this way, the Strategy not only produces an impact in the territory linked to the institution, but also makes it possible for the impact to continue to grow over the years, transmitting the skills linked to social innovation.

6. Challenges and considerations on replicability

There are a number of challenges that must be considered when carrying out this Strategy. In the first place, despite the fact that both teachers and authorities were considered throughout the co-creative process, the students were only surveyed in the Strategy design. For this reason, it is essential that all sectors of the development process be taken into account, especially those who will see SI in the classroom or in the projects in which they participate. Second, because the Santo Tomás Institution has 21 branches throughout the country, the design of the Strategy must consider the diversity of needs resulting from different territorial contexts. Since the latter could hinder the consolidation of a single Institutional Strategy. Thirdly, since the Institution has multiple actors and bureaucratic channels to carry out changes in its Institutional Strategy, time and spaces must be considered that the Institution can count on in order to approve and/or review the design, otherwise The Strategy may suffer from various delays and difficulties.

Regarding replicability, it is necessary to maintain a high project management capacity, conversation moderation skills and conflict mediation. This will generate networking and internal and external communication skills, which are in line with intercultural skills and an entrepreneurial culture that is constantly renewed by feedback. Another consideration is the validation of the Strategy transversally by the Institution, the management teams, officials and students. Finally, the Institution must cleanly/legally declare the desire to install an IS Strategy.

7. Conclusions

The purpose of this exploratory study was to get closer to understanding how the HEI, VET providers in particular, can co-create new models for fostering its social impact. The paper presents a model that could be easily replicated in different HEI institutions across Latinoamerica, taking into account the challenges and notes on replicability shared in the last section. However, a deeper study on the sustainability of these models is needed, where could be taken into account how the leading team is able to sustain such a creation over the time.

References

Gatica, S., Soto, W., & Vela, D. (2015). *Ecosistemas de innovación social: El caso de las Universidades de América Latina.* Santiago: Ashoka.

Martínez, M. C. (2015). Social Innovation in Higher Education of Mexico. *Revista Iberoamericana para la Investigación y el Desarrollo Educativo, 6*(11).

Ministerio de Educación. (2020). *Estrategia Nacional Formación Técnico Profesional.* Gobierno de Chile. Obtenido de Gobierno de Chile.

Mulgan, G., Tucker, S., Ali, R., & Sanders, B. (2007). *Social Innovation. What it is, why it matters and how it can be accelerated.* Skoll Centre for Social Entrepreneurship.

National Accreditation Commission of Chile (CNA). (February 09, 2022). *National Accreditation Commission of Chile (CNA).* Retrieved from https://www.cnachile.cl/Paginas/misionvision.aspx

Students4Change. (2019). *Innovación y Emprendimiento Social en Instituciones de Educación Superior.* Ciudad de México: Hola Publishing International.

UNESCO. (2016). *Estrategia para la Enseñanza y Formación Técnica Profesional (EFTP) (2016-2021).* París: UNESCO.

Voorberg, W. H., Bekkers, J. M., & Tummers, L. G. (2015). A Systematic Review of Co-Creation and Co-Production: Embarking on the social innovation journey. *Public Management Review*, 1333-1357.

Westley, F., Antadze, N., Riddell, D. J., Robinson, K., & Geobey, S. (2014). Five Configurations for Scaling Up Social Innovation: Case Examples of Nonprofit Organizations From Canada. *The Journal of Applied Behavioral Science, 50*(3), 234-260.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14682

Relationships in teaching for critical thinking dispositions and skills

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Abstract

As follow up to research that identified critical thinking evident in an undergraduate course on Technology in the Family (Walker & Brown, 2020), this study explored the role of the social context in critical thinking acquisition (e.g., Brookfield, 2020). Qualitative analysis of student responses to an end of semester survey in fall 2021 (n=46) identified the roles of learner relationships (who, how) as learning influences. A focus group of representative class students validated and deepened insights from the analysis. Results indicate how the instructor and teaching assistant created the classroom dynamic of comfort and trust, small groups encouraged gaining new perspectives, and personal relationships beyond the class facilitated application and sharing for deeper understanding. Relationship building offers important dimensions for student mental health and critical thinking skills in higher education.

Keywords: *Critical thinking; relationships; classroom dynamics.*

1. Introduction

The acquisition of critical thinking skills that transfer to learners' personal and professional lives and that apply to their roles as global citizens is a key value of higher education (Casigrahi, 2017; Niu, Behar-Horentstein, & Garvan, 2013). Available models guide higher education instructional designers and educators to provide learning experiences that challenge existing cognitions and develop competencies for decision-making and social action (e.g., Davies, 2015).

The use and presence of technology in our 21st century society demands attention to critical thinking experiences in higher education, including use of personal computing, social media, access to the Internet and digital devices, learning technologies and digital disparities. The topic is relevant for critical thinking in higher education – particularly given the near dependence on distance learning during COVID- through its impact on personal, professional, and societal application for learners. The use of ICT is ubiquitous in emerging adults' lives, in their relationships and family connectivity, across fields of practice, and impacts society (Bialek & Fry, 2019). Critical thinking and action skills are required to make intentional decisions about the use of devices amidst a sea of incomplete and changing data, and contexts that are inconsistent in their technology practices and supports.

Previous research as explored the design and testing of an undergraduate course on families and technology for building learner critical thinking skills, dispositions, and social actions (Walker & Brown, 2020). This study investigates the role of socio-contextual dimensions in student learning. It teases out if and how relationships within and outside of the classroom influence the development of critical thinking skills.

2. About the Course

Families and Technology (FSOS 3105) is a 3-credit undergraduate classroom-based course delivered at a public institution in the United States. It is offered in the fall and spring semesters (15 weeks each) and heavily integrates technology for communication, instruction, and assessment. On average 45 students are enrolled, representing learners across all undergraduate years. The course is required for majors and fulfills an elective university-wide; approximately one fourth of the students are non- majors. Topics represent personal and family structure and process interests (e.g., from use in contemporary society and individual differences to couple formation and the use of dating apps, through parent-child relationships and work-family balance), and theoretical foundations framing the study of family and technology use and impacts (Table 1). The course helps to fulfill higher education's role in building pre-professional competencies and experiences by focusing on field standards on digital skills and practice ethics inclusive of technology (e.g., American Association of Marriage and Family Therapists, 2015).

2.1. Opportunities for Building Critical Thinking Skills, Dispositions and Actions

The course aligns with Davies' (2015) model of critical thinking in higher education by placing cognitive skills and arguments as the central features. Competencies represent Bloom's taxonomy (knowledge, comprehension, application, analysis, synthesis, evaluation) and those represented in problem-solving and decision-making models (Brookfield, 2020). Critical 'propensities' further represent the 'critical thinking movement:' affective, dispositions, emotions, attitudes and states of readiness. These relate to the self (e.g., tolerance of ambiguity, perseverance, desire to be well-informed) to others (e.g., respect for alternative viewpoints, understanding of individual differences) and in relation to the world (e.g., interest, inquisitiveness, Halpern, 1998; p. 58) Critical consideration of social conditions and actions represent what Davies describes as the 'criticality' movement and the more familiar critical pedagogy movement. Table 1 lists the activities that foster critical thinking, critical propensities, and critical action.

2.2. Student Identification of Salient Critical Thinking Perspectives

In previous course research (Walker & Brown, 2020), analysis of end of course input identified the topics students would continue to think critically about. While nearly all topics were noted, personal technology use, recognizing the impact of technology on relationships, work-family balance and technology use by family professionals were key topics mentioned (noted with an *). This validated Ryan & Deci's (2000) assertion that critical thinking and action is goal directed. Students in higher education experience a range of motivations for their learning, from personal (e.g., better understanding of oneself and direction in life); to practical (e.g., completing a degree), professional (e.g., gaining necessary competencies for a vocation), to global and societal (e.g., identifying steps toward wider change).

3. Exploring Socio-contextual Factors that Influence Critical Thinking Acquisition

3.1. Method

At the end of the semester in fall 2021 students (n= 46) were given three open-ended questions in which they were asked to 1) identify topics that were most meaningful in their critical thinking and 2) course activities or conditions that inspired their learning. A third question asked students how if at all, relationships influenced their learning in the course. Students answered anonymously and responses were transcribed to text for analysis. Thematic analysis was applied to all responses to identify dominant themes. Three students from the course acted as a focus group to help validate interpretation of the analysis. The

Table 1. Course Topics and Learning Activities for Critical Thinking in FSOS 3105.

Course Topic	**Activities for Learning** (course frequency)
Critical perspectives on our technology use as self, social self and member of society* Theoretical foundations for understanding the family and technology Differences in Technology Use Within and Across Families* Technology use in Intimate and Couple Relationships* Use and Impact of Technology on Children and Young Adult Development Technology Use by Parents Technology Use and Parent-Child Relationships Work -family balance and technology* Health and financial interests and safety with technology Family professional technology applications and skills* Integrating research, practice and policy	In class small group discussion and collaborative decision making (e.g., debate, comparative action) – weekly Evidence-based blog posts in response to prompts on course topics (1000 words each; 4 times/semester) Personal technology tracking (12 hours) and written analysis applying course concepts (1/semester) Exams (including demonstration of independent decision making, affective perspectives and actions for equity; 3/semester) Topic Reading/ Short quizzes (10/semester; approximately 1/week)

students represented class gender, age, race, sexual orientation and major. The videoconference transcript was converted to text and qualitative analysis applied by two coders.

3.2. Results

3.2.1. Topics

Students in the fall of 2021 identified technology use in personal relationships (17), relationships with family (15), professional applications (15) and work and family balance (11) as most salient to their learning experience. Those identifying children and teen use (8) and parent-child relationships (8) were parents or had significant childcare responsibilities. On reflection of the key topics identified, the focus group agreed that they were those most relevant to college students. Other topics were interesting yet more aspirational (i.e., later life realities).

3.2.2. Course and Classroom Influences on Critical Thinking

Student responses reflected all types of activities in the course (e.g., blog writing, debates,

though group discussion and applications to real life experiences were mentioned by most. Students appreciated that the course foci included raising their awareness, a critical lens and technology use that was intentional.

Student comments on groups indicated a diminished sense of competition and allowed for discussion of different perspectives on topics. One student observed *"[My group] has influenced my learning in this course. I believe that not only did our ideas for group discussion come from what we learned in class but also how we related to the topic. As a result, it was really fun to hear about all of our ideas and how it related to our personal lives which made the course even more meaningful."* For some students this also meant the development of relationships for studying and getting missed course materials or assignments. The focus group expanded on the value of small groups. The observed that class groups offered others with similar mindsets and experiences and made activities more enjoyable; they helped learners understand the content, apply it, and hear different perspectives.

Regarding the classroom climate, the tone set by and enthusiasm of the instructor for the topic and for teaching was cited by several students. As one student remarked *"[The instructor] made everyone always feel included and that made me personally want to be there in class."* In written observations about the teaching assistant (TA) and instructor, students used words like "feeling seen", "safe", "valued", and "belonging to a community." Focus group students conveyed the importance of a safe classroom space. When they felt safe in the classroom, they were more likely to participate in class and it made them want to do well in the course. When treated as individuals (the instructor/TA learning their names, checking in with them, caring about their interests and days, providing opportunities for them to share their expertise and experiences) students felt they had a voice in the class and wanted to be there to share and learn.

3.2.3. Relationship Influences

Students cited their own families or partners as influential in their learning in FSOS 3105. Over half (25) cited these relationships. Family may represent a parent (mother, father), or grandparent or partner. Some mentioned their friends (4) or others in general (2). Some students responded by recognizing class groups and/or the instructor and TA (10). Relationships outside of the class helped students apply the content. Content application was the dominant role relationships played, as noted by 26 students. As one student said, *"I think having someone or multiple people to think about how technology affects families is*

important, because applying theories and technology to my life is how I learned better if I can apply something to my life then I think I will be able to apply it to other families."

The second dominant theme of relationship influence was 'to understand" (by 10). Having these relationships in mind helped students make the topics relevant. Speaking about their mother, one student wrote: "*We both use technology in very different ways, but our differences were great reference point for conceptualizing how variations in use influence family dynamics and cohesion. Walking away from this course I definitely have more patience for our differences and feel far more willing to accommodate her differences in use, which has had a positive influence on our relationship*." Another student's experience suggested that their relationship with their father allowed for observing differences in perspectives on use, leading to a shift in behavior*: "This course has made me more self-aware of my personal use. Awareness/ behaviors strengthens my relationships and has helped me avoid conflict. I realized I crossed boundaries with my dad when he was at work by calling slash texting him."*

The third relational dimension was sharing. Some students indicated that they shared the topics with family, friends, or a partner in discussion (8). Observing others or discussing the content also allowed for learning new perspectives outside their own viewpoint or experience, "*I enjoyed interviewing my parents and my sister and her husband. I think it helped me to understand the reasons behind things they do in their parenting, and I also think it improved our relationships."*

The focus group validated the immediate family and personal relationships as most vivid to extending their class learning. They also validated these relationships as informing critical skills through application, perspective taking, and sharing the content with valued others. They added the phenomenon of learning about technology use along with their parents. Unlike other aspects of their growing up which they look to their parents for guidance and support (i.e., driving, getting a job) and around which application and sharing content may have different values, with technology they felt they were learning alongside and in many cases are the ones to teach their parents. This unique topic perspective in a traditional relationship offered room for perspective and sharing.

4. Discussion and implications

The insights from students in an undergraduate course on technology and the family provide valuable direction for supporting the process of learning in higher education. First, they validate the importance of topics that hold relevance. Although immersed in a wide range of topics on current technology in family life including parenting, child development, and public policy on technology and equity, students reported those most impactful as those most relevant to their personal experience. This includes technology use and personal relationships, being mindful of time and space boundary erosion with technology use for

work (school) and personal life, and their future use as professionals. To encourage learning across *all* course topics, as discussed below, given the meaningful role that others play, encouraging discussions with others might be a good way to boost learning, application, and critical perspectives.

A second insight is the value of classroom conditions and course elements that students find valuable. Course assignments, exams, and activities indeed promote cognition and content learning. Yet working in the structure of small groups yielded meaningful connections that became consistent and familiar, allowing students to share perspectives and voice differences and find common ground. Brookfield (2020) encourages the value of peer interaction through instructional design to explore assumptions through both shared and diverse lens'. Design contributes through the structuring of groups (in this case random assignment) and activities with questions that invite constructive comparison, collaboration, experience, and opinion sharing and creativity.

Classroom culture that promotes community holds tremendous value, particularly as students face myriad mental health issues and classrooms diversify. Students in FSOS 3105 spoke of the welcoming, trusted, and safe atmosphere created by the instructor and teaching assistant. This helped them feel that their voices, opinions, and experiences were welcomed. The climate wasn't competitive, and they felt that the instructor was learning along with them. These conditions enable vulnerability for perspectives to be challenged and being open to view other ways of understanding. In turn this fosters transformative, cognitive growth (Mezirow, 1991).

Finally, students ' personal relationships may be an untapped resource for student critical thinking acquisition. The students in FSOS 3105 overwhelmingly cited their relationships with family and partners as key to their learning. Holding relationships in mind, observing relationships or overt discussions enabled the application of concepts, a deeper understanding, and conversation that allowed for different perspectives. Most interesting is that none of the activities or prompts from the class invited students to hold conversations or make observations of their family members or partners. The roles these relationships played in their lives word natural and familiar context two more deeply understand and apply what technology meant in their lives.

Brookfield (2020) speaks of the power neutrality value of peer relationships in critical thinking. However, because college students in 2022 are learning how to use technology and how technology impacts their lives and their relationships simultaneously with their own parents presents a fascinating phenomenon. Whereas other topics might produce the generational and role power dynamic that might not be conducive to critical thought when applied to young adults and their parents, the parallel learning experience of using technology today presents a more leveled power dynamic. Under the condition that parents are not

bothered by this power shift (and some technology use research suggests they might, e.g., Mesch, 2006) family members and parents might be constructive collaborators for the development of student critical thinking. Such power leveling dynamics might be explored and applied to student critical thinking acquisition in other fields and domains. Relationships convey significant value to students' learning course content and developing critical thinking skills and dispositions. As this study reveals these relationships are embodied within a social context that begins with instructor presence and construction of a meaningful context, peer groups as a component of learning, and students own personal relationships as a consistent and enduring presence in their lives.

References

American Association of Marriage and Family Therapy. (2015). Code of Ethics. Retrieved from https://www.aamft.org/Legal_Ethics/Code_of_Ethics.aspx

Bialik, M and Fry, R. (2019). Millennial life: How young adulthood compares with prior generations. Pew Internet. Retrieved from https://www.pewsocialtrends.org/essay/millennial-life-how-young-adulthood-today-compares-with-prior-generations/

Brookfield, S. (2020) Teaching for Critical thinking. Ch 12. pp. 229-245. In *Handbook of Research on Ethical Challenges in Higher Education Leadership and Administration*. V. Wang, Ed. IGI Global publications. DOI: 10.4018/978-1-7998-4141-8.ch012

Casigrahi, B. (2017). Fundamentals of teaching critical thinking in higher education. *Journal of Education and Human Development*, *6*(3), 98-103. doi:10.15640/jehd.v6n3a11

Davies, M. (2015). A model of critical thinking in higher education. In *Higher education: Handbook of theory and research* (pp. 41-92). Springer.

Halpern, D. F. (2014). *Thought and knowledge: An introduction to critical thinking* (5th ed.). London: Psychology Press/Routledge.

International Society for Technology [ISTE]. (2016). ISTE standards for students. Retrieved from https://www.iste.org/standards/for-students

Mesch, G. S. (2006). Family characteristics and intergenerational conflicts over the internet. *Information, Communication & Society*, *9*(4), 473-495.

Mezirow, J. (1991). *Transformative dimensions of adult learning.* San Francisco, CA: Jossey-Bass.

Niu, L., Behar-Horentstein, L. S., & Garvan, C. W. (2013). Do instructional interventions influence college students' critical thinking skills? A meta-analysis. *Educational Research Review*, *9*, 114-118. DOI: https://doi.org/10.1016/j.edurev.2012.12.002

Olson, D. H., DeFrain, J. D., & Skogrand, L. (2014). Marriages and families: Intimacy, diversity, and strengths (8th ed.). New York: McGraw-Hill. Chapter 3: Understanding Marriage and Family Dynamics, pp. 64-102.

Ryan, L. D. & Deci, R. M. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology*, *25*, 54–67. doi:10.1006/ceps.1999.102

Walker, S. and Brown, R.L. (2020). Critical Thinking on Technology Use: Higher Education Course Design to Promote Personal, Professional and Societal Change. 6th International Conference on Higher Education Advances (HEAd'20) Universitat Politecnica de Valencia, Valencia, 2020 ` DOI: http://dx.doi.org/10.4995/HEAd20.2020.11300

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14504

Comparing standard with high-ability groups at university: differences in GPA for equally able students and gender-differentials

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Abstract

In this paper we compare the academic performance of students who enter a high-ability program at university with those who stay in a standard program for the same major. We also study whether the effects differ by gender. We find that, on average, students in the high-ability groups outperform those in the standard groups. However, once we control for the student's university entrance score - that is, the student's ability – we find that those in the high-ability groups obtain lower grades than their counterparts in the standard groups. Hence, students entering a high-ability program face a cost in terms of foregone academic grades. Finally, the gender analysis shows that such a negative effect is greater for females. Our results suggest that the post-graduate assessment of academic performance should not only look at the grades obtained, but also at the program taken. The implications might be larger for women.

Keywords: *High-ability; gender; grades; university.*

1. Introduction

High-ability tracking in educational systems are common in many countries. One of the main reasons used to justify the creation of such programs is that, given that students instruct each other and academic attitude is contagious, joining high-ability peers will benefit all of them. This positive effect has been labelled as the '*peer effect'* (Zimmerman, 2003). Other channels through which positive effects could come are a better predisposition on the part of teachers, a more dynamic environment for group interactions, or a more homogenous group, which would benefit all students because teachers would not have to explain the same thing several times to suit the different levels of students.

However, the evidence available to date on the effects of ability-grouping shows contradictory results (Sacerdote, 2011). A possible explanation for this mixed evidence is that, besides joining better peers, students in high-ability groups have also to cope with two disadvantages as compared to standard groups. The first of such drawbacks is that in high-ability groups instructors tend to set higher academic standards, which entails greater difficulty to obtain high grades. The second is that the environment in the classes become more competitive, resulting in higher pressure, that is, in higher stress and anxiety to meet own's and others' expectations. Joint with this, the *relative ranking effect* (Elsner et al., 2021) predicts that students perform worse/better when ranking low/high in a group's ability distribution. Since students enrolling in high-ability groups used to be top students at high-school or even earlier, upon entry in a high-ability group they suffer a sharp downgrading in the relative position that they occupy in the ability distribution, what may impact their anxiety and self-confidence negatively (the *small-fish-in-a-big-pond effect*, Marsh 1987).

The adaptation of students to the new environment at university, particularly in high-ability groups due to their special characteristics, is likely to be subjective to a large extent. Given the by now abundant literature documenting substantial gender differences in preferences for and reaction to competition (e.g., Gneezy et al., 2003), gender-based differences are likely to appear in such responses.

Given that high-ability grouping can have both positive and negative effects on academic performance, the natural question that arises is which of the possible countervaling effects overuns the other, and whether or not the net effect of those pros and cons might be heterogeneus by gender. To evaluate this trade-off, the first question that we want to answer in this study is: *Do students, with the same university entrance score, who decide to enter academically selective programs get better grades than those who stay in a standard program?* And the second question we want to answer is: *Are the effects on academic performance of joining a high ability group different between male and female students?* Therefore, the rationale behind exploring these questions is whether it is worthy (in GPA terms) entering HA-groups, and whether the answer may be different depending on gender.

Enrolment in high-ability educational programs determines, in many instances, subsequent access to selective educational and professional settings. If joining a high-ability group imposes students with a penalty in terms of grades, this would put them in disadvantage with respect to students in standard groups. In the academic context, particularly so at the higher educational stages, this could imply lower chances of successful post-graduate applications to masters programs, scholarships, or job offers if the recruitment processes do not value the specific program that the graduate comes from. Female underperformance in such high-ability groups, if it exists, might be among the many obstacles that women encounter on their path towards top professional positions, where the higher gaps are observed (the *glass-ceiling* phenomenom). Identifying such differences and their determinants therefore represents a significant contribution to redressing existing gender imbalances.

Methodologically, we base our analysis on four-cohorts of academic records for students at a large public university in Spain (*Universitat de Valéncia*, UV henceforth) in standard groups of Business Administration and in two high-ability programs of Business that coexist with the former. The two kind of programs share the same subjects but differ considerably in the admission cutoff. Based on regression analysis, we isolate the effect of the baseline ability of the student, approximated by their entrance score, and analyse gender differences as we further detail below.

To anticipate our results, we find that, on average, students in high-ability groups outperform (in terms of GPA at the end of first year at university) students in standard groups. However, once we control by the university entrance grade, students in high-ability groups obtain lower grades than their counterparts in the standard groups. This result points in the direction that joining a high-ability group has a cost in terms of foregone opportunities to get a higher grades-transcript in the degree. Finally, when we do the gender analysis, we find that although females get better grades than males on average on standard groups, when they enter a high-ability group the negative effect is greater than for males.

2. Institutional setting and data

To carry out our analysis we use administrative data on four cohorts of students enrolling in the business degrees offered at UV. This comprises both students in a standard program of Business Administration and in the high-ability programs of Business Administration & Law and International Business (HA-groups, henceforth). The HA-programs were set up in the academic year 2010-2011. The data used here refers to first-year students from then to academic year 2013-2014.

The UV, with near 45,000 students in 2020, is one of the largest public universities in Spain, and offers a wide range of around 70 four-year major degrees in all areas of study. College

admissions in public universities in Spain are based on students' entrance scores and the specific admission cutoffs established by each university for each degree and year. The admission cutoff is determined by the number of slots on offer, the demand of slots and the incoming cohort's average score. The entrance score ranges between 0 and a maximum of 14 points. The cutoff established by the UV for admission to the HA-programs differ quite from the entrance grades in standard groups. The cutoff started at around 10.5 points (out of 14) in 2010 and has increased to above 11.3 in 2013. By contrast, in the regular groups the cutoff ranged from 7.45 in 2010 to 7.65 in 2013. Thus, on average between 2010 and 2013, the differences between the mean entrance scores of students in the regular groups and those in high-ability groups are above 3 points on the 1-14 scale of the entrance grade, which constitutes a considerable difference.

Following a formal request of data, we received from UV administrative records of all students enrolled in the above mentioned major degrees from year 2010 to year 2013. These administrative records contain information on each student's entrance score, which we will take in this article as our measure of student's baseline ability. The data also contain the academic grades obtained in all subjects of the first academic year (all of them compulsory subjects), as well as certain demographic characteristics such as gender. In our empirical set up below, the outcome variable of interest is the student's final average point grade (GPA) obtained in compulsory subjects of the first year. This GPA is measured on a 0-10 scale.

We exclude from the estimation sample all those students whose admissions were based on different entrance requirements. This includes special students, such as disabled and elite sports students, those who transferred across colleges or degrees, those aged above 25 and international students. In total, we count on the administrative records for 1,691 students, out of which 934 are students in the standard groups and 757 are students in HA-groups. In our estimation sample, each student enters as many times as subjects evaluated for this student, that is, we pool the GPA of all students across all subjects. As a result, the estimation sample comprises 17,440 observations, 9,322 corresponding to regular students and 8,118 to high-ability students.

3. Empirical procedure and results

Our first question of interest is whether equally able students obtain higher/lower GPA in either standard groups or in HA-groups. Our second question of interest is whether or not such differences, if any, differ by gender. To shed light on these issues, we provide two pieces of evidence. First, we estimate that part of a student's actual GPA at the end of the first year at university that is above or below the value predicted by her entrance grade. More specifically, we regress by OLS the student's GPA on her entrance grade and its squared

value (to allow for non-linearities in the relationship between the GPA and the entrance grade). We compute a 'residual' as the difference between the actual (observed) GPA and the predicted GPA. A positive residual indicates that the student performs better than predicted by his/her entrance grade; a negative value indicates the opposite. The results are shown in Figure 1 for students who have surpassed the admission threshold but decide to enrol into the standard program and for those deciding instead entering the high-ability groups. The results are displayed by entrance grade (below or above the average) and by gender. A considerable positive difference is observed in favour of female students in standard groups. However, such a difference is close to zero, and if any negative, in HA-groups. In the case of male students, they underperform with respect to their predicted GPA in both types of groups. Such underperformance of male students seems to be larger in HA-groups than in standard groups for students below the average of entrance grades, but the opposite is found among above-the-average students. These results would be suggesting that female students feel 'more comfortable' in standard groups than in HA-groups, or, in other words, that the more competitive environment of the HA-groups do not favor them in terms of performance.

Figure 1 does not allow us to observe if equally able students obtain higher or lower GPA on either standard or HA-groups. To proceed with this we next estimate by OLS a linear model whose results are shown in Table 1. Subsequently from column (1) to column (5) we proceed estimating each student' GPA as a function of an increasingly augmented set of variables as follows: i) Column (1), only with a constant. In this case, the estimated coefficient displayed in the table represents the sample average of the dependent variable, that is, the sample average of GPA regardless of the type of group, the student's entrance grade, and gender. ii) In column (2), we add a binary indicator variable taking the value 1 for students in HA-groups and 0 otherwise. The estimated coefficient of this variable indicates the GPA differential for HA-groups as compared to standard groups (measured by the constant), regardless of the entrance grade and gender. iii) In column (3), we further add the entrance grade of the student. By doing so, we discount the effect of the student's entrance grade. That is, the estimated coefficient of the variable 'High-ability group' now indicates the GPA differential for HA-groups as compared to standard groups if we were to compare students with the same ability - as measured by a same entrance grade-, and still regardless of gender. iv) In column (4), we further we add a binary indicator variable (Female) taking the value 1 for female students, in all groups, and 0 for males. The estimated coefficient of this variable indicates the GPA differential for female students, regardless of the type of group, as compared to their male counterparts.v) Finally, in column (5), we interact the binary indicator variable 'Female' with the binary indicator variable 'High-ability group'. This variable will then take the value 1 for female students in HA-groups, and the estimated coefficient of this variable indicates

the GPA differential for female students in such type of groups as compared to female students in standard groups.

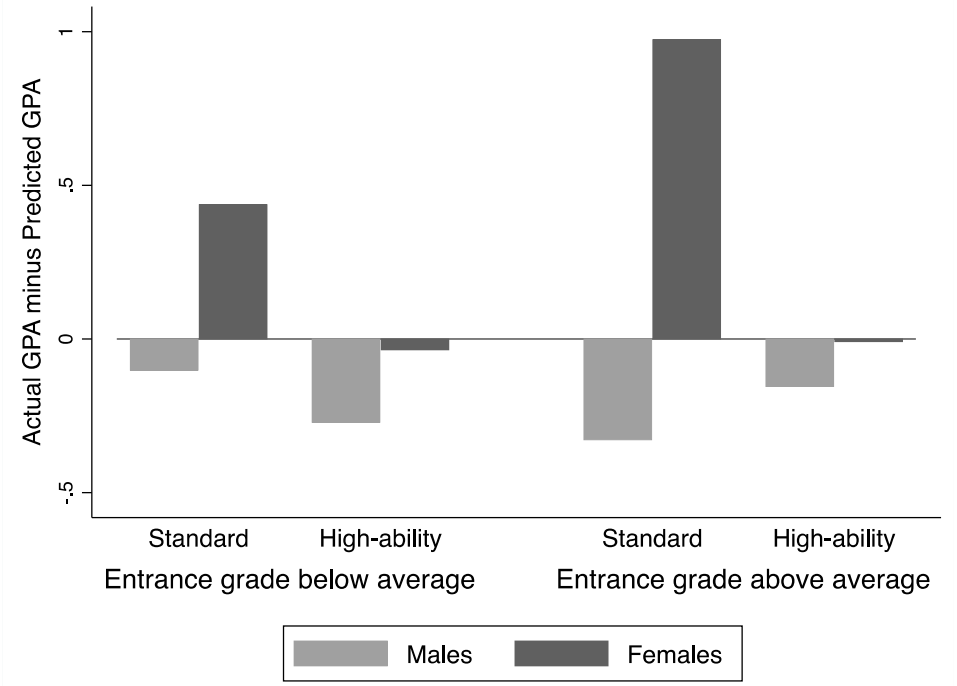

Figure 1. The figure shows the difference between the GPA at the end of the first academic year at university and the GPA that the entrance grade of the student would predict. A positive difference indicates that the student performs better than predicted by his/her entrance grade; a negative value indicates the opposite. The results are shown for students entering either the standard groups of business or the high-ability groups, by entrance grade (below or above the average) and by gender. A considerable positive difference is observed in favour of female students, particularly for those with above-the-average entrance grades on standard groups. Such an advantage is lost in the high-ability groups.

Our estimation procedure in Table 1 yields two main findings. Initially, column (2) indicates that the GPA differential in HA-groups as compared to standard groups is positive and statistically significant. This would be the average difference that we would observe in the raw data. Hoewer this is of course due to a large extent to the fact that students in HA-grups are on average more able students, that is, they have higher entrance grades. In colums (3), once we isolate the effect of the entrance grade (ability), the coefficient on the 'High-ability group' indicator becomes negative. This result is the first of our main findings: for a same ability, in HA-groups it becomes harder to obtain higher GPA. In other words, students in these groups would be 'giving up' to the opportunity of getting higher grades in standard groups. In the economists' jargon, students in HA-groups will be incurring in an 'opportunity

cost' since the alternative – the standard program- would result in higher grades transcript. The result is around half a point lower on average on the 0-10 scale of the GPA (estimated coeffient around -0.5), which constitutes a huge difference, for instance, for students aspiring to get a scholarship or to get admitted in some master program after college graduation.

The second of our main findings refers to the gender differences. On column (4) the positive coefficient of the 'Female' indicator variable is indicating that female students, on average, obtain near half a point higher GPA than their males counterparts, when we do not attend to the type of group. However, in column (5) the estimated interaction effect between female gender and HA-group tells us that the difference is considerably lower in HA-groups. This finding would be suggesting that the more competitive environment of HA-groups lead female students to underperform with respect to their performance in the standard groups.

Table 1. Dependent variable: Students' GPA at the end of first year at university. Standard vs. High-ability groups of Business Administration (BA) and gender differences. (OLS estimation)

	(1)	(2)	(3)	(4)	(5)
High-ability group[a]		1.437***	-0.532***	-0.503***	-0.142*
		(0.038)	(0.058)	(0.058)	(0.074)
Entrance grade			0.861***	0.827***	0.825***
			(0.020)	(0.021)	(0.021)
Female				0.533***	0.836***
				(0.037)	(0.053)
Female in High-A.					-0.659***
					(0.073)
Constant	5.873***	5.204***	-2.884***	-2.824***	-2.947***
	(0.020)	(0.028)	(0.197)	(0.196)	(0.196)
Observations	17,440	17,440	17,440	17,440	17,440
R-squared	0.000	0.073	0.153	0.163	0.167

High-ability: refers to a binary indicator variable equal to 1 for students in high-ability groups and 0 for students in standard groups of Business Administration. The estimated coeffcients show the difference in the dependent variable of students in HA-groups as compared to students in standard groups. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

4. Final comments

The evidence provided in this paper suggests that ability-based selective grouping may have several implications. For individuals deciding on whether or not to join a selective group, an opportunity cost comes in the form of giving up the academic premium associated with holding a top position in less demanding environments. In the academic context, particularly so at the higher educational stages, this could imply lower chances of successful post-graduate applications to masters programs, scholarships, or job offers when competing with candidates from standard programs. For evaluators of the academic merits achieved by students, our results suggest that in order to improve the recruitment of the best candidates, grades should not be the unique indicator of the candidate's ability, but rather a mix of grades and program studied. In the case of women, given that the grade penalty for belonging to a high-ability group is even greater, this mix of grades and program studied has even more pronounced consequences. In this sense, interventions are needed to provide female students with more tools to increase self-confidence, reduce risk aversion and feelings of anxiety when facing competitive environments.

References

Elsner, B., Isphording, I. E., and Zölitz, U. (2021). Achievement rank affects performance and major choices in college. *The Economic Journal*, *131*(640), 3182-3206. https://doi.org/10.1093/ej/ueab034

Gneezy, U., Niederle, M., and Rustichini, A. (2003). Performance in competitive environments: Gender differences. *The quarterly journal of economics*, 118(3):1049–1074. https://doi.org/10.1162/00335530360698496

Marsh, H. W. (1987). The big-fish-little-pond effect on academic self-concept. *Journal of educational psychology*, *79*(3), 280. https://doi.org/10.1037/0022-0663.79.3.280

Sacerdote, B. (2011). Peer effects in education: How might they work, how big are they and how much do we know thus far? Handbook of the Economics of Education, Vol. 3, 249-277.

Zimmerman, D. J. (2003). Peer effects in academic outcomes: Evidence from a natural experiment. *Review of Economics and statistics*, 85(1), 9-23. https://doi.org/10.1162/003465303762687677

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14598

Building Teacher Professional Judgement

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Abstract

The word 'assessment' is frightening to most student teachers since it carries with it many negative connotations. Schools of education around the world have stepped up in working on building confidence into preservice teacher candidates. Assessment and data literacy have now come to be common units of study within higher education. Many universities are still calling for a need to enhance these courses through more focus on psychometrics or statistics but missing from these courses is the essence of assessment and teaching in general, teacher judgement and voice. Building credible, reliable and valid teacher judgement begins within schools of education. This article presents a framework to enhance student teacher's voice within assessment practices. It builds on a Modern Assessment Theory perspective where teacher judgement is a key factor in understanding student learning and presents ways on how this theory of assessment intertwines within reflection and inquiry.

Keywords: *Assessment; Modern Assessment Theory; teacher professional judgeemnt; Preservice teachers; Reflection; Inquiry.*

1. Introduction

There has never been a more demanding time for teachers to utilise their professional judgements to provide accurate predictions of how their students measure in the learning content that is taught. Policymakers worldwide have crafted many methods to 'measure' the 'learning' that is being undertaken within their countries, and only in some very rare cases have governments sought teacher judgements on this issue. Measuring student learning is not a straightforward task that can be done through testing. Nor can it be decontextualised so that the measures apply across varying districts, states, nations or hemispheres. The idea of measuring student learning through standardised testing creates a predicament where teacher judgements be required to follow the 'what is considered valuable' guidelines.

Teacher judgement has, as a consequence of this fractured measurement focus, become distorted and weak. This distortion 'undermines the ability of teachers to be teachers and of schools, colleges and universities to be educational institutions rather than shops' (Biesta, 2015, p.83). In this paper, a framework is presented to help schools of education work on elevating teacher professional judgement. To date research has argued for the need to take teacher professional judgement into consideration, but the gap in presenting a conceptual framework of building professional judgement at the beginning of the teaching journey, within schools of education, has not been developed. This paper will present a conceptual framework to build preservice teacher professional judgement founded in theories of assessment, reflection and inquiry.

2. Building Pofessional Judgement Through Schools of Education

At an age where being capable of interpreting student results has become crucial, schools of education have realized that teacher preparatory courses must not only provide support in content and pedagogical areas. Preservice teachers (PsT's) are also in need of critically reflecting, inquiring and using their professional judgement to utilize their students' assessments in constructive and meaningful ways that lead to valid and reliable interpretations (DeLuca, Chavez, & Cao, 2013). Hence, teacher preparatory courses have provided candidates with more opportunities to enhance their own learning in areas of assessment, such courses we now see offered entail assessment literacy, measurement, data literacy through a lens of reflection and inquiry. Even though these courses do much to enhance PsT's professional judgements, nevertheless, still prevalent within the literature is that preservice teachers lack confidence in their own judgements (Mertler, 2004; Volante& Fazio, 2007). This is a problematic stance and one that needs dire attention on behalf of teacher educators and schools of education. The problem is that when these candidates are sent off to schools without both the proper levels of confidence in their own learning and the

ability to voice their judgements and interpretations, their own competence becomes frail (DeLuca, Chavez, & Cao, 2013).

Reflection (Schön, 1984) and inquiry (Dewey, 1910) have been introduced into teacher preparatory programs to help PsT's enhance their own critical thinking skills and overcome any biases towards their own teaching pedagogies or understandings. In most of these courses the link to student achievement data is made, hence courses on assessment literacy have also been mandated. However, the link between reflection, inquiry and assessment has not been looked at in terms of explicitly enhancing PsT judgements and voice. Moreover, most of the student assessment data PsT's use are tangible tests or tasks, not informal assessments such as classroom discussions.

Modern Assessment Theory (MAT) presents a way of looking at assessments that traverses tangible data. It is a new way of looking at assessment that can help to empower PsT's and teacher educators alike. The following framework shows how each one of the three spaces of reflection, inquiry and assessment can all build a foundation in teacher judgement, beginning within schools of education and subsequently having an effect in classrooms once these candidates become teachers.

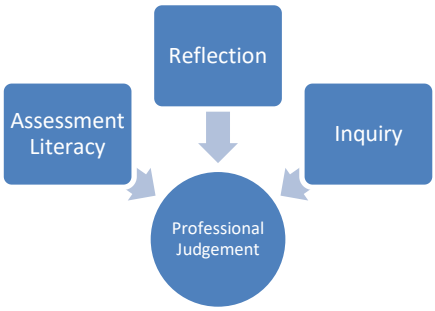

Figure1. Framework for enhancing preservice teachers professional judgements of student achievement data.

3. Modern Assessment Theory

MAT defines assessment as involving 'professional judgement based upon an image formed by the collection of information about student performance' (Tognolini & Stanley, 2011 p.25). The definition brings together teachers' professional judgement, information or evidence-based decisions, and student achievement data. It calls for the use of both qualitative and quantitative data to form an accurate measurement of 'how much' content a student has and whether it is suffice enough for the student to move on to more challenging content or whether some form of intervention needs to be put in place to help the student understand the current content. It calls on educators to collect and use a 'wide variety of evidence-eliciting techniques' (Popham, 2009, p.5) to understand their students'. The

definition allows educators, specifically teachers, to form a mental image of the student and to map this image accurately along the learning progressions.

3.1. The Image

Governments all around the world are now using standardised tests throughout both primary and secondary school years in order to track the progress of a certain cohort along a defined learning progression or continuum. In doing so, stakeholders are capable of tracking learners throughout their learning journey to understand 'what they know'. Within a school setting, teachers form mental images of their students and track that image to a point on the learning continuum. As teachers provide students with ongoing content knowledge, they need to find valid and reliable ways of assessing their students' learning. PsT's do not have enough time with the students to track each of them on a learning trajectory and analyse where each student is. Thus, PsT's must use their intuition through mainly informal methods of assessment and learn to analyse these mentally or within short timeframes to be able to adapt their teaching methods to suit their students learning needs.

3.2. A Continuum of Collecting Student Assessments

The methods of assessment in Modern Assessment Theory can be traced along a continuum from less formal to more informal as in Figure 2.

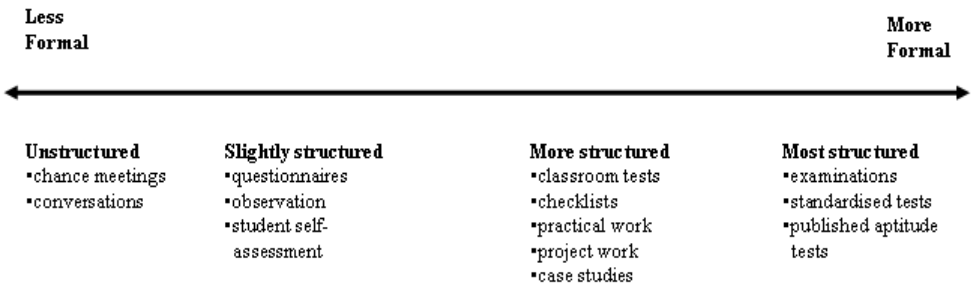

Figure 2. Methods for collecting information on student performance in MAT. Source:Tognolini & Davidson (2012).

At the 'more formal' end the assessments follow testing procedures that are highly structured and are tightly controlled and standardized produced by professional assessment experts, PsT's are not expected to produce these forms of tests although they should be able to understand their structures and their results. Schools of education must provide student teachers with opportunities to understand and interrogate these tests, especially if they are placed in a classroom that has undergone standardized testing.

Formative assessment has been argued to be a crucial facilitator of student outcomes (Black & Wiliam, 1998). Unstructured or slightly structured assessments are also methods for

collecting information about students. They can provide information that is just as pertinent and relevant about a student as the more highly structured means of collecting information.

3.3. Building Teacher's Professional Judgement Through MAT

To be able to know where to locate a student appropriately on a continuum, teachers need to reference the students' performance to a predetermined standard. This involves, teachers combining relevant student data and with their professional judgements to form an accurate image of what a student can or cannot achieve and then comparing this image to pre-determined standards of performance.

This form of intuitive 'measurement' of student 'image' must be made justifiable. These judgements of students' outcomes must also be accurate in order to support various instructional and professional decisions (Artelt & Rausch, 2014; Shavelson & Stern, 1981). For these judgements to be accurate teacher's need to build confidence in their ability to evaluate and measure student's performance (Tognolini & Shakra, 2021). Building this confidence takes time and begins within schools of education. PsT's need to be supported with assessment and evidence-driven decision making courses for them to build the confidence to have a 'voice' in assessing their students through judgements.

PsT's lack confidence in their own professional judgements, specifically in the area of assessments (Maclellan, 2004; Mertler, 2004; Volante& Fazio, 2007). This is in part due to the limited assessment education (DeLuca, Klinger, Searle, & Shulha, 2010). Professional judgement has been a focus during the assessment phase of teaching and learning (Bruniges, 2007) and so the focus on assessment literacy in teacher preparatory courses is key for future teachers to start building confidence in their judgements. PsT's confidence may have a 'ripple' effect into the other two crucial factors that underpin education, curriculum and pedagogy.

Schools of education need to start focusing on building PsT voice and confidence in their own professional judgements. They need to structure courses and frameworks that centralise around developing credible, valid and reliable teacher judgement. This may be achieved by linking assessment literacy, reflection and inquiry in both theoretical and practical courses. The framework in figure 1 may be considered as a starting point.

4. The Role of Reflection in Building Professional Judgement

Teacher preparatory courses must be capable of understanding the beliefs and conceptions PsT's hold, especially when approaching teacher education through a cognitive/constructivist approach to learning. These courses should be set up in ways that allow the lecturers or course designers to track how teacher educators develop and change as they progress through their training (Hill, Cowie, Gilmore & Smith, 2010). Reflection in this case can be a powerful tool.

Problems which arise in the classroom cannot be easily solved (Reiman, 1999). Reflection as Dewey (1910) explains allows teachers and student teachers to make meaning of a situation by putting facts and beliefs pertaining to a certain problem and rigorously analysing these pieces of evidence to come to a solution. Similarly, Schön (1984) identifies reflection as a process that is driven by a 'problematic situation' that leads to an interrogation of a practitioners existing knowledge (p.63). The definitions are not very far from the theoretical underpinning of MAT where teachers must make sense of the information they have through assessments and build an image of where the students are in their learning, if the image does not fit into the attributing standard, then a problem is presented and reflection to judge on why this has happened needs to take place intuitively. If teachers are not prepared for this sort of intuitive analysis, they will not be confident in voicing their judgements, and this may cause a threat to student learning.

Teachers need to possess reflection as one of their characteristics (Darling-Hammond, 1998). Additionally, reflection is considered as a key element of a teacher's professional judgement. Therefore, it should be adopted by schools of education as a goal for their student teachers to purposefully analyse their professional actions. As the field of education moves towards a standards referenced system, so too has the model of evaluation moved from an input to an output model. Teacher preparatory courses are to demonstrate that their candidates have the ability to exercise their professional judgements to 'critically analyse student work in terms of how it is meeting standards' (Ward & McCotter, 2004, p.244) and henceforth showcase their capability to make a positive impact on student learning (Ward & McCotter, 2004; Ridley, Rowe, Borkowski, & Hikida, 2022).

At the heart of reflection lies the aim of creating a rigorous emphasis on student learning mindset. PsT's who are aware of basic assessment literacy skills will have a valid and reliable basis on which to reflect. MAT posits that PsT's reflect constantly on the 'image' that they have built by continuously and consistently adjusting the location of their students on the learning progression through the continuum of assessments that they use. This will allow teacher preparatory programs to understand how PsT's situate their thinking within the practicum contexts, still a missing piece of reflection frameworks to date (Ward & McCotter, 2004).

5. The Role of Inquiry in Building Professional Teacher Judgement

MAT places 'collecting information' at the heart of its definition. Information is formed when teachers collect and assign meaning to any formal or informal piece of student assessment data. The data may be quantitative or qualitative. The build up of information from student data leads to evidence and the use of this evidence to plan actionable positive change in student learning is deemed data literacy (Mandinach & Gummer, 2013). It has been found

that teachers lack the competency and skills for data literacy, because these courses were not offered correctly to them by their faculties (Mandinach & Gummer, 2013).

The aim of inquiry for Dewey (1910) was to allow teachers to use their judgements to think about how they can enhance their students learning opportunities. Dewey (1910) believed that PsT's should be adequately supported in enacting these transformative pedagogies.

Inquiry can build the data literacy skills of PsT's. In doing so it can lead to more confidence in their own judgements. Building an inquiry habit of mind for PsT's by asking them to use the data that they have, turn it into information to build images of their students learning and understand where they are on the learning progression, where they need to be and to formulate an action plan of how to get them there. Inquiry does not occur in isolation. PsT's need to voice their concerns to a knowledgeable other. In doing so, they build their professional judgements.

Schools of education have come to recognise the foundational role that inquiry plays in PsT preparation and have included inquiry courses, however these courses are at best a semester long. This time restriction, while understandable in a university setting, will not suffice to disseminate an inquiry mindset (Lammert, 2020). Inquiry should be teamed up within assessment and data literacy courses from the beginning of a PsT's journey, by allowing the student teachers to constantly collect data, reflect on their students learning and collaborate with peers, lecturers and supervising teachers.

6. Conclusion

As educational policies worldwide move towards performance or standards referenced systems where student outcomes only have meaning when teachers ensure that the curriculum content, learning outcomes and the assessments they develop for their students are aligned. Teacher's professional judgement is a central contributing factor within these systems since they are the ones who can accurately align their students' work to the standards (Bennett, Tognolini, Pickering, 2012). Insights into how student teachers' value and conceptualise assessment learning experiences will inevitably provide more foundational evidence for teacher preparatory courses.

References

Artelt, C., & Rausch, T. (2014). Accuracy of teacher judgments: when and for what reasons?. In *Teachers' professional development* (pp. 27-43). SensePublishers.

Bennett, J., Tognolini, J., & Pickering, S. (2012). Establishing and applying performance standards for curriculum-based examinations. *Assessment in Education: Principles, Policy & Practice*, *19*(3), 321-339.

Biesta, G. (2015). What is education for? On good education, teacher judgement, and educational professionalism. *European Journal of education*, *50*(1), 75-87.

Black, P., & Wiliam, D. (1998). Assessment and classroom learning. *Assessment in Education: principles, policy & practice*, *5*(1), 7-74.

Bruniges, M. (2007). Teacher professional judgement in teaching and learning decisions. In *Learning and teaching for the twenty-first century* (pp. 233-254). Springer, Dordrecht.

DeLuca, C., Klinger, D. A., Searle, M., & Shulha, L. M. (2010). Developing a curriculum for assessment education. *Assessment Matters*, *2*, 20-42.

DeLuca, C., Chavez, T., & Cao, C. (2013). Establishing a foundation for valid teacher judgement on student learning: The role of pre-service assessment education. *Assessment in Education: Principles, Policy & Practice*, *20*(1), 107-126.

Dewey, J. (1910). *How we think*. D.C. Heath & Co. https://doi.org/10.1037/10903-000

Hill, M., Cowie, B., Gilmore, A., & Smith, L. F. (2010). Preparing assessment-capable teachers: What should preservice teachers know and be able to do?. *Assessment Matters*, *2*, 43-64.

Lammert, C. (2020). Becoming inquirers: A review of research on inquiry methods in literacy preservice teacher preparation. *Literacy Research and Instruction*, *59*(3), 191-217.

Maclellan, E.(2004). Initial knowledge states about assessment: Novice teachers' conceptualisations. *Teaching and Teacher Education*, *20*(5), 523-535.

Mandinach, E. B., & Gummer, E. S. (2013). A systemic view of implementing data literacy in educator preparation. *Educational Researcher*, *42*(1), 30-37.

Mertler, C. A. (2004). Secondary teachers' assessment literacy: Does classroom experience make a difference?. *American secondary education*, 49-64.

Popham. (2009). Assessment Literacy for Teachers: Faddish or Fundamental? *Theory into Practice, 48*(1), 4–11. https://doi.org/10.1080/00405840802577536

Reiman, A. J. (1999). The evolution of the social roletaking and guided reflection framework in teacher education: Recent theory and quantitative synthesis of research. *Teaching and teacher education*, *15*(6), 597-612.

Ridley, J., Rowe, L. W., Borkowski, M., & Hikida, M. (2022). From reflection to analysis: Languaging literacy teaching and learning. *Teaching and Teacher Education*, *112*, 103634.

Schön, D. A. (1984). *The reflective practitioner: How professionals think in action* (Vol. 5126). Basic books.

Shavelson, R. J., & Stern, P. (1981). Research on teachers' pedagogical thoughts, judgments, decisions, and behavior. *Review of educational research*, *51*(4), 455-498.

Tognolini, J., & Davidson, M. (2012). Assessment, standards-referencing and standard setting. In *Self-directed learning oriented assessments in the Asia-Pacific* (pp. 23-41). Springer, Dordrecht.

Tognolini, J., & Shakra, R. (2021). Give teachers a stronger voice in assessment. *Independent Education*, *51*(1), 16-18.

Tognolini, J., & Stanley, G. (2011). A standards perspective on the relationship between formative and summative assessment. *East Asia: British Council*.

Volante, L., & Fazio, X. (2007). Exploring Teacher Candidates' Assessment Literacy: Implications for Education Reform and Professional Development. *Canadian Journal of Education*, *30*(3), 749-770.

Ward, J. R., & McCotter, S. S. (2004). Reflection as a visible outcome for preservice teachers. *Teaching and teacher education*, *20*(3), 243-257.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14371

A review of tertiary formative assessment using digital technology in the past decade: what has been facilitated?

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Abstract

Assessments serve a pivotal component of any teaching and learning system, especially when they motivate and enhance better teaching and learning. Together with the seamless permeation of digital technology in universities, formative assessment(FA) using digital technology has been increasingly used at the tertiary level of educaiton in recent years. FA using digital technology plays an important role in the quality assurance of teaching and learning (and hence assessment) in nuniversities. How has the emerging digital technology efficiently served and enhance the formative teaching and learning in universities in the past decade? This study explores this issue by conducting a systematic review of peer-reviewed empirical papers on formative assessment using digital technology in universitites over the past decade. It is found that mainly four major aspects of FA has been facilitated by the emerging digital technology applied in higher education in past ten years.

Keywords: *formative assessment; digital technology; higher education.*

1. Introduction

Assessments serve a pivotal component of any teaching and learning system, especially when they motivate better teaching and learning, help to improve the educational system, assist the teachers to ameliorate their teaching practice, and change how we approach education. The P21 framework (Partnership For 21st Century Skills, 2009) and ATCS framework of 21st century skills (Griffin et al., 2012) emphasise the move towards formative assessment (FA) as a means of teaching because of the powerful positive effects it has on students' learning. In recent years formative assessment has been increasingly used at the tertiary level of educaiton.

Among this trend, digital technology has become a popular part of university lecturers' FA practice and important section of university students' learning experience in the 21st century (Henderson et al., 2017; Scott et al., 2018; etc). For the millennium generation, the internet is their way of daily life and learning, offering them the non-stop and closely engaging social space in their university life, rather than simply mechanical functional tools.

Given such a significant role of digital technology in university formative teaching and learning, How has the emerging digital technology served and facilitated formative teaching and learning in universities in the past decade? This study aims to answer this problem by conducting a systematic review of peer-reviewed empirical papers on formative assessment using digital technology in higher education over the past decade and discuss the positive impact of these studies over this time period.

Systematic qualitative review (Green et al., 2006) is employed to produce an analysis of the literature in three major steps (Galvan, 2006): searching, reviewing and writing the literature review. The data were retrieved from the databases using major search engines in education (e.g., Elsevier, ERIC, EBSCOHost, and SAGE), focusing on the key words (formative assessment) and (digital technology Or technology) and (university Or higher education). The time period is 2011-2021. The search is further limited to focus on peer-reviewed empirical studies that explicitly applied the digital technology in FA at the tertiary level. Ultimately, 49 papers were selected as key papers for the review. Some relevant review papers on FA and digital technology in higher education are also included to provide a complete picture of the literature.

2. An overview of tertiary FA using digital technology

Given the main target of this paper is the facilitative impact of formative assessment on the university lecturers' instruction in essence, Black and Wiliam's (Black & Wiliam, 2009) definition of formative assessment is adopted in this research:

"Practice in a classroom is formative to the extent that evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers, to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited." (Black & Wiliam, 2009, p.9)

This definition highlights an important feature of FA as a part of the actual teaching and learning process. The ultimate aim of FA is to better the teaching and learning. This echoes the purpose of mastery learning in Bloom et al's conceptual framework (1971).

There have been some empirical studies and review papers on tertiary FA using digital technology in the past decade. Webb et al (2018) identified three major aspects of FA processes that can be particularly facilitated by digital technology (p. 441):

1) datafication of learning

2) feedback & scaffolding

3) peer assessment & peer feedback

One problem with Webb et al's (2018) classification is the overlapping and over generalisation of the FA aspects, especially the overlapping of the second and the third aspects. What's more, new breakthrough of digital technology has occurred very swiftly each year and sped up new applications rapidly since 2018. So the digital technology employed in tertiary FA now is quite different from that of four or five years ago. Some digital technology used in FA four years ago may not be in use now, while some new functions of other digital technology has been developed and is now more popular. The implication for the researchers is that there is a need to speed up the relevant theoretical and empirical studies that deal with formative assessment. This paper provides this systematic review to identify the FA processes currently promoted by digital technology.

Henderson et al (2017) investigated the university students' perception of the usefulness of digital technology in their learning. Based on the survey results of 1658 undergraduates, they identified 11 benefits of digital technology that are especially useful to the university students' learning (p.5):

Organizing and managing the logistics of studying

Flexibility of place and location

Time-saving

Reviewing, replaying and revising

Researching information

Supporting basic tasks

Communicating and collaborating

Augmenting university learning materials

Seeing information in different ways

Cost saving

Despite the obvious facilitation of digital technology on university students' learning, Henderson et. al. (2017) noted on the other hand that digital technology did not completely alter the nature of university teaching and learning. This justifies that the focus of our research on the tertiary FA using digital technology should be on tertiary education rather than the digital technology alone. Another issue is that their research targeted at the university students' learning in general, not addressing specifically the tertiary FA. So an unclear picture still remains as to what aspects of tertiary FA has been facilitated by the digital technology. But despite this, the study serves as a helpful reference as a strong contention of this paper is that tertiary FA is an integral part of university learning.

Given the above mentioned, a systematic qualitative review has been conducted of 49 papers and four major aspects of tertiary FA using digital technology have been identified: emerging intelligent personalised FA, dataficated formative learning and management, multi-media feedback, and swift communication in FA.

2.1. Emerging intelligent personalized FA

Artificial Intelligence in Education (AIEd) is a newly emerging and promising procedure that has been used in digital technology in higher education in recent years. Some researchers predict that AIEd will grow by 43% from 2018 to 2022(EDUCAUSE, 2018), and as a direct consequence there will be a direct influence on teaching and learning in higher education. Some emerging AIEd have been applied to personalize tertiary FA in the past decade. DeMara, et al (2020) use data mining to generate personalised learner remediation groups for their complementary peer formative learning. Hooshyar et al (2016) online used an FA quiz of tic-tac-toe for self assessing formatively individual student learning in a flowchart-based Intelligent Tutoring System (FITS).

Conejo et al (2016) conducted a technology-enhanced FA of university students' plant identification with Siette, a domain-independent intelligent online evaluation system for mobile devices, to support the whole cycle of FA in a biology course. Utilising a reusable item bank, an authoring tool and options to analyse assessment results to generate statistical information, Siette enables the different question types, selection criteria, and scoring procedures to provide tailored questions for each individual student according to their location on a developmental continuum of learning. The students in turn use the mobile

device to position or scan a QR code attached to a plant in a arboretum or herbarium. Then Siette will offer the student some detailed feedback including correct answers accordingly after the FA questions.

In their review of research papers on AIEd from 2007 to 2018, Zawacki-Richter et al (Zawacki-Richter et al., 2019, p.1) identified 4 areas of AIEd applications in higher education institutional and administrative services:

profiling and prediction

assessment and evaluation

adaptive systems and personalisation

intelligent tutoring systems

Apart from the assistance and facilitation effects of AIEd, Zawacki-Richter et al (2019) also pointed out that a significant problem wit the research is that there is a dearth of critical reflection on the risks of AIEd, the weak application of pedagogical theories, and the need for future investigation of ethical and educational aspects of AIEd application in higher education.

2.2. Dataficated formative learning & management

Thanks to the emerging digital technology, various forms and scales of FA and management have emerged during the past decade. Not only the feedback in the forms of words and verbal signals are dataficated via digital technology, but also voice (Gleason, 2013), 3D visual images (Yoders, 2014), podcast (Forbes, 2011), online actions such as Wikipedia editing (Ng, 2018), etc. Datafication of formative learning and management for the traditional small-sized courses has been extended to include unprecedented large courses of thousands of students at the same time in online platforms such as Moocs (Xiong & Suen, 2018), and even the whole university campus (Lafuente, et al., 2014) being dataficated.

2.3. Multi-media feedback

With emerging digital technology, new forms of feedback have become available in the past decade. Apart from the traditional words and verbal signals as the forms of feedback, new forms such as visual portfolios, in which the learners self-select the images that they produce during their daily activities on the high-fidelity 3D human heart simulator for the undergraduate level health care sciences students (Yoders, 2014), screen-captured digital video feedback (Jones, et al., 2012), or online Skinquizition gaming with audience response systems such as TurningPoint (Schlegel & Selfridge, 2014). Mobile electronic devices including smartphones, tablets, laptops are also used for formative tasks and feedback (Wijtmans et al., 2014).

2.4. Swift communication in FA

Traditionally, swift communication among participants in FA, especially in large classes seemed to be impossible for university lecturers a number of years ago. But with digital technology, the participants can now have access to swift communications and better collaboration even in large classes. Tempelaar et al (2015) examined the use of e-tutorials in a large introductory quantitative methods module in which 922 students were enrolled. This module blended face-to-face problem-based learning with e-tutorials. It is found that computer-assisted FA seemed to best predict students who were under-performing. Besides enabling timely feedback, the user-intensity data and learning dispositions from the e-tutorial systems are worthwhile sources for lecturers' feedback as well.

Fernández-Ferrer& Cano (2016) investigated university students' use of Twitter to create their personal and unique social networks during formative learning. Their results show that the microblog social network tool facilitated the students' motivation, involvement and learning perception, but no significant improvement was identified in their achievement. It is noted that future research needs to examine the effects of self-regulating feedback and the influence of the application of social network tools on the learners' self-regulating capacity.

In conclusion, based on our systematic qualitative review on the 49 key papers, it is found that emerging digital technology has been applied in tertiary FA in the past decade and has had an increasing influence on university education. Four major aspects of tertiary FA have been facilitated by digital technology: emerging intelligent personalized FA, dataficated formative learning and management, multi-media feedback, and swift communication in FA. On the other hand, it is also noted that application of digital technology in FA may not necessarily lead to the university students' improvement of learning performance. More research is needed to examine the factors of the students' self-regulation during the FA process.

References

Conejo, R., Garcia-Viñas, J., Gastón, A., & Barros, B. (2016). Technology-Enhanced Formative Assessment of Plant Identification. *Journal of Science Education & Technology*, *25*(2), 203–221. http://10.0.3.239/s10956-015-9586-0

DeMara, R. F., Bacanli, S. S., Bidoki, N., Xu, J., Nassiff, E., Donnelly, J., & Turgut, D. (2020). Data Mining of Assessments to Generate Learner Remediation Teams: Method, Efficacy, and Perceptions in an Undergraduate Engineering Pilot Offering. *Journal of Educational Technology Systems*, *48*(4), 464–492. http://10.0.4.153/0047239520901863

Fernández-Ferrer, M., & Cano, E. (2016). The influence of the internet for pedagogical innovation: using twitter to promote online collaborative learning. *International Journal of Educational Technology in Higher Education*, *13*(1), 1–15. http://10.0.4.162/s41239-016-0021-2

Forbes, D. (2011). Beyond lecture capture: Student-generated podcasts in teacher education. *Waikato Journal of Education*, *16*(1), 51–63. http://10.0.61.47/wje.v16i1.70

Galvan, J. L. (2006). *Writing literature reviews: A guide for students of social and behavioural sciences*. Los Angeles: Pyrczak publishing.

Gleason, J. (2013). An Interpretive Argument for Blended Course Design. *Foreign Language Annals*, *46*(4), 588–609. http://10.0.4.87/flan.12050

Green, B. N., Johnson, C. D.,& Adams, A. (2006). Writing narrative literature reviews for peer-reviewedjournals: secrets of the trade. *Journal of Chiropractic Medicine*, *5*(3), 101–117.

Griffin, P., McGaw, B., & Care, E. (2012). Assessment and teaching of 21st century skills. In *Assessment and teaching of 21st century skills* (Vol. 9789400723). https://doi.org/10.1007/978-94-007-2324-5

Henderson, M., Selwyn, N., & Aston, R. (2017). What works and why? Student perceptions of 'useful' digital technology in university teaching and learning. *Studies in Higher Education*, *42*(8), 1567–1579. https://doi.org/10.1080/03075079.2015.1007946

Hooshyar, D., Ahmad, R., Yousefi, M., Fathi, M., Abdollahi, A., Horng, S.-J., & Lim, H. (2016). A solution-based intelligent tutoring system integrated with an online game-based formative assessment: development and evaluation. *Educational Technology Research & Development*, *64*(4), 787–808. http://10.0.3.239/s11423-016-9433-x

Jones, N., Georghiades, P., & Gunson, J. (2012). Student feedback via screen capture digital video: Stimulating student's modified action. *Higher Education*, *64*(5), 593-607.

Lafuente, M., Remesal, A., & Álvarez Valdivia, I. M. (2014). Assisting learning in e-assessment: a closer look at educational supports. *Assessment & Evaluation in Higher Education*, *39*(4), 443–460.

Ng, E. M. W. (2018). Are Students Receptive to Formative Assessment When Authoring Wiki Projects? *Ubiquitous Learning: An International Journal*, *11*(3), 1–15. http://10.0.73.160/1835-9795/CGP/v11i03/1-15

Partnership For 21st Century Skills. (2009). *Assessment: A 21st Century Skills Implementation Guide*. http://p21.org/documents/p21-stateimp_assessment.%0Apdf

Schlegel, E. F. M., & Selfridge, N. J. (2014). Fun, collaboration and formative assessment: Skinquizition, a class wide gaming competition in a medical school with a large class. *Medical Teacher*, *36*(5), 447–449. http://10.0.12.37/0142159X.2014.888409

Scott, K., Morris, A., & Marais, B. (2018). Medical student use of digital learning resources. *Clinical Teacher*, *15*(1), 29–33. http://10.0.4.87/tct.12630

Tempelaar, D. T., Rienties, B., & Giesbers, B. (2015). In search for the most informative data for feedback generation: Learning analytics in a data-rich context. *Computers in Human Behavior*, *47*, 157–167. http://10.0.3.248/j.chb.2014.05.038

Wijtmans, M., van Rens, L., & van Muijlwijk-Koezen, J. E. (2014). Activating Students' Interest and Participation in Lectures and Practical Courses Using Their Electronic Devices. *Journal of Chemical Education*, *91*(11), 1830–1837. http://10.0.3.253/ed500148r

Xiong, Y., & Suen, H. K. (2018). Assessment approaches in massive open online courses: Possibilities, challenges and future directions. *International Review of Education /*

Internationale Zeitschrift Für Erziehungswissenschaft, *64*(2), 241–263. http://10.0.3.239/s11159-018-9710-5

Yoders, S. (2014). Constructivism Theory and Use from 21st Century Perspective. *Journal of Applied Learning Technology*, *4*(3), 12–20. http://ezproxy.library.usyd.edu.au/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=eue&AN=99079927&site=ehost-live

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14660

Use of Assessment and Feedback Systems for Introductory Computer Programming Modules of Higher Education: A Comparative Study

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Abstract

Teaching introductory programming modules in higher education is highly challenging. In particular, it is hard to motivate novices if there is a lack of tutoring support and it is also difficult to assess their progress when there is a large class. Automated assessment and feedback systems help in this scenario. The use of automated assessment and feedback systems support teaching programming and motivate the novices in their learning process. This paper discusses these assessment and feedback systems which enable academics to assess, grade and support students learning programming. This study mainly concentrates on whether these systems enable them to understand basic programming concepts and help to improve their skills. The result of this study is that they are very effective in scaffolding the teaching of programming and assessing programming assignments. This study concludes that these systems still need some development to be more effective to motivate their learning process.

Keywords: *Automatic assessment; computing education; digital learning environment; formative assessment; higher education; interactive feedback.*

1. Introduction

Programming modules are essential for any software development related courses at higher education institutions all over the world. In Ireland, there are a number of programming modules with different names (Becker 2019), although many of them have similar content. The objective of these courses is to give the basic knowledge of programming languages by introducing syntax and semantics. Therefore, these modules play an important role to make them comfortable in continuing their education in computing. There are a number of activities introduced to motivate the novice students in programming modules: e.g. Intelligent tutoring, real-time problem solving, competence based (Najar A *et al*., 2012) and computational thinking (Lockwood *et al*., 2018). Assessment and feedback are also important to help and motivate their programming skills (Wang *et al*., 2017). Once assessment motivates their confidence, then their interest in programming will increase and the dropout rates will decrease (O'Brien *et al.,* 2016). Most of the studies found that the traditional feedback system does not notify students what the errors are exactly, what type of mistakes they made in programming assignments. It just assesses what they know, what they can achieve and not where they failed. It will enhance their ability if it points out exact information.

There are a number of solutions that have been found in order to make assessment easy and feedback to students where they made mistakes or found difficulties. Some of them are automated assessments and rubric styled evaluation. Automated assessment system (Qian *et al*., 2019) evaluates the student's program submissions and gives the feedback immediately. There are a variety of automatic assessment systems available to evaluate student programming assignments. They support automatic evaluation of student submissions based on different approaches such as natural language processing, machine learning, image recognition, targeted feedback, and gamified web systems. The objective of this study is to compare these automated assessment and feedback systems and approaches in order to motivate and build up the confidence of novice students in higher education.

2. Related Systems

This paper reviews the following assessment systems with regards to assessment and feedback techniques for first year programming modules. The reason for choosing these systems is that they are currently practising in some academic institutions.

1. Leed's automated assessment and feedback platform (Evans *et al*., 2020).
2. CodeRunner – Quiz based programming assessment system (Lobb *et al*., 2016).
3. VPL, the Virtual Programming lab for Moodle (Rodríguez-del-Pino *et al*., 2012)
4. Browser based pedagogical coding environment (Culligan *et al*., 2018, Azcona *et al.*, 2018).
5. 2TSW: Gamified Web Based System (Polito *et al*., 2019).

2.1. Leed's automated assessment and feedback platform

This system (Evans *et al*., 2020) enables students to receive automatically generated, instant and personalised feedback. It provides formative feedback to students after each learning exercise, with feedback usually provided following formal summative assessment. It is designed for multiple programming languages: C, C++, Python and simulation packages. It allows electronic submission and students receive the automatic grading with textual feedback on their submission. It follows a student-centred approach. The drawbacks of the system are unsuitability for learning management systems as it is a stand-alone system, and it fails to notify exactly where errors are.

2.2. CodeRunner

CodeRunner (Lobb *et al*., 2016) is another feedback system which was developed at the University of Canterbury. It follows the Moodle question type. Therefore, it is suitable for learning management systems (LMS). It runs millions of student quiz question submissions in Python, C, JavaScript, PHP, Octave and Matlab. CodeRunner is a Moodle quiz question type that allows teachers to run a program in order to grade a student's answer. By far the most common use of CodeRunner is in programming courses where students are asked to write program code to solve programming problems and that code is then graded by running it in a series of tests. CodeRunner enables the provision of different possible correct answers to assess the correctness of student's programs. These questions can be used in different computer science areas as well. Adaptive mode is available in Coderunner which allows students to write the programs to get immediate test case results. If they find any errors, they can resubmit with correct answers with a small penalty. It is a student-centred approach with immediate feedback to resubmit for further grading.

2.3. VPL: The virtual programming lab

The VPL (Rodríguez-del-Pino *et al*., 2012) is an extension to Moodle which enables academics to assess and grade programming assignments in many programming languages. It allows students to edit, run and test the computer programs in the browser. It also allows the academics to automatically evaluate and check plagiarism. It supports many programming languages: Java, Python, C#, PHP, JavaScript, Matlab and more. It allows the academics to set up different test cases in order to check student's submissions. Therefore, the students are immediately able to receive the feedback about the errors against the test cases. It helps to manage all the programming assignments on Moodle which makes the students' learning process easier.

2.4. Browser based pedagogical coding environment (MULE & Einstein)

There are a number of pedagogical coding environments available in use. MULE stands for Maynooth University Learning Environment. MULE (Culligan *et al*., 2018) is an on-line,

browser-based pedagogical coding environment, for delivering, marking and providing feedback on coding assignments. This system evaluates and provides feedback for 'Java' programs. The major advantage of this system is providing feedback immediately when learners submit their programming assignments. However, this tool needs to enhance how it provides error messages to support novice programmers. It follows the unit testing technique in order to grade.

Einstein (Azcona *et al.*, 2018) is another browser (docker) based learning system for programming modules. This is a stand alone virtual learning environment and it is in use at Dublin City University for a number of programming modules. This system lists out the programming exercises on its dashboard and allows the students to submit their solutions in 'Python' language. This system calculates the grades and provides the feedback immediately against predefined test cases. These both systems do not notify the student as to where the errors exactly are, how to improve them and what type of the error. However, they both provide immediate feedback and allow resubmission for improved grading. Also, they do not run on LMS as they are stand-alone applications.

2.5. 2TSW: Gamified Web Based System

2TSW is a web based assessment and feedback system to assess complex programming tasks (Polito *et al*., 2019). It follows the gamified structure to motivate and engage students in programming tasks. This is a teacher-centred approach as teachers are able to post different tasks in the module space and students can submit their solutions. Instead of traditional grading, it provides batches to reward student's completions along with grade percentages. It motivates them to attempt different test cases. For failed results, it provides possible feedback to reattempt the questions. It supports peer feedback as well.

3. Review Criteria & Discussion

In order to investigate the use of assessment and feedback systems for introductory computer programming modules, the following criteria has been used for effective review of these systems.

3.1. Feedback types

This criterion defines the types of feedback the assessment systems provide.

- Text feedback
- Audio or visual feedback
- Peer feedback

3.2. Assessment approaches

Assessment approaches that the system follows are classified into three types based on the assessment escalation (Souza 2016).

- Teacher-centred: Teachers initiate the assessment process in these tools, so students do not get immediate feedback.
- Student-centred: Students get immediate feedback as they initiate the assessment process in these tools.
- Hybrid: Either student or teacher can initiate the assessment process and students get partial feedback.

Table 1. Comparison of Automated assessment and feedback systems

Tool	Technology	Features	List of Languages support	Approach	Feedback type
Leed's	Stand-alone application	Formative feedback	C, C++, Python	Teacher centred	Text
CodeRunner	Moodle plugin	Moodle quiz of programming assignments	Python, C, JavaScript, PHP, Octave, Matlab	Student centred	Text
VPL	Moodle plugin	Immediate feedback	Many programming languages including Python & Java	Student centred	Text
MULE	Stand-alone application	Immediate feedback	Java	Student centred	Text
Einstein	Stand-alone application	Immediate feedback	Python	Student centred	Text
2TSW	Stand-alone application	Summative feedback	C	Teacher centred	Text & Peer

3.3. Features of the tools

This criterion lists out different features that the assessment systems provide.

- Electronic submission
- Automatic assessment
- Automatic grading
- Immediate feedback

3.4. Assessment system interfaces

This criterion describes the working environment of the systems.

- Learning management system
- Stand-alone system
- Web user interface
- Integrated development environment

3.5. Discussion

This study revealed that Leed's, MULE, Einstein and 2TSW are stand-alone systems which do not support common learning management systems as Coderunner and VPL do as shown in Table.1. Every system supports different programming languages. Coderunner, Einstein and MULE are student-centred as students can start to run the system whenever they need contrast with others. In conclusion, most of the systems have established that their primary motivation is to provide the feedback immediately as a student-centred approach to help them understand where the code went wrong, what type of the errors are in the code and the option to make the changes and re-submit. The 2TSW allows peer assessment where students can get feedback from their fellow students. Therefore, these assessment systems help the students to reflect and enable them to learn from the mistakes.

4. Conclusion

This study reviewed different assessment and feedback systems and looked at how they assess computer programming assignments, how they provide feedback and grading and how they help academics in online teaching. All of them are very useful in different ways and for different requirements. Therefore, these systems help the students to reflect and enable them to learn from their mistakes. However, this study found that there are some drawbacks with these systems. The primary one is that they assess the students with the same questions, with no differentiation for student ability. Adaptive assessment is the process for assessing the students with different abilities with different sets of questions (Chatzopoulou 2010). It assesses the students repeatedly until they attempt the correct answer in the level. Therefore, it confirms the students' knowledge in the level and notifies them the area where they lack

competence or have difficulties. This study suggests an adaptive assessment for these systems which fosters student commitment to complete the programming tasks. It would be better to implement the adaptive assessment in addition to the automated feedback to enhance the learning process.

References

Azcona, David and Hsiao, I-Han and Smeaton, Alan F. (2018), "Personalizing Computer Science Education by Leveraging Multimodal Learning Analytics," *2018 IEEE Frontiers in Education Conference (FIE),* pp. 1-9, doi: 10.1109/FIE.2018.8658596.

Becker, Brett A. (2019). A Survey of Introductory Programming Courses in Ireland. *The 2019 ACM Conference on Innovation and Technology in Computer Science Education (ITiCSE '19)*. Association for Computing Machinery, New York, NY, USA, 58–64. https://doi.org/10.1145/3304221.3319752

Chatzopoulou, Dimitra I. and Economides, Anastasios A. (2010). Adaptive assessment of student's knowledge in programming courses, *J. Comput. Assist. Learn.* 26 (2010): 258-269: 10.1111/j.1365-2729.2010.00363.x

Culligan, Natalie and Casey, Kevin (2018). Building an Authentic Novice Programming Lab Environment. *Irish Conference on Engaging Pedagogy*, 13-14 December 2018, Dublin City University.

Evans, Craig A. and Wilson, Sam (2020). Development of an automated assessment and feedback platform*, Project report*, Feb 2020, University of Leeds.

Lockwood, James and Mooney, Aidan. (2018). Developing a Computational Thinking Test using Bebras problems.

Lobb, Richard and Harlow, Jenny. (2016). Coderunner: a tool for assessing computer programming skills. *ACM Inroads* 7, 1 (March 2016), 47–51. DOI: https://doi.org/10.1145/2810041

Najar, Amir Shareghi and Mitrovic, Antonija (2012). Using Examples in Intelligent Tutoring Systems. In: Cerri S.A., Clancey W.J., Papadourakis G., Panourgia K. (eds) *Intelligent Tutoring Systems. ITS 2012. Lecture Notes in Computer Science, vol 7315.* Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-30950-2_76

O'Brien, C., Humphreys, J., & Ide McAuliffe, N. (2016). Concern over drop-out rates in Computer Science courses. *Irish Times*. Available: http://www.irishtimes.com/news/education/concern-over-drop-out-rates-in-computer-science-courses-1.2491751

Polito, Giuseppina & Temperini, Marco and Sterbini, Andrea (2019). "2TSW: Automated Assessment of Computer Programming Assignments, in a Gamified Web Based System," *18th International Conference on Information Technology Based Higher Education and Training (ITHET)*, 2019, pp. 1-9, doi: 10.1109/ITHET46829.2019.8937377.

Qian, Yizhou and Lehman, James D. (2019). Using Targeted Feedback to Address Common Student Misconceptions in Introductory Programming: A Data-Driven Approach. *SAGE Open*. https://doi.org/10.1177/2158244019885136

Rodríguez-del-Pino, Juan Carlos and Royo, Enrique Rubio and Zenón José Hernández Figueroa. (2012). A Virtual Programming Lab for Moodle with automatic assessment and anti-plagiarism features. *International Conference on e-Learning, e-Business, Enterprise Information Systems, and e-Government.*

Souza, Draylson and Felizardo, Katia and Ellen Barbosa. (2016). A Systematic Literature Review of Assessment Tools for Programming Assignments. *2016 IEEE 29th International Conference on Software Engineering Education and Training (CSEET),* 147-156. 10.1109/CSEET.2016.48.

Wang, Xiao-Ming, Gwo-Jen Hwang, Zi-Yun Liang, and Hsiu-Ying Wang. (2017). Enhancing Students' Computer Programming Performances, Critical Thinking Awareness and Attitudes towards Programming: An Online Peer-Assessment Attempt. *Journal of Educational Technology & Society*, 20(4), 58–68. http://www.jstor.org/stable/26229205

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14695

Build an Assessment Rubric of Student Creativity in Higher Education

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Abstract

Attention to student creativity has triggered a number of educational transformations in higher education. However, widespread measures of creativity in higher education are primarily based on a norm-referenced assessment, which provides minimal information on student performance against the learning development in creativity. In response to the lack of effective measures and criteria to link assessment with instruction in creativity education, this article discusses the process of building an assessment rubric of creativity based on the standards-referenced model. It is intended to help teachers and students better understand the learning objectives related to creativity, as well as to monitor and guide the development of student creativity.

Keywords: *creativity; assessment rubric; standards-referenced model; performance standard; higher education.*

1. Introduction

Creativity has been regarded as the 3rd in-demand employability skill in the next five years according to a report 'The Future of Jobs' from the World Economic Forum (Anon, 2020). The increasing value of creativity in the labor market has driven the focus on higher education as one of the most critical skills for the 21st century (Bapna *et al.*, 2017). Fostering and developing creativity is consistently recognised in higher education (Livingston, 2010; Egan *et al.*, 2017; Gaspar & Mabic, 2015). As a key component of education, effective assessments can provide a wealth of evidence for improving teaching and learning (Wilson & Scalise, 2006).

However, the lack of effective creativity assessment inadvertently hinders teachers from identifying and monitoring creativity development in students (Ehtiyar & Baser, 2019). Psychometric tests of creativity, widely used at all levels of the education system, are based on a norm-referenced assessment and can only provide minimal information about what students know and can do in relation to creativity. In this paper, the process of building an assessment rubric of creativity based on the general procedures proposed by Tognolini (2018) is discussed to provide a new possibility for the future development of creativity assessment in higher education.

2. Limitations of current measures of creativity in higher education

A summary of existing creativity measures reflects the widespread use of psychometric tests in creativity assessment in higher education (Bapna et al., 2017). In higher education, the priority of representing and measuring student creativity will be given to the creative process and the creative outcome. The creative process, referring to the development of thoughts and actions toward original and appropriate outcomes (T. I. Lubart, 2001), can be examined through various tests of divergent thinking, such as Guilford's Alternate Uses Test (AUT) and Torrance's Test of divergent thinking (TTCT) (Guilford, 1966; Torrance & Ball, 1984). On the other hand, creative outcomes focus on the destination of the creative process (Barron, 1955), which is typically measured by the Consensual Assessment Technique (CAT), a subjective evaluation judged by experts or participants on a Likert scale without specific criteria for the rating (Amabile, 1982).

For instance, in investigating the effects of different teaching strategies, including brainstorming and games, on adult students' creativity, Tsai (2013) applied the CAT to measure the creative outcomes of students' collages. Similar studies related to the relationship between brainstorming techniques and creativity have used idea generation tasks from the TTCT or the CAT to measure student creativity (Al-Samarraie & Hurmuzan, 2018). In a study analysing the prediction of creativity and critical thinking on students' success in

completing excellent programs, creativity was represented by the fluency index in the AUT (Leest & Wolbers, 2021).

However, the assessment theory that underpins tests of divergent thinking is the traditional norm-referenced model, in which creativity is scored by comparing students' performance with their peer cohort (Torrance & Ball, 1984; Pi, Hong, & Hu, 2019), rather than against a pre-determined standard. The meaning behind the numbers of measures is more important than the numbers themselves because it provides meaningful information about what students know and can do with respect to a construct, helping teachers better understand students' creativity and develop appropriate instructions (Tognolini, 2018). Findings from an investigation of student and teacher perceptions of creativity at the University of Mostar underline the significance of building a rubric as a common and explicit learning goal to promote creativity education (Gaspar & Mabic, 2015). Understanding the fairness and equity of an assessment rubric, Cuenca and his colleagues (2016) established a holistic rubric on innovation, creativity, and entrepreneurship in the undergraduate curriculum, although it is criteria-based that only demonstrates different levels of output characteristics, rather than cognitive development.

The contention is that if a rubric designed to measure student creativity could be developed to provide evidence of student performance related to creativity, it would be possible to position students along with a rubric that would measure student creative performance in terms of what they know and what they can do. Once this is done, it will be possible to foster and assess student performance in creativity in daily instruction.

3. Standards-referenced assessment

Unlike norm-referencing, where student achievement is measured by comparing it to that of their peers, standards-referencing measures student development by referencing student achievement on a construct-related assessment rubric. The standards-referenced model is built upon the criterion-referenced model. Instead of concentrating on expected behaviors in specific courses or examinations, standards-referencing produces a pre-determined scale using items to define growth along a developmental continuum (Andrich & Marais, 2019; Bond & Fox, 2007). A progression continuum can describe what students should know and can do about knowledge, skills, and understandings in a learning area at different progressive stages (Masters & Forster, 2010).

Generally, there are three steps to building up an assessment rubric (Tognolini, 2018). The first step is to clearly define the construct, which is creativity in this case. Second, a set of progress variables aligned with the definition will be identified as the components of the measurement. Finally, the levels of learning achievements which refer to performance standards, will be used to provide a qualitative interpretation of student performance relative

to the rubric. Take creativity as an example, its performance standards should answer how much students have performed along the developmental trajectory of creativity. Once an assessment rubric is developed, it is still a long way from being finalised and needs to go through multiple rounds of the validation process to ensure the effectiveness and objectivity of the rubric in practice.

4. Process of building an assessment rubric of creativity

This section demonstrates the process of building an assessment rubric for measuring creativity in higher education based on the standards-referenced model, as shown in Figure 1. It is not intended to generate a uniform definition and rubric of creativity, but to perceive the process and adapt it to a variety of educational settings to suit different educational goals.

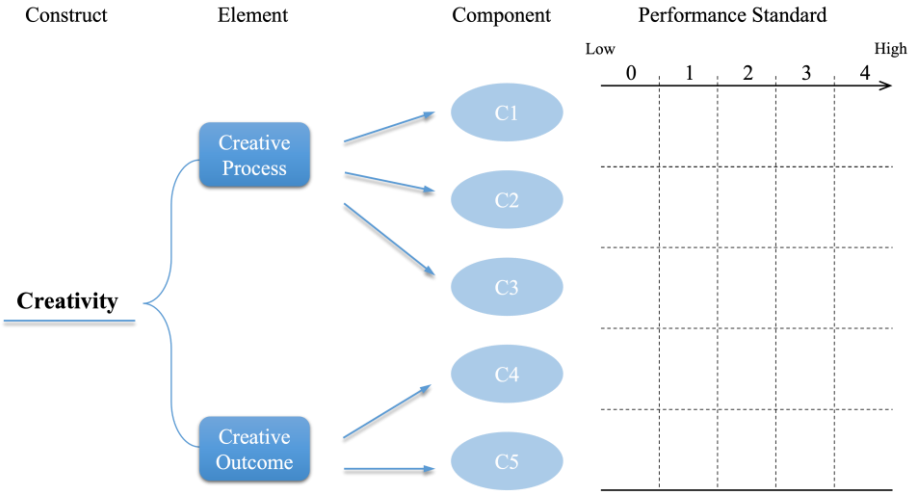

Figure 1. The procedure of building an assessment rubric of creativity

4.1. Define the construct

Creativity is well understood as a multifaceted capability that involves different influences, such as divergent thinking, personality, motivation, and even environmental factors (Lubart, 2011). Instead of answering the question, 'what tools can be used to measure creativity', educators should first consider 'what is it going to measure in relation to creativity' (Runco, 2009). Evaluating all factors simultaneously can disrupt the creative process, and the validity of assessing each factor separately at different times needs to be questioned (Fryer, 2009)

The excessive focus on creative outcomes in higher education has been criticised for some time, and there is a growing call for attention to and measurement of creative processes because of its ongoing impact on competency development (Runco, 2009). A study on the

development of criteria to assess creative outcomes in accounting programs reflects the dominant role of "product-oriented" measures of creativity in higher education (Rensburg et al., 2021). It is well known that there is no universal definition of creativity to date, and different definitions of creativity serve different purposes. A contextualised and appropriate definition of creativity should be in alignment with a specific purpose. If a consensus can be reached on the value of the creative process and the product within a particular context, it is important to develop a clear definition of creativity that includes these two important elements.

4.2. Deconstruct the definition and identify observable components

If the creative process and creative outcome are recognised as the two main elements of the definition, the next step is to break them down and select crucial and measurable components regarding the process and product that match the goals and context. Either a 'top-down' process, a 'bottom-up' process, or a mixture of both can be used to determine the observable variables as the components of the measurement.

A 'top-down' approach starts with a literature review. By critically reviewing literature associated with the targeted element, appropriate and observable variables can be selected and synthesized as the components of the rubric. Take the creative process as an example, the components in the Four-Stage model (Wallas, 1926) and its associated theories can be the starting point, where the concept of the creative process can be extended to the creative potential for different purposes (Lubart, 2011). A protocol of a scoping review of the literature presented by Egan et al. (2017) is an example of a research-based process in defining creativity. It is worth noting that multiple influential factors in the creative process make it easy to get lost in identifying measurement indicators. Constantly reviewing the purpose and context of classroom assessment can be effective in helping to select the appropriate components.

An opposite approach is a "bottom-up" process, where components are selected from experienced lecturers or policymakers through empirical data such as interviews or surveys. The process of developing the Six-Facet-Model, which summarises six channels for observing student creativity through interviews and online surveys with lecturers, is a typical "evidence-based" approach (Jankowska & Karwowski, 2015). Considering the advantages and disadvantages of both methods, using a hybrid approach for the construction and validation process can enhance the effectiveness of the rubric.

4.3. Describe performance standards

Performance standards, also called a developmental continuum, describes the typical order of learning development about the knowledge, skills, and understandings of a learning area (Masters & Forster, 2010). It clarifies how well the students perform in relation to the

construct (Tognolini & Davidson, 2012). When it comes to creativity, it is easy to fall into the trap of focusing on the characteristics of the output and ignoring the description of learning development, especially when students' creativity is assessed only through creative products. One strategy to effectively avoid this mistake is to think about "why a student can reach this level or why a student can produce this output".

In addition, different taxonomies of learning, such as Bloom's Revised Taxonomy (BRT) and the Structure of Observed Learning Outcomes (SOLO) Model, can be utilised to better describe and distinguish between different levels of performance standards. Moreover, accessible language should be used in performance standards to make them user-friendly, since the customers of the assessment rubric are teachers who are already overloaded with tasks in their daily teaching.

Once an assessment rubric of creativity is developed, the opposing view between teachers and students on the evaluation of creativity cultivation in higher education (Gaspar & Mabic, 2015; Ehtiyar & Baser, 2019) can be overcome. Teachers and students can get a comprehensive understanding of their learning objectives because the construct of creativity is clearly described in the definition of the first step and is continuously unpacked in the next step with specific descriptions provided in the rubric.

5. Conclusion

The prominent role of a rubric and the need for criteria in measuring creativity have been recognised in promoting creativity education in university education (Ehtiyar & Baser, 2019). Assessment rubrics based on the standards-referenced model have become an emerging topic in measuring individual competency as its effectiveness in linking assessment to instructions (James Tognolini, 2018). The application of assessment rubrics of creativity allows teachers to monitor students' learning progress over time and adjust their scaffolded instruction accordingly, while students can self-monitor their progress in a timely manner by referencing their performance to the standards. This article conceptualises an assessment rubric of creativity based on the standards-referenced model, which can be further achieved through an in-depth analysis of the literature and a wealth of information from educational practice.

References

Al-Samarraie, H., & Hurmuzan, S. (2018). A review of brainstorming techniques in higher education. *Thinking Skills and Creativity*, 27, 78-91. doi: 10.1016/j.tsc.2017.12.002

Amabile, T. M. (1982). The social psychology of creativity: A consensual assessment technique. *Journal of Personality and Social Psychology, 45(2)*(5), 357-376. doi:10.1037/0022-3514.45.2.357

Andrich, D., & Marais, I. (2019). A course in Rasch Measurement Theory. *Measuring in the Educational, Social and Health Sciences*, 41-53. doi:10.1007/978-981-13-7496-8

Anon. (2020). *The future of jobs report 2020*. Retrieved from Geneva: https://www.weforum.org/reports/the-future-of-jobs-report-2020.

Bapna, A., Sharma, N., Kaushik, A., & Kumar, A. (2017). *Handbook on Measuring 21st Century Skills*. doi: 10.13140/RG.2.2.10020.99203

Barron, F. (1955). The disposition toward originality. *The Journal of Abnormal and Social Psychology, 51*(3), 478-485. doi:10.1037/h0048073

Bond, T. G., & Fox, C. (2007). *Fundamental Measurement in the Human Sciences.* Chicago, IL: Institute for Objective Measurement.

Cuenca, L., Alarcón Valero, F., Boza, A., Fernández Diego, M., Ruiz Font, L., Gordo Monzó, M. L., . . . Alemany Díaz, M. d. M. (2016). Rubric to assess the competence of innovatoon, creativity and entrepreneurship in bachelor degree. *Brazilian Journal of Operations and Production Management, 13*(1), 118-123. doi: 10.14488/BJOPM.2016.v13.n1.a14

Egan, A., Maguire, R., Christophers, L., & Rooney, B. (2017). Developing creativity in higher education for 21st century learners: A protocol for a scoping review. *International Journal of educational research, 82*, 21-27. doi: 10.1016/j.ijer.2016.12.004

Ehtiyar, R., & Baser, G. (2019). University Education and Creativity: An Assessment From Students' Perspective. *Eurasian Journal of Educational Research, 19*, 1-20. doi: 10.14689/ejer.2019.80.6

Fryer, M. (2009). Promoting creativity in education and the role of measurement. *Measuring creativity*, 327.

Gaspar, D., & Mabic, M. (2015). Creativity in higher education. *Universal Journal of Educational Research, 3*(9), 598-605. doi: 10.13189/ujer.2015.030903

Guilford, J. P. (1966). Measurement and creativity. *Theory Into Practice*, 5(4), 185-189. doi: 10.1080/00405846609542023

Jankowska, D., & Karwowski, M. (2015). Measuring creative imagery abilities. *Frontiers in Psychology*.

Janse van Rensburg, C., Coetzee, S. A., & Schmulian, A. (2021). Developing digital creativity through authentic assessment. *Assessment & Evaluation in Higher Education*, 1-21. doi: 10.1080/02602938.2021.1968791

Leest, B., & Wolbers, M. H. J. (2021). Critical thinking, creativity and study results as predictors of selection for and successful completion of excellence programmes in Dutch higher education institutions. *European Journal of Higher Education, 11*(1), 29-43. doi: 10.1080/21568235.2020.1850310

Livingston, L. (2010). Teaching creativity in higher education. *Arts Education Policy Review, 111*(2), 59-62. doi: 10.1080/10632910903455884

Lubart, T., Besançon, M., & Barbot, B. (2011). *EPOC: Evaluation du Potentiel Créatif*: Hogrefe.

Lubart, T. I. (2001). Models of the creative process: past, present and future. *Creativity research journal, 13*(3-4), 295-308. doi: 10.1207/S15326934CRJ1334_07

Masters, G., & Forster, M. (2010). Progression and Assessment: Developmental Assessment. In *International Encyclopedia of Education, Third Edition* (Vol. 3, pp. 369-377): Elsevier Science.

Pi, Z., Hong, J., & Hu, W. (2019). Interaction of the originality of peers' ideas and students' openness to experience in predicting creativity in online collaborative groups. *British Journal of Educational Technology, 50*(4), 1801-1814. doi: 10.1111/bjet.12671

Runco, M. A. (2009). Parsimonious creativity and its measurement. *Measuring creativity*, 393.

Tognolini, J. (2018). *Assessing skills and measuring performance of students on skills that are aligned with the needs of the 21st Century: A practical example.* Paper presented at the Proceedings of the UR International Conference on Educational Sciences (pp. 1-10).

Tognolini, J., & Davidson, M. (2012). Assessment, standards-referencing and standard setting. In *Self-directed Learning Oriented Assessments in the Asia-Pacific* (Vol. 18, pp. 23-41): Springer, Dordrecht.

Torrance, E. P., & Ball, O. E. (1984). *Torrance Tests of Creative Thinking: Revised manual*. Scholastic testing service, Bensenville, IL.

Tsai, K. C. (2013). Facilitating creativity in adult learners through brainstorming and play. *Higher Education of Social Science*, 4(3), 1-8. doi: 10.3968/j.hess.1927024020130403.3153

Wallas, G. (1926). *The art of thought* (Vol. 10). Harcourt, Brace.

Wilson, M., & Scalise, K. (2006). Assessment to improve learning in higher education: The BEAR Assessment System. *Higher Education*, 52(4), 635-663. doi. 10.1007/s10734-004-7263-y

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14415

Perception and confidence on weather forecasts among Spanish undergraduate students enrolled in different subjects related to physics

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Abstract

The current study focuses on Spanish undergraduate students enrolled in Meteorology-related subjects that would make use of weather forecasts in their future professional careers. The main aim of this study is twofold. Firstly, to evaluate the students' confidence in the current weather forecasts. Secondly, to analyze the students' perception and understanding of uncertainty associated with weather-related forecasts. To address these issues, a Google Form questionnaire was developed. A total of 101 students participated in the corresponding survey during the academic year 2018-2019. Results show that students have a well-founded opinion and a fairly solid knowledge of weather forecasts, both regarding confidence and in relation to the trend found in the current weather forecasts towards less accurate predictions for larger lead times. The results found in the current study are in line with previous research conducted in different specific contexts and should be taken into account to implement different learning strategies in the classroom.

Keywords: *weather forecasts; uncertainty; perception; confidence; physics students.*

1. Introduction

Weather predictions have been used in the classroom as part of the learning process in order to facilitate students to better understand complex theoretical concepts as well as different atmospheric processes addressed in the corresponding lectures (Morss and Zhang, 2008; Bond and Mass, 2009; Schultz et al., 2015; Suess et al., 2013; Gómez Doménech et al., 2016). In addition, the usage of weather forecasts in an educational environment provides students with first-hand experiences to visualize and contextualize different theoretical concepts and handle available information. In this regard, Schultz et al. (2015) pointed out that weather forecasts used in the classroom stimulate different levels of Bloom's taxonomy (Bloom, 1956), such as application, analysis, synthesis and evaluation, as well as critical thinking. However, Gómez Doménech and Molina Palacios (2018) found that the use of these models still shows some difficulties regarding how students interpret the uncertainties associated to the weather-related forecasts. This can be a serious limitation for their use if students' expectations on the forecasts skill are far from the current forecasting capabilities.

The aim of this paper is to perform an exploratory analysis to assess to what extent Spanish students enrolled in subjects related to physics interpret correctly the uncertainty of weather predictions as well as determine how they perceive the forecast of the different weather elements. Specific objectives have been defined in this sense: to evaluate students' perception on the weather forecasts and their trust on the accuracy of predictions; to analyze the degree of knowledge of students on the uncertainties of the predictions; to find out how students value forecasts of different weather elements. A survey has been used for these purposes including questions developed in previous studies focused on analyzing these same issues on member of the general public (Morss et al., 2008; O'Hanrahan and Sweeney, 2013; Zabini et al., 2015; Kox et al., 2015). These previous studies have highlighted the need to further testing their results in other contexts. The current work spreads previous research topics, but now focused on Spanish undergraduate students. It is intended to yield valuable information regarding different questions related to their perception and confidence on weather forecasts as well as how these predictions may be effectively used and introduced in the classroom.

2. Methodology

101 individuals enrolled in the Degree in Marine Sciences (University of Alicante, UA), the Degree in Environmental Sciences and the Degree in Physics (University of Valencia, UV) have participated in the current work. The study design was based on the application of a non-experimental quantitative method, and a cross-sectional exploratory and descriptive design, through a survey. There are, thus, three different groups. The first group corresponds to the optional subject "Introduction to Meteorology", taught in the 4th year of the Degree in Marine Sciences at the UA; the second group corresponds to the compulsory subject

"Meteorology and Climatology", taken in the 2nd year of the Degree in Environmental Sciences at the UV; while the third group corresponds to the subject "Atmospheric Physics", taught in the 2nd year of the Degree in Physics at the UV.

A questionnaire directly focused on the research goals of the current study was used to gather student's information. The questions used in this questionnaire were drawn from previously published studies (Morss et al., 2008; O'Hanrahan and Sweeney, 2013; Kox et al., 2015; Zabini et al., 2015). The first question of the survey (Q1) is related to the frequency with which students perceive they receive an inaccurate weather forecast. The degrees of perception in this case are the following: "Very often", "Often", "Sometimes", "Rarely", "I don't know", and an additional point called "Other" (six-point Likert scale). The second question (Q2) refers to the confidence that students have in weather forecasts for different lead times: "Less than a day", "1 day", "2 days", "3 days", "5 days" and "7 to 15 days", from the publication of the corresponding forecast. The degrees of confidence in the corresponding prediction for each of these periods are: "Very low", "Low", "Medium", "High", "Very high" (five-point Likert scale). Finally, students' confidence in the accuracy of the prediction of different weather elements: temperature, wind speed, probability of precipitation and amount of precipitation (Q3).

3. Results and discussion

Fig. 1 shows the answers related to the confidence of students in weather forecasts (Q1). 28% of students experienced wrong forecasts "Rarely", whereas 62% experienced wrong weather forecasts "Sometimes".

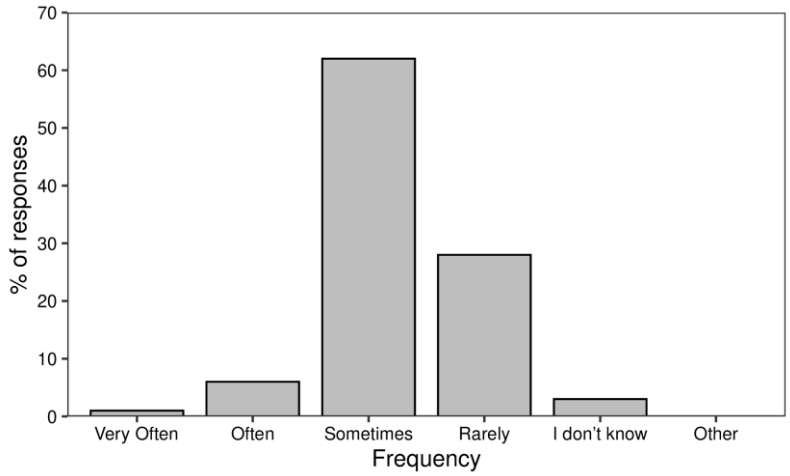

Figure 1. Percentage of responses related to the frequency with which students perceived incorrect weather forecasts.

Comparing the current results shown in Fig. 1 with those previously obtained by O'Hanrahan and Sweeney (2013) among the Irish public, a similar distribution of results is found in both studies. In this regard, O'Hanrahan and Sweeney (2013) concluded that 25% and 46% of their survey participants considered weather forecasts "Rarely" and "Sometimes" inaccurate. At the other end, 25% of the Irish public experienced weather forecasts as inaccurate "Often" or "Very often".

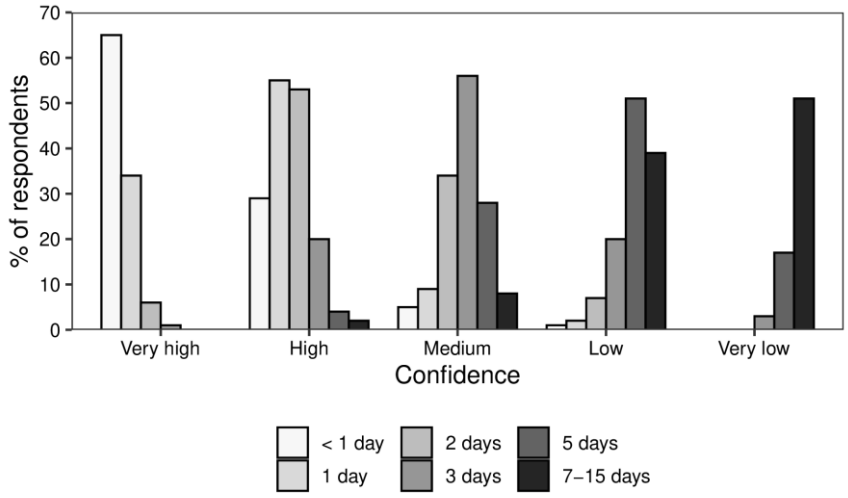

Figure 2. Percentage of responses related to the confidence in weather forecasts for different lead times.

Fig. 2 displays that students' levels of confidence in weather forecasts lead times (question Q2). 65% of the answers showed a very high level of confidence in forecasts for lead times of a few hours. In addition, medium-high confidences were obtained for 2-day forecasts. For 5-day forecasts, 51% of the answers corresponded to "Low" confidence levels, while the confidence was "Very low" for forecasts lead times of 7 days or higher, with 51% of the answers. From Fig. 2, it seems clear that confidence decreases as the forecast lead time increases. The results shown in Fig. 2 are coincident to those found in other previous works (e.g. Morss et al., 2008; Zabini et al., 2015). For instance, O'Hanrahan and Sweeney (2013) showed that, on the one hand, 48% of students experienced very high levels of confidence in the forecast lead times of a few hours, whereas only 2% reported this same confidence in the longest forecast lead times (more than 7 days). On the other hand, no answers were obtained for very low confidence levels for time scale forecasts lower than 24 hours. Morss et al. (2008) obtained that 40% of the answers of their respondents reported a very high confidence in forecast lead times lower than 1 day, while less than 2% showed a very low confidence considering this time interval. Lazo et al. (2009) concluded that nearly half of the answers reported a medium confidence in predictions within the first 3 forecast days and a similar

percentage (47%) reported a very low confidence in forecast lead times of 7 days and beyond. Similar results were reported by Joslyn and Savelli (2010), Zabini et al. (2015) and Kuonen et al. (2019). Likewise, Kox et al. (2015) found that the confidence in 2-day forecasts was higher than the confidence in 7-day forecasts. The results found in the current study, therefore, confirms the correct understanding of students that forecast uncertainty increases for longer lead times (Vitart, 2014).

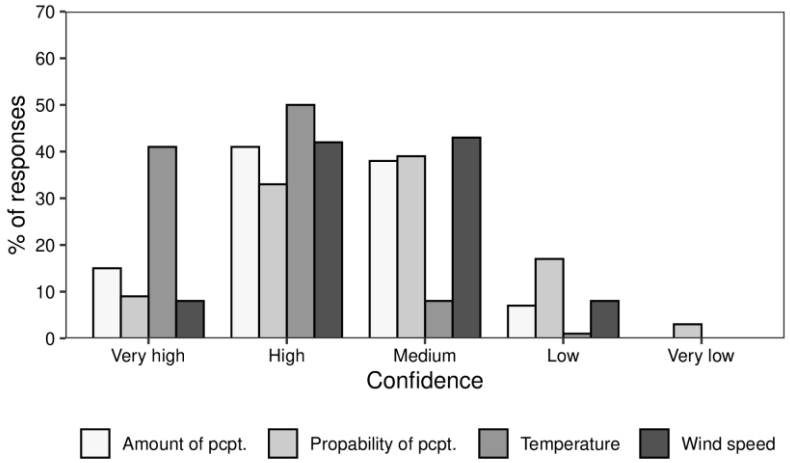

Figure 3. Percentage of responses related to the confidence in weather forecasts for different weather elements.

Fig. 3 shows the confidence in the 24-hour weather forecasts for different weather elements: temperature, amount of precipitation, probability of precipitation and wind speed. Among these weather elements, temperature forecasts are rated as those with the highest confidence and the amount of precipitation is the one with the least confidence levels among students. However, the confidence levels for the probability of precipitation were rated high-medium, similarly to the wind speed. In addition, "Very low" level responses were only obtained in the case of the probability of precipitation. These results agree with those previously found by Morss et al. (2008). In this case, temperature forecasts were as well rated with the highest confidence. In contrast, the lowest confidence was reported for amount of precipitation forecasts, whereas the probability of precipitation presented an in-between confidence. Considering expectation ranges in different weather elements, Joslyn and Savelly (2010) showed wider expectation ranges in the case of wind speed compared to temperature forecasts, thus indicating a lower confidence in these weather forecasts. Regarding wind speed, an intermediate confidence is also found for this magnitude in the present work.

Demuth et al. (2011) evaluated the perceived importance of and confidence in forecast information. They concluded that among the different weather elements, temperature and precipitation were the most relevant ones. Therefore, students in the current study have a clear understanding that the forecast of some weather elements presents a higher uncertainty

than others, in agreement with members of the general public (Morss et al., 2008). These results are in line with those obtained in different studies related to operational Numerical Weather Prediction (NWP) systems (Gómez et a., 2014). Moreover, it appears that confidence in forecasts addressing probabilities, such as precipitation chance, is higher than confidence in forecasts addressing absolute values, such as wind speed or precipitation amount.

4. Conclusions

The results found in the current study show that students appear to accept that forecasts are not perfect as they expect some degree of uncertainty. They reported well-founded intuitions about uncertainty on a practical level and a well-formed opinion on weather forecasts. In this regard, students are aware of the fact that larger errors on longer-term forecasts are expected. The outcomes obtained in the current study have also been compared with to date preexisting literature. This issue has permitted us to answer three different questions. Firstly, whether the same research questions are comparable among different contexts and cohorts. Secondly, whether the responses to the same research questions have evolved and changed over time. And finally, whether responses among undergraduate students are different from those reported by members of the general public and students in different countries and contexts. As a general conclusion, we may say that the outcomes of the current work support and reinforce previous research studies regarding confidence on weather forecasts, but in this case applied to undergraduate students in a pedagogical context. Understanding students' preexisting concepts related to the forecast uncertainty is important for designing and developing teaching and learning strategies directed to establish when and how to provide additional forecast uncertainty information in the classroom. In this regard, considering the usage of open and available models and weather forecasts to introduce complex meteorological concepts in the classroom should first explore the perceptions, expectations and confidence of students in weather forecasts. Previous studies have been focused on the general public, whereas this study focuses on undergraduate students that have a scientific education. Therefore, the comparison conducted in this study may be considered as a limitation. In this sense, extending the study to the general public would be an interesting topic bearing in mind the need of comparing the results among people with different levels of formal education, but sharing the same cultural background. The results of such a study would yield a broaden perspective on the research questions addressed in the current study.

Acknowledgments

This work has been funded by the Assistance Programmes of the University of Alicante ''Programa de Redes-I3CE de calidad, innovación e investigación en docencia universitaria. Convocatoria 2018-19. Alicante: Instituto de Ciencias de la Educación (ICE) de la Universidad de Alicante. Ref: [4334].'', "Programa de Redes-I3CE de calidad, innovación e

investigación en docencia universitaria. Convocatoria 2019-20. Alicante: Instituto de Ciencias de la Educación (ICE) de la Universidad de Alicante. Ref: [4669]", and ''Programa de Redes-I3CE de calidad, innovación e investigación en docencia universitaria. Convocatoria 2020-21. Alicante: Instituto de Ciencias de la Educación (ICE) de la Universidad de Alicante. Ref: [5150].''

References

Bond, N. A., & Mass, C. F. (2009). Development of skill by students enrolled in a weather forecasting laboratory. *Weather and Forecasting*, 24, 1141-1148. doi: 10.1175/2009WAF2222214.1.

Demuth, J. L., Lazo, J. K., & Morss, R. E. (2011). Exploring Variations in People's Sources, Uses, and Perceptions of Weather Forecasts. *Weather, Climate, and Society,* 3(3), 177-192. doi: 10.1175/2011WCAS1061.1.

Gómez, I., Caselles, V., & Estrela, M. J. (2014). Real-time weather forecasting in the Western Mediterranean Basin: An application of the RAMS model. *Atmospheric Research*, 139, 71-89. doi: 10.1016/j.atmosres.2014.01.011.

Gómez Doménech, I., Molina-Palacios, S., & Reyes-Labarta, J. A. (2016). Aplicación de una metodología de enseñanza-aprendizaje en Meteorología a través de herramientas de software libre y datos de modelización numérica. En Roig-Vila, R. (Ed.), *Tecnología, innovación e investigación en los procesos de enseñanza-aprendizaje* (pp. 2078-2087). Barcelona: Octaedro.

Gómez Doménech, I., & Molina-Palacios, S. (2018). Aprendiendo a mirar profesionalmente utilizando episodios meteorológicos reales de interés para el alumnado. En Roig-Vila, Rosabel (Ed.), *El compromiso académico y social a través de la investigación e innovación educativas en la Enseñanza Superior* (pp. 582-591). Barcelona: Octaedro.

Hanrahan, P. O., & Sweeney, C. (2013). Odds on weather: Probabilities and the public. *Weather, 68*, 247-250. doi: 10.1002/wea.2137.

Joslyn, S., & Savelli, S. (2010). Communicating forecast uncertainty: public perception of weather forecast uncertainty. *Meteorological Applications*, 17, 180-195. doi: 10.1002/met.190.

Kox, T., Gerhold, L., & Ulbrich, U. (2015). Perception and use of uncertainty in severe weather warnings by emergency services in Germany. *Atmospheric Research*, 158-159, 292-301. doi: 10.1016/j.atmosres.2014.02.024.

Kuonen, J., Conway, F., & Strub, T. (2019). Navigating Mental Models of Risk and Uncertainty within the Ocean Forecast System: An Oregon Case Study. *Weather Climate and Society*, 11(2), 431-447. doi: 10.1175/WCAS-D-18-0057.1.

Lazo, J. K., Morss, R. E., Demuth, J. L. (2009). 300 billion served. *Bulletin of the American Meteorological Society*, 90, 785-798. doi: 10.1175/2008BAMS2604.1.

Morss, R. E., Demuth, J. L., & Lazo, J. K. (2008). Communicating uncertainty in weather forecasts: a survey of the U.S. public. *Weather and Forecasting*, 23(5), 974-991. doi: 10.1175/2008WAF2007088.1.

Morss, R., & Zhang, F. (2008). LINKING METEOROLOGICAL EDUCATION TO REALITY: A Prototype Undergraduate Research Study of Public Response to Hurricane

Rita Forecasts. *Bulletin of the American Meteorological Society*, 89(4), 497-504. doi: 10.1175/BAMS-89-4-497.

Schultz, D. M., Anderson, S. A., Fairman Jr., J. G., Lowe, D., McFiggans, G., Lee, E., & Seo-Zindy, R. (2015). ManUniCast: a real-time weather and air-quality forecasting portal and app for teaching. *Weather*, 70(6), 180-186. doi: 10.1002/wea.2468.

Suess, E. J., Cervato, C., Gallus, W. A., & Hobbs, J. M. (2013). Weather Forecasting as a Learning Tool in a Large Service Course: Does Practice Make Perfect?. *Weather and Forecasting*, 28(3), 762-771. doi: 10.1175/WAF-D-12-00105.1.

Zabini, F., Grasso, V., Magno, R., Meneguzzo, F., & Gozzini, B. (2015). Communication and interpretation of regional weather forecasts: a survey of the Italian public. *Meteorological Applications*, 22, 495–504. doi: 10.1002/met.1480.

Vitart, F. (2014). Evolution of ECMWF sub-seasonal forecast skill scores. *Quarterly Journal of the Royal Meteorological Society, 140*, 1889-1999. doi: 10.1002/qj.2256.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14585

Co-assessment and self-assessment as types of evaluation in an online and offline blended learning

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Abstract

The main objective of this research is to analyze the influence that co-assessment has on the students' learning process and to analyze whether there are differences regarding the teacher's grades (hetero-assessment), the grades awarded by the students (co-assessment), and the grades that the students award themselves (self-assessment). In addition, the attitude of the students when using co-evaluation as a learning system want to find out. When analysing the data collected, it can be seen that the students are satisfied with the use of co-assessment, showing great involvement. Moreover, co-assessment, self-assessment and teacher's marks are positively correlated. Most of the self-assessment marks coincide with the teacher's marks, albeit there are 20% of students who do not coincide.

Keywords: *Co-assessment; self-assessment; hetero-assessment; satisfaction; involvement.*

Editorial Universitat Politècnica de València

1. Introduction

According to Dicheva *et al.* (2015), traditional evaluation methods do not achieve their main objective according to the opinion of the students themselves, which is to teach. Thus, it is suggested that this traditional form of teaching should be superseded and, therefore, replaced by a wide range of more innovative and sophisticated methodologies, something that, on the other hand, seems to be taking place in recent years.

In relation to the above, new assessment modalities are recently being incorporated, such as self-assessment, peer assessment or co-assessment, however, several difficulties are being encountered. The disconnection between a conventional teaching staff and new innovative teaching techniques, together with the institutional inertia of universities, put traditional exams before advanced solutions to the challenges posed by evaluation (Rodríguez *et al.*, 2010).

During the realization of this work, we have found that, although there are numerous research that focus on this topic and develop it in a fairly broad way, there are areas that are still unexplored and that it would be beneficial to address. It could be said that there is a gap in the research that lies in how learning could be improved through the use of co-assessment. Should we provide the student with different exercises so that they can evaluate exercises different from their own? Or should the student evaluate the same exercise to see different response options or that by mere repetition consolidate that learning? (Cavas Toledo *et al.*, 2010).

In this work, as a general objective, we are going to focus on analyzing the influence that co-assessment has on the students' learning process and analyze whether there are differences between the teacher's marks, the marks given by the students (co-assessment), and the grades that students give themselves (self-assessment). With these learning techniques we want to check if the student is capable of acquiring the necessary skills to self-assess, getting a more realistic view of his/her abilities (Valdivia, 2008). In addition, we want to analyze the attitude of students towards the general use of co-assessment and satisfaction and what factors may influence it.

2. Co-assessment and self-assessment in the learning process

Co-assessment, also called peer evaluation, is defined as an evaluation that is carried out jointly between teachers and students, in which reaching a consensus on the assessments provided is paramount (Ruiz and Serra, 2017). Topping (2018) distinguishes two types within peer review. On the one hand, quantitative co-assessment, which consists of providing the student with a numerical grade, without offering feedback and, therefore, the possibility of discovering its errors and improving them in the future. On the other hand,

formative co-assessment consists of giving verbal feedback, where both the teacher and the students intervene so that the evaluated colleague sees her weaknesses and strengths and sees the way in which she can improve her work. In this paper we are going to focus on formative co-assessment.

On the other hand, we also consider self-assessment as an important tool in the learning process. In self-assessment, students assess themselves and in co-assessment, it is the classmates themselves who, following the teacher's instructions, are responsible for carrying out the assessment process. One of the great advantages of these two evaluation methods is that students achieve a great habit of reflection, in which they are able to analyze their own mistakes and, therefore, improve their development (Valero-García and Cerio, 2005). In addition, Topping (2018) states that in the long term they can develop both communication and collaboration skills.

These assessment techniques can also be used online and are much more flexible than if used face-to-face, where we can monitor the activity of the students, and recapitulate a great source of information where we see the progress of each one. In addition, the teacher can also choose two types of online communication: asynchronous, where students do not have to meet simultaneously, that is, there is no temporal coincidence between sender and receiver; and synchronous, when there is online communication, which can be achieved through various software such as Skype or Zoom (Pacheco, 2010). Both types of evaluation are used in the present study.

Other authors maintain that the use of self-assessment accompanied by a support process from the teacher helps to improve relationships between teachers and students, losing the level of verticalization that characterizes traditional teaching and promoting greater commitment and involvement by students (Vidal *et al.*, 2014). In addition, it helps teachers analyze the results obtained on the self-assessment of each student to make a predictive diagnosis and develop learning strategies that are adapted to the group (Vidal Tallet *et al*., 2014).

When Boud and Falchikov (1989) collected several investigations on the self-assessment of students, they realized that the best students scored below the teacher's grade, since they were more realistic. On the other hand, the students with more difficulties were scored above the theacher’s grade. Therefore, we pose the following research question:

RQ1: Is there a relationship between the students' self-assessment grade and the teacher's grade (hetero-assessment)?

3. Student behavior on co-assessment: antecedents and consequences

To analyze the attitude of students towards the general use of co-assessment and what factors can influence it, different concepts from the literature have been used that can act as antecedents and consequences. After a review of the literature, it has been observed that the student's behavior towards co-assessment can be influenced by the degree of involvement that the student has (how much effort is made to do the co-assessment), its usefulness for learning, the motivation, the interaction that it allows with colleagues and the final satisfaction with the methodology. Based on an extensive review of the literature, we propose the following hypotheses (see Figure 1):

H1. The degree of student involvement in the co-assessment helps to improve the attitude towards the co-assessment.

H2. The degree of student involvement in the co-assessment has a positive influence on greater student satisfaction.

H3. The perceived usefulness of co-assessment in the learning process positively influences the attitude towards co-assessment.

H4. The perceived usefulness of co-assessment in the learning process has a positive influence on the degree of student involvement in co-assessment.

H5. Attitude through the use of peer-assessment positively influences satisfaction.

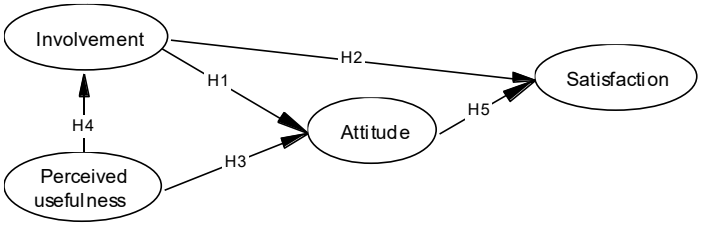

Figure 1. Proposed model for studin g student behaviour on co-assessment.

4. Methodology

A Web-based survey was distributed by e-mail to students of Marketing and Business Administration from University of Murcia (Spain) in the academic course 2020/2021. We obtained a final sample size of 88 students. The constructs used in our study were adapted from previous studies: satisfaction (Chaiyo and Nokham, 2017), loyalty (Petri *et al.,* 2016), attitude (Huang *et al*., 2012) and usefulness (Rodríguez-Fernández, 2017). Moreover, it also was added questions about involvement and opinion about co-evaluation. Additionally, the data obtained in the survey has been crossed with the data collected from the subjects

under study. Specifically, the grades compiled from an online synchronous communication that has been developed on the Zoom platform have been used, since due to the pandemic the subjects were taught online. Within these grades, we find the qualification of both the teacher and the students on the work of their classmates (co-assessment), as well as a self-assessment grade, that is, the one that the student himself has qualified his work. We also have the final mark of the subject, which includes the continuous evaluation and the final mark of the exam, which has been carried out in person (offline). Regarding the analysis, for developing descriptive analysis we have used the SPSS software, and for testing the proposed model using PLS Structural Equation Modelling, we have used SmartPLS 3.0.

5. Analysis of results

To answer the research question about whether there is a relationship between the students' self-assessment grade and the teacher's grade, a correlation analysis has been carried out and a positive and significant correlation has been obtained between the teacher's grades, the co-assessment mark and the self-assessment mark ($r>0$, p-value<0.01). On the other hand, if we recode the grades into two groups, the first group called "below average" with grades ranging from 0 to 7.5 and the second group called "above average" with grades from 7.5 to 10, we observe that there is a relationship between the self-assessment marks and the teacher's marks ($\chi^2=29.42$, sig.$=0.00$). As we can see in Table 1, of the students that the teacher has qualified below the average, 74.3% coincide with his criteria, while there is 25.7% of students who consider that they are above the average on their self-assessment. On the other hand, the students that the teacher has rated above average, we can see that there are 85.1% of students who match their criteria since they have self-rated above average, however, there is 14.9% of students who are above average who have rated themselves below average.

Table 1. Contingency table between recoded self-assessment and teacher's grades.

		Hetero-assessment (teacher's grades)				
		Below average	Above average	Total	Chi-square	p-value
Self-assessment	Below average	74.3%	14.9%	40.2%	29.42	0.00
	Above average	25.7%	85.1%	59.8%		
	Total	100%	100%	100.0%		

In Table 2 we have performed a bivariate analysis, where we can see how there is a significant correlation between satisfaction and self-assessment grades and teacher's grades (p-value<0.05). In addition, the two correlations are positive, being higher in the self-assessment grade variable with a Pearson correlation value of 0.433, while the teacher grade variable obtains a value of 0.222. Therefore, by increasing teacher and self-assessment grades, satisfaction increases, and vice versa. In the variables loyalty, attitude

and usefulness there is only a significant correlation with self-assessment grades, in addition, all these correlations are positive since we obtain a Pearson correlation value of 0.368 in loyalty, 0.363 in attitude and 0.338 in utility, therefore, by increasing the self-assessment grade, loyalty, attitude and usefulness will increase, and vice versa. Finally, we can see a significant and positive correlation between self-assessment and degree involvement and teacher's scores and involvement, with a Pearson correlation value of 0.459 in self-assessment and 0.294 in the teacher's score variable. Therefore, by increasing the self-assessment marks and the teacher's marks, the involvement increases and vice versa.

Table 2. Pearson correlation analysis between grades and behavioral variables.

	Self-assessment grade	Co-assessment grade	Hetero-assessment grade
Satisfaction	0.433***	0.097 ns	0.222**
Loyalty	0.368***	-0.030 ns	0.152ns
Attitude	0.363***	0.074 ns	0.196ns
Usefulness	0.338***	-0.004 ns	0.169ns
Involvement	0.459***	0.122 ns	0.294***

***p-value<0.01;**p-value<0.05; ns=non-significative.

Subsequently, we have carried out regression to analyze whether the three marks (self-assessment, co-assessment and hetero-assessment) influence satisfaction, loyalty, attitude and usefulness towards these evaluation systems. Table 3 shows only the significant relationships. We can conclude that the higher the grade that the student gets in the self-assessment, the greater the satisfaction, the loyalty (wanting to apply the peer-assessment in the future), the attitude towards the peer-assessment, and the perceived usefulness in learning.

Table 3. Simple linear regressions.

Relationships	Coefficients	p-value
Self-assessment grade → Satisfaction	0.361***	0.002
Self-assessment grade → Loyalty	0.327**	0.016
Self-assessment grade → Attitude	0.278**	0.026
Self-assessment grade → Usefulness	0.273**	0.039

Independent variables: grades; Dependent variables: behavioral variables. ***p-value<0.01; **p-value<0.05

On the other hand, a structural equation modeling (SEM), specifically partial least squares (PLS), is proposed to assess the measurement and structural model. SmartPLS 3.0 software was used to analyze the data. After concluding that the scales used in the study provided sufficient evidence of reliability and validity, we test the structural model. Table 4 shows the hipotheses testing. The results confirm that the perceived usefulness of co-assessment influences the student's involvement and positive attitude towards this system. In turn,

greater involvement and a positive attitude influence greater student satisfaction. However, we have observed that greater student involvement does not influence a more positive attitude towards co-assessment.

Table 4. Hypotheses testing of the proposed model.

Hipotheses	Coefficients	p-value
H1. Involvement → Attitute	0.050^{ns}	0.413
H2. Involvement → Satisfaction	0.178***	0.000
H3. Perceived usefulness → Attitude	0.878***	0.000
H4. Perceived usefulness → Involvement	0.434***	0.002
H5. Attitude → Satisfaction	0.798***	0.000

6. Conclusions

The students state that learning through co-assessment has helped them in their involvement and usefulness in the subject, and they are also satisfied, indicating that they would repeat this learning method again, as shown by their high degree of loyalty.

The mean of the self-assessment, co-assessment and hetero-assessment are very similar, and they are also positively correlated. However, when we analyze the frequency table, we appreciate how difficult it is for students to qualify their classmates as failing, as well as with an outstanding grade. It is also curious how the students' self-assessment grades find it difficult to qualify as outstanding compared to the grades obtained by the teacher (hetero-assessment.

On the other hand, when making the hypotheses to find out if the students score above or below the teacher, we are surprised to observe how approximately 1 out of 5 students who are below the average score above the teacher, a similar case that is repeated with students who are above average, since approximately 1 out of 5 are scored below the teacher's grade.

It should be noted that the analysis of the linear regressions has shown us how involvement in co-assessment helps to improve both the student's attitude and satisfaction, since when the student is involved in new study techniques that help improve their learning, their attitude and satisfaction increases. In addition, as hypotheses 3 and 4 prove, co-evaluation has been useful for them, which has positively influenced their attitude and involvement.

References

Boud, D., & Falchikov, N. (1989). Quantitative studies of student self-assessment in higher education: A critical analysis of findings. *Higher Education*, 18(5), 529-549.

Cavas Toledo, M., Chicano García, F., Luna Valero, F., & Molina Tanco, L. (2011). Autoevaluación y evaluación entre iguales en una asignatura de redes de

ordenadores. *JENUI 2011: XVIII Jornadas de Enseñanza Universitaria de la Informática, 303-310*.

Chaiyo, Y., & Nokham, R. (2017). The effect of Kahoot, Quizizz and Google Forms on the student's perception in the classrooms response system. *2017 International Conference on Digital Arts, Media and Technology (ICDAMT)*, 178-182.

Dicheva, D., Dichev, C., Agre, G., & Angelova, G. (2015). Gamification in education: a systematic mapping study. *Educational Technology & Society*, 18(3), 75-89.

Huang, W. H. D., Hood, D. W., & Yoo, S. J. (2013). Gender divide and acceptance of collaborative Web 2.0 applications for learning in higher education. *The Internet and Higher Education*, 16, 57-65.

Pacheco, A. Q. (2010). Aprendizaje colaborativo e interuniversiario en línea: una experiencia asíncrona y síncrona. *Revista de Lenguas Modernas*, 12, 197-210.

Petri, G., von Wangenheim, C. G., & Borgatto, A. F. (2016). A Large-scale Evaluation of a Model for the Evaluation of Educational Games. *Technical Report INCoD*. Brazilian Institute for Digital Convergence.

Rodríguez, G., Ibarra, M. S., & García Jiménez, E. (2013). Autoevaluación, evaluación entre iguales y coevaluación: conceptualización y práctica en las universidades españolas. *Revista de Investigación en Educación*, 2(11), 198-210.

Rodríguez-Fernández, L. (2017). Smartphones y aprendizaje: el uso de Kahoot en el aula universitaria. *Revista mediterránea de Comunicación*, 8(1), 181-189.

Ruiz, M. Á. G., & Serra, V. Q. (2017). Coevaluación o evaluación compartida en el contexto universitario: la percepción del alumnado de primer curso. *Revista Iberoamericana de Evaluación Educativa*, 10(2), 9-30.

Topping, K. (2018). Using Peer Assessment to Inspire Reflection and Learning (Student Assessment for Educators). New York: Routledge.

Valdivia, I. Á. (2008). La coevaluación como alternativa para mejorar la calidad del aprendizaje de los estudiantes universitarios: valoración de una experiencia. *Revista Interuniversitaria de Formación del Profesorado*, 22(3), 127-140.

Valero-García, M., & de Cerio, L. M. D. (2005). Autoevaluación y co-evaluación: estrategias para facilitar la evaluación continuada. *Actas del Simposio Nacional de Docencia en Informática (SINDI),* 25-32.

Vidal Tallet, L. A., Noda Albelo, A., Báez Pérez, E., Fernández Morín, J., Montell Hernandez, O., & Rodríguez Díaz, E. (2014). La autoevaluación y la coevaluación. Experiencia con estudiantes de 4to año de la carrera de Medicina, en la asignatura Pediatría. *Revista Médica Electrónica*, 36(3), 304-312.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14601

Examination of online education experiences from stakeholder perspective – a Hungarian case study

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Abstract

With the rise of Covid-19, higher education has undergone a major transformation. Prior to the pandemic, many universities offered online courses, but the majority of universities were characterized by face-to-face teaching. The goal of this research is to find out students' and teachers' opinions on the online education introduced in the first phase of Covid, with the help of a survey. As teachers had to react very quickly to the situation, the research would like to assess what worked well and what didn't during the online education period, what is in the focus of positive and negative opinions. The aim of this survey is to get feedback from students and faculty members regarding their experiences with online education during Covid.

Keywords: *Online teaching; online education; covid-19, survey.*

1. Research Background

With the rise of Covid-19, higher education has undergone a major transformation. Prior to the pandemic, many universities offered online courses, but the majority of universities were characterised by face-to-face teaching. The aim of this research is to find out students' and teachers' opinions on online education introduced in the first phase of Covid. The research also intends to find out in which areas do students and teachers have a more negative and in which areas a more positive opinion. The aim with this survey is to get feedback from students and faculty members on the online education which they experienced during Covid. In this study, we present the opinions of the two target groups, the similarities between the opinions and the correlation between the responses, and cluster the students and the teachers into groups according to their attitudes towards online education.

There has been a lot of research on the introduction of online education under Covid-19. In the literature review, we provide an essential overview of the research findings that present the opinions and experiences of both students and faculty members in relation to online education. Rafique et. al. (Rafique, 2021) conducted a survey involving 340 students to draw attention to several factors: (1) the interactivity of online education, including students' lack of self-efficacy in posting questions during an online discussion. As a result, the students performed poorly during the semester; (2) the students lacked knowledge in the use of IT tools and needed to be taught by the IT department of the university; (3) lack of knowledge about the organisation of learning, insufficient time management. They found it difficult or impossible to keep their attention focused solely on learning; (4) The role of university administration was also highlighted (Nambiar, 2020). A monitoring system should be established to monitor student activity during online classes. Tang et al. (2021) also examined the faculty and student side in their study. A total of 35 measurement items were used and "five contributing factors, technology readiness, self-directed learning, learner control, motivation for learning, and online communication self-efficacy, were used for investigation (Tang, 2021, p. 13.).

According to these suggestions include the importance of lecturers to offer different solutions for students with different attitudes: more active group work, designing online tools to increase learning efficiency. For lower level students, more intensive online activities should be introduced, such as virtual games. A new area of technological problems related to online education is highlighted by Augustina and co-authors (Augustina et al., 2020). Not only for students in higher education, but also for secondary school students, there was a lack of direct communication between teachers and students.

Mulenga, & Marbán's (2020) survey in Zambia also draws attention to the former factors. In addition, a similar conclusion was reached by Adnan, M., & Anwar, K. (2020) in a study conducted in Pakistan. Based on their research, it can be said that online education cannot be

effective in developing countries like Pakistan. The reason for this is that a significant proportion of students do not have the financial and the technical means to participate in online classes (Mukhtar, et al. 2020). In such countries the biggest problem was the lack of personal interaction and socialization (Mahmood, S. 2021).

The difficulty and lack of networking is highlighted by Slimi (2020) in his study in Oman. In addition, there was a lack of student cooperation and inadequate student time management. A survey in Jordan found similar results. Although some students were satisfied with online learning, a larger proportion of them missed face-to-face interaction. Students felt more isolated during online education, Alawamleh (2020). Adedoyin & Soykan, E. (2020) propose a solution to the problems of technological and network connectivity by suggesting that educational institutions should cooperate with telecommunication companies. Companies can subsidise internet subscription costs or provide free browsing for students.

A further solution could be the widespread deployment of 5G to ensure adequate internet connectivity, in which policy makers, service providers and educational institutions should work together (Shah et al, 2021). König and colleagues found that teachers who kept in regular contact with their students and their parents and used effective and modern educational software and platforms were more effective in online education than teachers who did not. (König et al 2020).

Asynchronous methods are of particular importance for students with poor internet connections (Lapitan et al., 2021). The authors note that their method could be applied in the future to school closures due to natural disasters or other cases where taking immediate action is required. Chiu (2020) discusses the motivation of students and how to increase the effectiveness of teaching. Student motivation can clearly be increased by giving students more autonomy from the instructor.

In his 2021 paper, Chiu details the challenges related to online education that, in his opinion, need to be addressed by researchers and educators alike. (1) understanding the motivation process is important (2) preparing students for online learning: autonomy, collaboration, digital skills. (3) taking into account students' psychological needs and providing emotional support and development (4) strengthening technological and social support (5) bridging the gap between theory and practice by educators (6) supporting teacher well-being (7) supporting learning for special needs groups (8) conducting policy comparative studies.

Partly similar results were obtained in a study carried out in the Kingdom of Saudi Arabia (Almusharraf & Khahro, 2020). The trainers and students agreed on the specific use of the online platform, the evaluation system, the possibilities for technical support and the training workshop. Students were the most satisfied with Google Hangouts and least satisfied with Moodle. However, the study points to the need for further research into how practical training

can be delivered effectively in the online space. Furthermore, new innovative teaching techniques and assessment methods need to be developed.

2. Methodology

The aim of the primary research is to find out the views and experiences of students and teachers about online education. Our research questions are: What correlations can be identified between students' and teachers' experiences of online education? Is it possible to classify teachers and students into different clusters based on their opinions? The primary research consists of two parts: in the qualitative research, focus group interviews were conducted (2-2 interviews with teachers and students). During the focus group research, we identified the areas that stakeholders considered important or in need of improvement. Quantitative research was then conducted for both stakeholders. The questionnaires differed only regarding the demographic question, so the results can be compared across stakeholders.

The questionnaire consists of two parts, both open and closed questions (using a 4-point Likert scale): (1) What do respondents consider important for effective online education? (1 open question; 7 closed questions); (2) What changes do respondents consider important for online education? (1 open question; 4 closed questions)

The demographic questions were designed to ensure that the respondents could not be identified at a later stage. The questionnaires were sent to students and teachers in online format at the faculties of economics, law, engineering and teaching at the university. A total of 304 student and 59 faculty responses were received.

3. Findings

After examining the answers of the survey, based on the average of the responses, the respondents consider the factors listed in the questionnaire to be equally important in relation to online education, and think that the development of the areas listed in the questionnaire is uniformly considered necessary. Both faculty members and students gave an average score of around 3.5 on a scale of 4 for the items listed.

The availability of hardware and software tools, ongoing communication between teacher and student, the flexibility of the requirements system, and adherence to a pre-announced schedule are considered by both faculty and students to be important building blocks for effective online education. Each factor received an average above 3 from both groups.

However, a significant difference can be observed between the two stakeholders in terms of the following aspects. Students consider it particularly important (average 3.71) that instructors make the curriculum and materials available to them from the beginning, as opposed to instructors who do not really consider it important (average 2.89). The same

difference can be observed with regard to the communication interface: students seem to be more in demand of teachers sharing the curriculum on a uniform interface (average 3.35), while teachers are less concerned with this (average 2.75).

We can observe a reversed attitude towards resources: students are less interested in the institution providing the resources needed for teachers to hold the lesson (average 2.77), teachers consider this to be a more important factor (average 3.24). Thus, the different preferences of students and faculty members can be observed in these issues.

By creating the correlation matrix, we had a dual goal. On the one hand, the correlation matrix provides information on which columns of the table are related to each other, ie which questions received coherent answers. On the other hand, it also shows how consistent the respondents are.

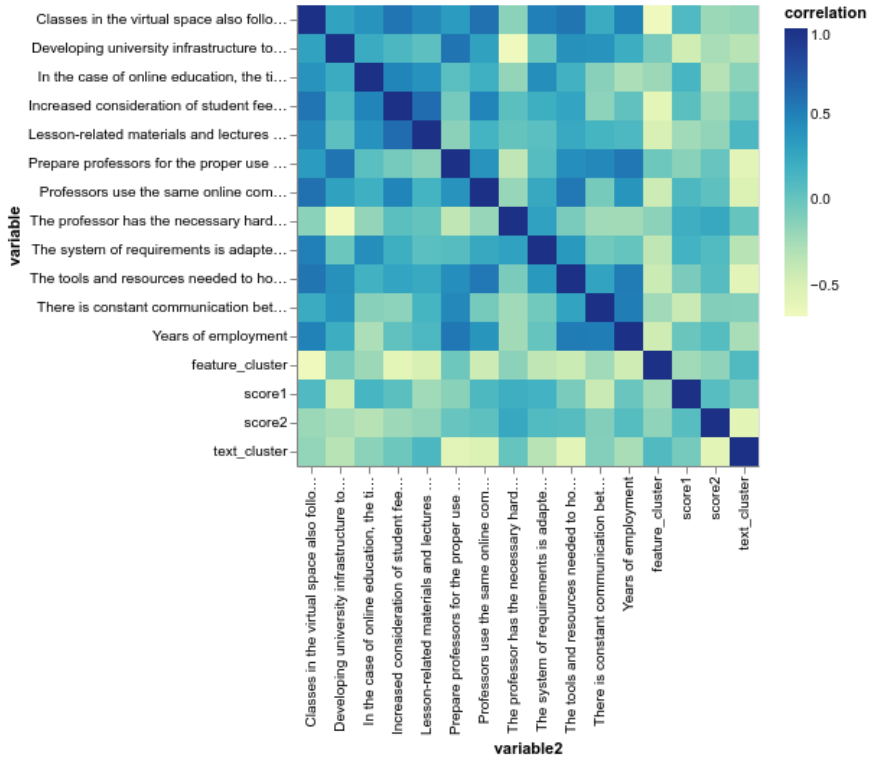

Figure 1. Correlation matrix of teachers' answers

In case of teachers, surprisingly, we found that there was no strong correlation between responses: all values were below 0.5. Instructors are consistent with respect to university infrastructure, the extent to which they want to change the development of university infrastructure, the same they want to change the technical readiness of faculty.

We can also observe a synergy in the fact that whoever considers it important to have the hardware and software to keep the lesson also considers it necessary to develop the university infrastructure. Furthermore, another pattern seems to emerge from the correlation matrix: for teachers, the announced schedule of lessons seems to be the origin, as this statement correlates with most statements.

We consider it a very surprising, but also a telltale phenomenon that we do not find a strong correlation between the answers in the case of students. The highest values are around 3.0 and also revolve around the infrastructure theme.

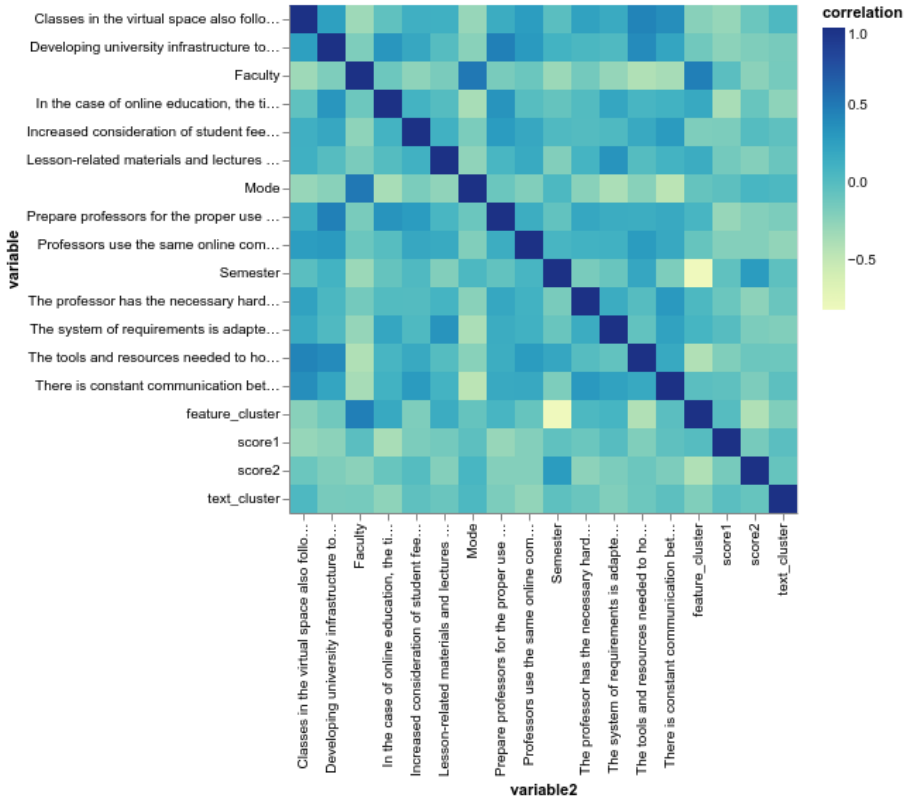

Figure 2. Correlation matrix of students' answers

In the case of clusters, only the textual responses were taken into account when creating the clusters automatically. Respondents were divided into five groups because this seemed to be the most optimal distribution. In this way, clustering was also performed separately for students and teachers. Keywords of each cluster were automatically generated and the first twenty over 1 log likelihood were studied.

In the case of students, based on the two open-ended questions, respondents in the 5 clusters appear to highlight different aspects of online education. Cluster 1 sees the key to effective online education in schedule keeping; Cluster 2 considers the lack of personal presence important; Cluster 3 considers the technical background of online education to be the most important in its answers; Cluster 4 also highlights the technical conditions, but more specifically than the previous one; and Cluster 5 describes importance of health in the description of effective online education, and also draws attention to the technical aspects of online education, but rather to its communication aspect.

We obtained a surprising result when we examined the keywords of the second open question in the five student clusters. It turned out that in the case of clusters 3, 4 and 5, twenty words do not reach the value of 1 log likelihood. We got 9 words for cluster 3, 5 for cluster 4, and only one for cluster 5. Thus, the results are very difficult to compare. In addition, we found that typical themes that would be specific to each cluster did not emerge.

In the case of the teachers, when studying the keywords of the clusters, we found that in the case of the first open question, the aspects considered important by the teachers and students partially overlap, but the teachers associate more nuanced words with some topics. The answers to the first question show that all 5 groups of teachers consider the visual aspect of online education important, as the visual word appears among the keywords in each cluster. 1-4. group also highlights the technical aspect of online education, the word curriculum is included in both clusters 1 and 4.

It is clear from the keywords in the answers to the second question that teachers in all five clusters consider changes to the technical background of online education necessary. This theme appears uniformly in all clusters, and there are quite a few words attached to it. In clusters 2 and 5, the topic of accountability is also available in action and the interactive relationship between people.

4. Conclusion

The rise of Covid-19 created challenges for higher education, which in response has undergone a major transformation. The aim of this research was to find out students' and teachers' opinions on online education introduced in the first phase of Covid with the help of a survey. Results show that there is a significant difference on several occasions. Students consider particularly important the immediate availability of materials and the usage of a unified system, while teachers consider these less important. In case of both teachers and students, no strong correlation was found between responses, but teachers are consistent with respect to university infrastructure, the extent to which they want to change the development of university infrastructure. We can conclude that the view of the stakeholders are partially the same but the emphasis is not the same from different perspectives. It needs to be examined

in the future whether generational or other reasons are behind it, and more analysis is needed for a deeper understanding of the differences and reasons.

Acknowledgement

Supported by the ÚNKP-21-22 New National Excellence Program of the Ministry for Innovation and Technology from the source of the National Research, Development and Innovation Fund.

References

Adedoyin, O. B., & Soykan, E. (2020). Covid-19 pandemic and online learning: the challenges and opportunities. *Interactive learning environments*, 1-13.

Adnan, M., & Anwar, K. (2020). Online Learning amid the COVID-19 Pandemic: Students' Perspectives. *Online Submission*, *2*(1), 45-51.

Agustina, P. Z. R., & Cheng, T. H. (2020). How students' perspectives about online learning amid the COVID-19 pandemic?. *Studies in Learning and Teaching*, *1*(3), 133-139.

Alawamleh, M., Al-Twait, L. M., & Al-Saht, G. R. (2020). The effect of online learning on communication between instructors and students during Covid-19 pandemic. *Asian Education and Development Studies*

Almusharraf, N., & Khahro, S. (2020). Students satisfaction with online learning experiences during the COVID-19 pandemic. *International Journal of Emerging Technologies in Learning (iJET)*, *15*(21), 246-267.

Chiu, T. K. (2021). Applying the self-determination theory (SDT) to explain student engagement in online learning during the COVID-19 pandemic. *Journal of Research on Technology in Education*, 1-17.

Chiu, T. K., Lin, T. J., & Lonka, K. (2021). Motivating online learning: The challenges of COVID-19 and beyond. *The asia-pacific education researcher*, *30*(3), 187-190.

König, J., Jäger-Biela, D. J., & Glutsch, N. (2020). Adapting to online teaching during COVID-19 school closure: teacher education and teacher competence effects among early career teachers in Germany. *European Journal of Teacher Education*, *43*(4), 608-622.

Lapitan Jr, L. D., Tiangco, C. E., Sumalinog, D. A. G., Sabarillo, N. S., & Diaz, J. M. (2021). An effective blended online teaching and learning strategy during the COVID-19 pandemic. *Education for Chemical Engineers*, *35*, 116-131.

Mukhtar, K., Javed, K., Arooj, M., & Sethi, A. (2020). Advantages, Limitations and Recommendations for online learning during COVID-19 pandemic era. *Pakistan journal of medical sciences*, *36*(COVID19-S4), S27.

Nambiar, D. (2020). The impact of online learning during COVID-19: students' and teachers' perspective. *The International Journal of Indian Psychology*, *8*(2), 783-793.

Rafique, G. M., Mahmood, K., Warraich, N. F., & Rehman, S. U. (2021). Readiness for Online Learning during COVID-19 pandemic: A survey of Pakistani LIS students. *The Journal of Academic Librarianship*, *47*(3), 102346.

Shah, S. K., Tang, Z., Sharif, S. M. F., & Tanveer, A. (2021). An empirical study of Chinese students' behavioral intentions to adopt 5G for smart-learning in Covid-19. *Smart Learning Environments*, *8*(1), 1-17.

Slimi, Z. (2020). Online learning and teaching during COVID-19: A case study from Oman. *International Journal of Information Technology and Language Studies*, *4*(2).

Tang, Y. M., Chen, P. C., Law, K. M., Wu, C. H., Lau, Y. Y., Guan, J., ... & Ho, G. T. (2021). Comparative analysis of Student's live online learning readiness during the coronavirus (COVID-19) pandemic in the higher education sector. *Computers & Education*, *168*, 104211.

Mahmood, S. (2021). Instructional strategies for online teaching in COVID-19 pandemic. Human behavior and emerging technologies, 3(1), 199-203.

Mulenga, E. M., & Marbán, J. M. (2020). Prospective teachers' online learning mathematics activities in the age of COVID-19: A cluster analysis approach. Eurasia Journal of Mathematics, Science and Technology Education, 16(9), em1872.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14600

VisionARi: An online community-based augmented reality platform for immersive learning

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Abstract

This paper outlines the development of VisionARi, an online community-based augmented reality (AR) platform for immersive learning. At the core of the platform is a public digital library where creators can upload educational AR content, which is then viewable by users on a dedicated mobile application. VisionARi enables educators with little to no experience in immersive technology to begin creating educational AR content in a matter of minutes through short video tutorials and template files, achieved by leveraging popular free-to-use or open-source software such as Unity and Blender. The ubiquity of smartphones enables VisionARi to overcome barriers and issues related to technical competencies and hardware accessibility currently hampering immersive learning, while the community-based ecosystem facilitates online collaboration across multiple disciplines, potentially leading to improved student learning outcomes.

Keywords: *Augmented reality; immersive learning; community-based; online platform; digital library.*

1. Introduction

1.1. Penetration of digital technology in education

Technological development in the digital age has been transforming the pedagogical landscape since the late 1990s, when the growth of the internet enabled educators to realise the use of the computer as a tool for communication and collaboration, rather than as just a means of information dissemination (Zawacki-Ritcher and Latchem, 2018). Zawacki-Ritcher and Latchem (2018) also attribute the launch of the iPhone in 2007 as the beginning of a period of *online learning in a digital age*, in which emphasis is placed on digital media interactivity. It is important to note just how fast the adoption of smartphones in our daily lives has been throughout the 2010s, reaching an estimated 78% global penetration rate by 2020 as a share of the world population (Statista, 2021). The COVID-19 pandemic further accelerated the adoption of digital tools in education, so sudden and dramatic in fact, that the transformation has put a strain on many teachers and students who struggled to equip themselves with the tools and competencies of a digital distant-learning environment (Iivari et al., 2020).

1.2. Emergence of virtual learning environments

In recent years, virtual reality (VR) technologies have been gaining attention owing to their unprecedented level of user immersion. VR relies on computer technology to create a simulated world around the viewer with digital media, creating a highly immersive experience. Whereas VR creates an entirely digital world, augmented reality (AR) and mixed/merged reality (MR) technologies overlay virtual content in the viewers' real-world by incorporating live camera data. Figure 1 illustrates the differences between VR, AR, and MR from a user-immersion perspective. The umbrella term *extended reality* (XR) is often used to refer to the whole spectrum of the reality-virtuality continuum.

The XR industry is poised for rapid growth, with a market size estimated to triple by 2023 (Wolfstein, 2021). This is reminiscent of the early years of the smartphone industry, further evident from the recent public interest in the metaverse. Furthermore, a survey of industry experts has revealed that the education sector is expected to experience the second most disruption by immersive technologies, only after the healthcare and medical devices industry (Perkins, 2020).

However, despite the ostensible potential of immersive technologies in education, a systematic review of immersive VR applications for higher education conducted by Radianti et al. (2020) has shown that while there has been widespread interest, applications of immersive technologies in education has mostly been experimental and confined to a small set of usability tests, rather than being deployed regularly in actual teaching. This raises questions concerning the maturity of the technology.

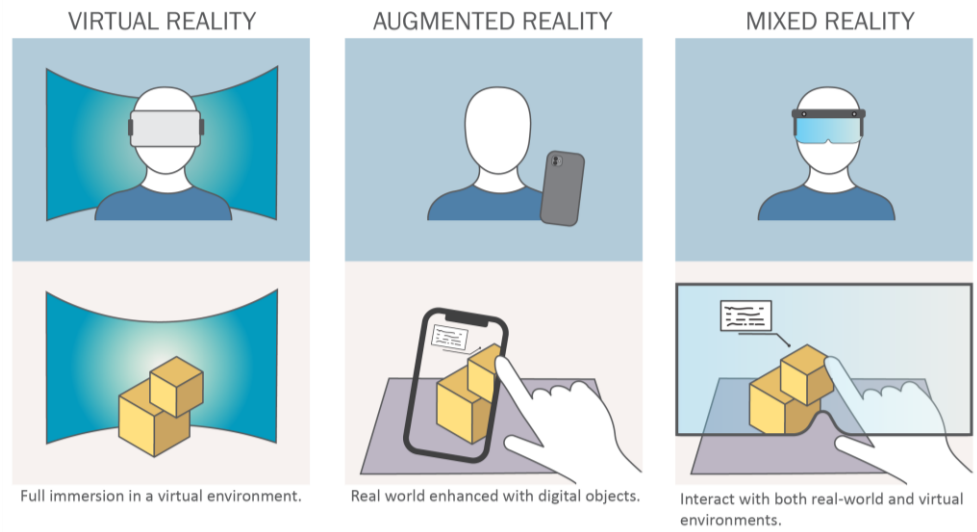

Figure 1. Comparison of VR, AR, and MR

1.3. Barriers of using immersive technologies in education

There are two major requirements for immersive technologies such as VR, AR, and MR to be effectively used by educators and students. First, the hardware must be readily accessible. Immersive technologies traditionally require the use of specialised hardware, such as head-sets fitted with screens, and may additionally require gloves or hand-held devices fitted with sensors, such as the Oculus VR kit. MR headsets such as Microsoft's HoloLens 2 can cost upward of US$3,500 per set. The high costs of dedicated hardware limit their accessibility.

Smartphones, on the other hand, have already reached mass adoption, and the onboard computing power has advanced to the point where it can reliably support AR technology. ARtillery Intelligence (2021) estimates that among the 1.35 billion active users running AR applications on their smartphones, 374 million users (28%) are running them on ARKit or ARCore, which are opensource AR software development platforms provided by Apple and Google, respectively. These numbers show that AR technology is easily accessible to the wider public with an active base of application developers. Thus, while it may take another few years for dedicated immersive technology hardware to mature and be easily accessible to the education sector, smartphones make a compelling bridge towards such a future, while achieving high outreach immediately.

Another major requirement for immersive technologies to be effectively deployed in education is the technical competency of both educators and students. As of now, immersive technologies require special training to use, and most of the time require lengthy and costly application development by third-party developers. Indeed, through a semi-structured

interview with school teachers who use VR/AR technology regularly, Alalwan et al. (2020) found that a lack of competency, a lack of environmental resources, and limited instructional design are some of the key challenges preventing the effective use of VR/AR in classroom settings.

2. Development of the VisionARi platform

2.1. The need for a common platform

A major hurdle for educators in incorporating immersive content in their teaching is that they need to design, develop, and test their application from scratch. As mentioned earlier, this requires educators to gain strong technical competency in immersive technology first. A common platform with simplified and semi-automated processes for creating immersive content can alleviate much of this burden, enabling educators to focus more on content quality for their learning outcome goals.

To overcome these technical barriers and limits with hardware accessibility, we propose a new framework that leverages free-to-use or open-source software to create a community-based educational AR platform for mobile devices. The platform is being developed by our team at the Hong Kong University of Science and Technology in collaboration with VisionARi Limited, with the aim of empowering educators, students, and professionals to create, share, and use high-quality educational AR content more effectively and more collaboratively.

2.2. Our proposed framework: VisionARi

Our proposed framework is called VisionARi and its outline is illustrated in Figure 2. At its core is an online digital library that hosts “modules” for users to download and run. Each module contains a compressed package of files such as 3D models, animations and toggles, which collectively make up the central AR content. Modules are uploaded by content creators directly to an online library, analogous to how a video creator would share their content on an online streaming platform. Users can access the modules through our dedicated mobile application, enabling them to view the AR content. The library is also accessible through the community website, where users can also manage their account and content, leave comments on specific modules, and share tips and experiences.

The VisionARi viewer is built on the Unity engine, a free-to-use game development engine with AR plug-in capabilities. Content creators would use Unity to create their AR content through the provided templates, with support from short tutorial videos. Unity has a large online community owing to its relatively simple and modular workflow, making it ideal for novices to get started on creating AR content, in just a few minutes, without any expert coding skills.

Our framework enables all levels of creators, from teachers and educators with no experience to professional 3D modelers and animators, to create and share AR content in a collaborative and interactive manner. Beyond this, students themselves can become content creators, for instance, using AR content to present their science/engineering project.

Compared with other AR platforms, the VisionARi ecosystem has the distinct advantage that it can enable any given module to be accessed by educators all around the world to incorporate into their teaching. Furthermore, as the modules are deployed onto smartphone devices instead of dedicated hardware, the technical barrier is significantly reduced while hardware accessibility is drastically improved.

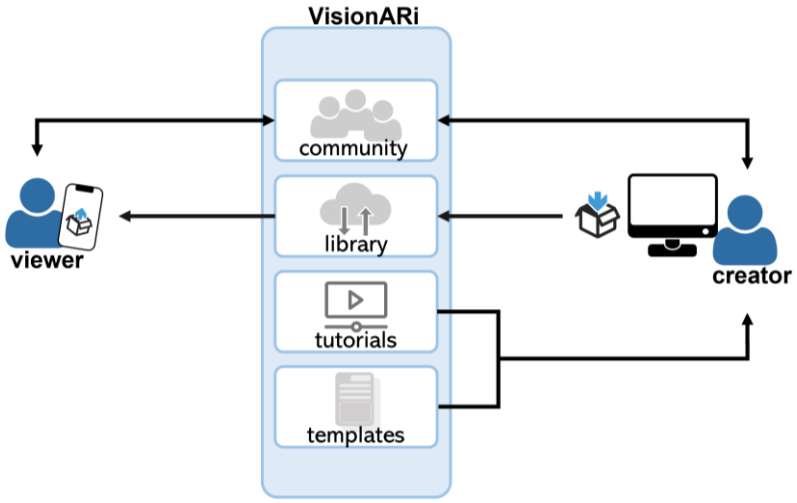

Figure 2. Framework of the VisionARi platform

A short video demonstration of the mobile application running different example cases can be found here: https://youtu.be/S0KtApSDa1U (VisionARi, 2022).

2.3. Case study A: CAD model of a DC motor

A simple example module was created using a generic CAD model of a DC motor downloaded from an external online library (Suchet, 2021). The CAD model contains all the internal components of a DC motor, such as permanent magnets, rotor, and copper coil. The CAD model can demonstrate the inner workings of a DC motor effectively.

The CAD model was imported into Blender, a popular open-source 3D modeling software, where realistic materials and textures were added to the various motor components. Once prepared, the CAD model was imported into Unity, where two toggles were defined that can show/hide the outer casing and cover of the DC motor in the mobile application. Once the

module was prepared, it was packaged as an asset bundle and uploaded to the VisionARi library.

Figure 3 shows the example case being viewed on the VisionARi mobile application, with the outer casing and cover of the motor shown (top) and hidden (bottom). The steps to creating this module – including the use of Blender – have been documented as a 5-minute tutorial video. Tutorials of example modules will equip novice creators with the skills and knowhow to create their own modules via Unity, Blender, and other open-source software.

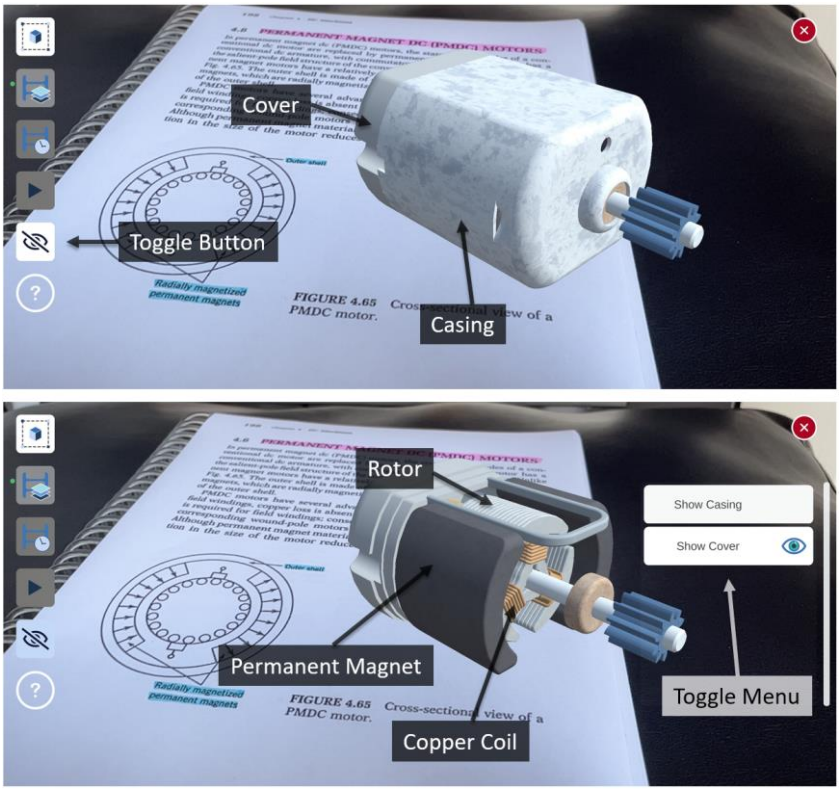

Figure 3. Case study A: DC motor viewed on the VisionARi mobile application

2.4. Case study B: CFD simulation data of a ship propeller

A second example module geared towards professional engineers is discussed next. In this module, computational fluid dynamics (CFD) simulation data of the fluid flow around a rotating ship propeller is considered. As Figure 4 shows, viewers can toggle through various types of datasets on the VisionARi mobile application, such as the Q-criterion and the pressure distribution on the propeller surface (top) and slices of the velocity field (bottom).

Such scientific datasets can easily consume tens of gigabytes and usually require professional software and computing skills to process and interpret. With the VisionARi platform, educators would have the option to incorporate high-level scientific datasets into the classroom, with module files on the order of just a few megabytes.

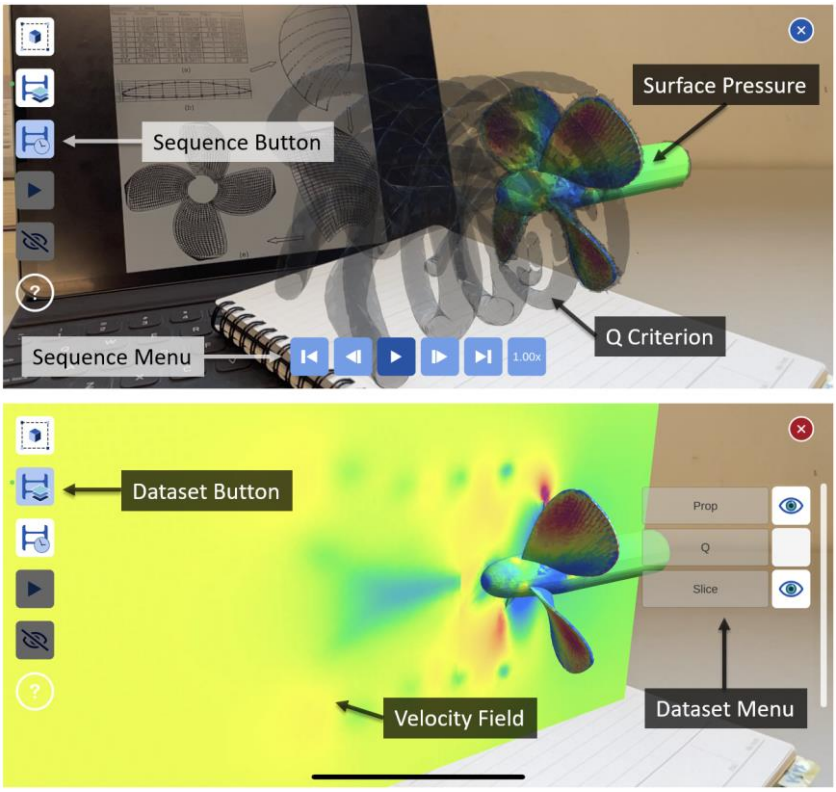

Figure 4. Case study B: Ship propeller CFD data viewed on the VisionARi mobile application.

3. Summary and outlook

In this paper, we have presented a fully integrated online educational platform, VisionARi, that aims to empower students and educators with a more technically accessible and more effective teaching tool based on augmented reality (AR). The VisionARi ecosystem achieves this by creating an active online community and by facilitating the use of various open-source tools to develop immersive content. By providing templates, short tutorial videos, and example modules, all within a unified framework, VisionARi empowers educators and professionals alike to create, share, and use AR content, without the technical and mass-adoption barriers that have traditionally hindered faster and wider adoption of immersive technology for education.

The VisionARi platform is currently being internally tested with various example modules, based on feedback from educators at the secondary and tertiary levels, as well as from professional designers and engineers. Currently, there are 23 individual beta-testers. The platform is planned for official launch in July 2022, beginning with a hands-on augmented reality workshop for highschool students, organised with a local international school.

While the current development of VisionARi focuses on AR content for mobile phones due to the maturity and ubiquity of smartphones, our platform can easily be scaled up to other immersive technology hardware as they mature in the future.

References

Alalwan, N., Cheng, L., Al-Samarraie, H., Yousef, R., Ibrahim Alzahrani, A., & Sarsam, S. M. (2020). Challenges and prospects of virtual reality and augmented reality utilization among primary school teachers: A developing country perspective. *Studies in Educational Evaluation, 66*, 100876. doi:10.1016/j.stueduc.2020.100876

ARtillery Intelligence. (2021). *Mobile AR global revenue forecast, 2020-2025*. https://artillry.co/artillry-intelligence/mobile-ar-global-revenue-forecast-2020-2025/

Iivari, N., Sharma, S., & Ventä-Olkkonen, L. (2020). Digital transformation of everyday life – how COVID-19 pandemic transformed the basic education of the young generation and why information management research should care? *International Journal of Information Management*, 55, 102183. doi:10.1016/j.ijinfomgt.2020.102183

Perkins Coile LLP. (2020, March). *2020 Augmented and virtual reality survey report.* https://www.perkinscoie.com/images/content/2/3/v4/231654/2020-AR-VR-Survey-v3.pdf

Radianti, J., Majchrzak, T. A., Fromm, J., & Wohlgenannt, I. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. *Computers and Education, 147*, 103778. doi:10.1016/j.compedu.2019.103778

Statista. (2021). *Global smartphone penetration rate as share of population from 2016 to 2020.* https://www.statista.com/statistics/203734/global-smartphone-penetration-per-capita-since-2005/

Suchet, S.K. (2021, October 7). *DC Motor & Components*. GrabCAD. Retrieved February 10, 2022, from https://grabcad.com/library/dc-motor-components-1

VisionARi. (2022, February 11), *VisionARi -DEMO* [Video]. YouTube. https://youtu.be/S0KtApSDa1U

Wolfstein, K. (2021). *Augmented Reality (AR)* [PowerPoint slides]. Xpert.Digital. https://xpert.digital/wp-content/uploads/2021/04/Augmented-Reality.pdf

Zawacki-Richter, O., & Latchem, C. (2018). Exploring four decades of research in computers & education. *Computers and Education, 122*, 136-152. doi:10.1016/j.compedu.2018.04.001

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14195

Using data analysis to predict the students' trend of choosing preferred data storage

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Abstract

Predicting trends is crucial for any business. No exception for education as well. Usually, this is a complex task that needs good planning and hard working to get to results. But sometimes luckily, a result from a study could be recognized as something that could reveal a potential trend, though it was not its primary goal, but spending some time digging deeper into data would pay off.

This paper presents results from a study of the students' trend for choosing favorite database type to learn and use, which was found during analyzing data from the software agents that work for our e-learning portal DeLC, serving as helpers for students and lecturers. These agents are there for very different purpose, but from the data they collect many interesting facts and behavioral patterns of our students could be revealed.

Keywords: *e-learning; software agents; data analysis; databases.*

1. Introduction

Our e-learning portal is called DeLC (Distributed e-Learning Center) and it's a project developed in Department of Computer Systems, University of Plovdiv "Paisii Hilendarski", Bulgaria, to serve our needs regarding distance learning, exams and other educational and organizational activities, subject of many studies as Stoyanov, S., Doychev, E., et al., (2012); Stoyanov, S., Zedan, et al., (2012). Among the most important advantages of this project is that its code base is available for researchers from that university, and thus possible are developing, reengineering, and improving most of the features it provides, allowing "insider" look of what's happening during this system's work, what data is stored, and the researchers are able to run many analytical processes trying to extract useful information and knowledge. Over the years, users from other universities started using it and thus it became a huge system, that combines functionalities and data from several satellite systems, which extend its capabilities. Among these extensions is IntelliDeLC, described in Cholakov (2013) – to provide a personalized e-learning environment with reactive and proactive behavior – in its nature this is agent-oriented extension, which provides environment that contains software agents. These agents are being developed and improved constantly and their functionalities, behavior, and latest results are discussed in many articles, among which: Cholakov (2020), Cholakov (2021), Cholakov & Stoyanova-Doycheva (2021).

The results of agents' work are subject to various analyzes, and they often reveal information, that is not visible at first sight. Such case was described in Cholakov (2021), when analysis was done on the results from automated tests assessments so far, made by the software agent that is dedicated to this task (EvaluatorAgent), for a particular course in our department – "Database management systems" (DBMS). The success/failure of the students was summarized by the points, earned during exams, and discovered which topics are difficult for

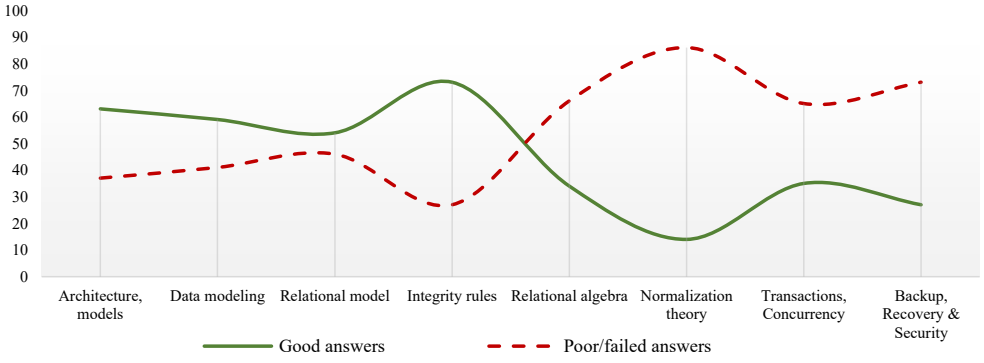

Figure 1. Percentage of the good/poor answers, grouped by topic for the DBMS course.

students. This is summarized and clearly visible on Figure 1 – when the materials are getting more theoretical and require more attention to be paid, the results are dropping significantly, and on the other hand, with more practical topics the results are higher.

It formed an interesting, but unwanted trend – students tend to rely on their practical knowledge to pass the exam, trying to avoid usually more complex theoretical topics (the assessment consists of two parts – practical and theoretical, which form the final grade, but the details will be skipped for brevity as they are not a subject of this study). Unwanted because it may lead to lower quality of knowledge and lack of analytical thinking. This information came as a side effect of our analyzes and led to course materials updates and other measures in order to keep students' attention, discussed in Cholakov (2021).

Now, could even more information be extracted from the data collected (Fig. 1) about students' behavior and preferences, and get to new conclusions?

2. The problem and results from further analysis

What happens to those students that ignore DBMS course and at a later stage they meet the requirement to use data storage of any kind for their projects in other courses or diploma thesis? It was worth to check out. A survey was conducted among the students and graduates, questioning what the preferred data storage type is – relational or NoSQL, used for their course projects and diploma theses, and then another trend was discovered. The survey was conducted online through Google Survey (Google Inc., 2022) and among the participants were 146 graduates and 274 undergraduates – all went through DBMS course. Here is the moment to mention, that our DBMS course educates primarily in relational databases. Many cases were observed when students use NoSQL databases just because:

- They have missed the relational databases course, don't know relational model at all or just don't feel comfortable with it.
- They find non-relational databases (particularly key-value and document storages) easier to learn and use, avoiding in-depth thoughts regarding relational theory.
- They want to keep up with the newest cutting-edge technologies – this is the smallest number of students, but they deserve special attention as they clearly see their future growth path and can distinguish between current market circumstances and what the demands would be in the nearest future.

And this was thought provoking – which are the main drivers for choosing the right database? Are our students lazy? Do they hate theory? Or are they bringing the future with all emerging technologies? Are NoSQL databases the choice of less educated? Or probably teaching DBMS should be revised with a different look, because the reality has changed. No simple or definite answer.

As Figure 2 depicts, among the students that achieved high results after the DBMS exam about 74% prefer using relational databases, the rest prefer other types; among the students with low results in DBMS exam the preference is split between relational and NoSQL databases; globally, the situation doesn't differ too much from the first part of the students, according to the most popular sources (DB-Engines Ranking (2022), Developer survey (2022), Top 10 Databases to Use in 2021 (2022)) – nearly 70% usage of relational databases.

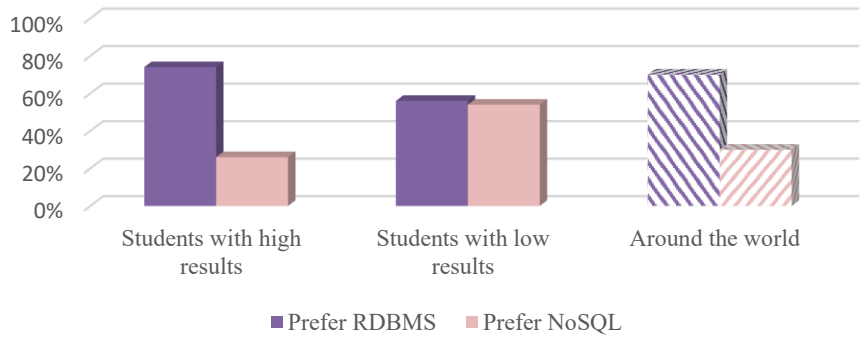

Figure 2. Percentage of students' preferable database type, and globally.

So, what those graphics above reveal – are the students lazy enough to push the progress further? Or probably relational model is not perspective to meet the modern world's needs? Both yes and no probably – it's a simple truth that:

- Practice makes perfect – learning new databases alone on demand trains problem solving skills, which is among most wanted qualities in IT branch these days.
- All things that one can do with NoSQL databases are possible with relational ones as well – so those who learned relational model didn't waste their time, as the statistics for global situation from Figure 2 clearly states (third data series).

The summary above should be considered as a red flag – the teachers need to review their understandings about databases, and this should involve updating courses, materials, and minds too – to reflect the reality properly. Some of these activities have already started – there is undergoing process of updating lectures and labs guides to include materials for modern databases, but it needs careful planning as the course still needs to fit in the same number of hours. To avoid this limitation, we already have an elective course for MongoDB (MongoDB (2022), the most popular among document-oriented ones, according to the statistics in the sites cited above) that students could enroll if they are interested in NoSQL databases, as it is a good starting point.

3. Conclusion

Using data analysis and data mining most of the times helps discover things that aren't obvious, and we witness their appliance in large range of domains – finance, education, medicine, social science, automotive industry, intelligent agriculture, to name a few. In our case revealed the trend of our next generation – what kind of database our students tend to use and what could be their career's choice. Discovering students' preferences helps us choosing the right tooling for education and gives direction for future updates of course materials.

Whilst investigating the most difficult parts in the teaching materials, we figured out that there are many students that don't try hard to learn the theory of relational model. Later, they tend to use non-relational databases as they find them easier to start with – and they do it quite well.

The results from this study could serve as direction what course materials must include to meet the modern requirements.

Acknowledgements

The research is supported by the project КП-06Н36/2 "Competition for financial support of basic research projects – 2019" of the National Scientific Fund of the Ministry of Education and Science in Bulgaria.

The statistics for global situation on database market are taken from the fellows from db-engines.com, towardsdatascience.com, and insights.stackoverflow.com, so special thanks to them for the interesting surveys they do each year.

References

Cholakov, G. (2013). Hybrid Architecture for Building Distributed Center for e-Learning. *PhD Thesis*. Plovdiv, Bulgaria.

Cholakov, G. (2020). Approbation of software agent Evaluator in a nonspecific environment for extension of its purpose. *2020 International Conference Automatics and Informatics (ICAI)*, (pp. pp. 1-5). Varna. doi:10.1109/ICAI50593.2020.9311346

Cholakov, G. (2021). Secondary effects converted to useful knowledge in e-Learning system. *International Conference Automatics and Informatics (ICAI)*, (pp. pp. 117-120). doi:10.1109/ICAI52893.2021.9639599

Cholakov, G., & Stoyanova-Doycheva, A. (2021). Model for Profiler Agent during unexpected educational circumstances. *7th International Conference on Higher Education Advances (HEAd'21).* Retrieved from http://ocs.editorial.upv.es/index.php/HEAD/HEAd21/paper/view/12841

DB-Engines Ranking. (2022, January 15). Retrieved from db-engines.com: https://db-engines.com/en/ranking

Developer survey. (2022, January 15). Retrieved from stackoverflow.com: https://insights.stackoverflow.com/survey/2021#overview

Google Inc. (2022, April 1). *Google Surveys*. Retrieved from https://surveys.google.com

MongoDB. (2022, January 15). Retrieved from www.mongodb.com

Stoyanov, S., Doychev, E., Valkanova, V., & Cholakov, G. (2012). Education Cluster for Intelligent Provision of eLearning Services. *DBKDA 2012: The Fourth International Conference on Advances in Databases, Knowledge, and Data Applications, Reunion, IARIA*, (pp. pp. 45-50).

Stoyanov, S., Zedan, H., Doychev, E., Valkanov, V., Popchev, I., Cholakov, G., & Sandalski, M. (2012). Intelligent Distributed eLearning Architecture. In *Intelligent Systems* (pp. pp. 185-218). InTech.

Top 10 Databases to Use in 2021. (2022, January 15). Retrieved from towards data science: https://towardsdatascience.com/top-10-databases-to-use-in-2021-d7e6a85402ba

8th International Conference on Higher Education Advances (HEAd'22)
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DOI: http://dx.doi.org/10.4995/HEAd22.2022.14864

Learning Analytics for Measuring Engagement and Academic Performance: A Case Study from an Irish University

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Abstract

This paper presents an analysis of various metrics of student engagement and academic performance, based on data extracted from a virtual learning environment (VLE) and other supporting technologies. The level of student activity on the VLE, as measured by hours and count of accesses to content areas, was found to be a strong indicator of engagement and impacted the level of performance. Participation in self-regulated optional learning activities was also found to be a strong indicator of engagement, which again impacted students' scores. As regards gender comparisons, males and females demonstrated different study approaches but there was no difference in performance. Senior (final year) students out-performed sophomore (second year) students, and students on programmes with higher entry bars fared better. Interestingly, students who adopted a steady approach with consistent levels of activity through the semester achieved higher scores than those who procrastinated. The paper concludes with some recommendations on where learning analytics technologies need to go to truly be useful for teachers and students in higher education.

Keywords: *Academic performance; Engagement; Student behaviour; Gender differences; Learning analytics; Virtual learning environments; Structural equational modelling.*

1. Introduction

This paper presents an analysis of the engagement and performance of students taking a course in "Database Systems for Business" at an Irish university. Prior research has highlighted the importance of engagement as a factor impacting retention and academic achievement (Hussain *et al.,* 2018). Levels of interaction, self-regulation (e.g. working on optional exercises), prior knowledge of the subject area, gender, and secondary school grades are also amongst the many factors that can impact performance in higher education (Pardo *et al.*, 2016; Koç, 2017; Pizarro *et al.*, 2017; Hellas *et al.*, 2018). An exploratory data-driven research approach as opposed to a theory-driven approach (Maass *et al.*, 2018) was followed. Student profile data and analytics from the Blackboard virtual learning environment (VLE) and other sources were combined and analysed to build up a picture of various indicators of engagement and to explore their impact on academic performance, as indicated by scores on the course assignment and end-of-semester test.

2. Teaching and Assessment Approach

The course was pursued by 59 students across four separate undergraduate programmes, running from September to December 2020. The class was 32% female and 68% male, all Irish nationals with the exception of two visiting international students. Because of emergency public health guidelines in force during the COVID-19 pandemic, the course moved out of the normal classroom environment and was taught fully on-line by means of a regular live two-hour session delivered on Microsoft Teams each week for the duration of one semester. Presentation slides, supplementary notes and other lecture materials were made available in advance on Blackboard and remained available on-line for the full duration of the course. The weekly lecture sessions were also recorded and shared on Blackboard.

The teaching style was interactive; as the lecturer worked through examples of problems, students were invited to ask and answer questions via the Microsoft Teams chat dialogue or by clicking the 'Raise Hand' button and speaking. Building on the material covered in lectures, students were provided with a set of practical exercises and formative assessment quizzes designed to prepare them for the end-of-semester test. Students could attempt the quizzes as often as they wished and received a feedback score each time upon completion.

The course was assessed by means of an assignment (30%, teams of two or three) and a final test (70%, individual). The assignment was based on the *Jay's Collectibles* teaching case (Cappel & Gillman, 2011) and required students to work together on a problem-based learning exercise to design a database schema. The lecturer made himself available for on-line consultation meetings with student groups seeking guidance on the assignment; most groups availed of this opportunity at least once. The end-of-semester test consisted of fifty

multiple choice quiz (MCQ) questions, each with four possible options of which one and only one was correct. The first half of the test examined knowledge of database design concepts. The second half was based on knowledge of the Structured Query Language (SQL) and used the same familiar database schema as was employed throughout the course in the lectures and practical exercises.

This teaching and assessment approach incentivised students to attend lectures, engage deeply with the assignment, attempt the practical exercises and quizzes, and consult the other learning materials made available on Blackboard, which included a link to an electronic version of the recommended textbook. The fact that learning materials were made available on Blackboard had no impact on class attendance levels, which were in line with historical averages.

3. Learning Analytics

As summarised in Table 1, various metrics were extracted from the Blackboard VLE platform, Microsoft Teams and Microsoft Forms surveys and quizzes. The process of extracting and consolidating data into a clean, usable format was rather cumbersome and therefore these metrics were not available in real-time, only retrospectively after the course was completed.

Table 1. Learning analytics measures.

Measure	Description
anon_id	Anonymous identifier (all PII removed)
completed_year	Did student complete this academic year?
assignment_mark	Mark awarded for assignment
exam_mark	Mark awarded for end-of-semester test
programme_code	Degree programme code
final_year	Is this student in final year of degree?
overall_mark	Overall Mark (Assignment + Examination)
gender	Gender (Male or Female)
prev_knowledge_subject_area	Did student have any prior knowledge of the area?
how_many_others_do_u_know	How many other students in the class did this student know at beginning of semester?
bb_hours	Total hours of Blackboard access for this course
bb_access_lecture_materials_percentile	Extent of access to Lecture Materials on Blackboard
bb_access_recordings_percentile	Extent of access to Recordings on Blackboard
bb_access_practical_exercises_percentile	Extent of access to Practical Exercises on Blackboard
bb_access_textbook_percentile	Extent of access to Textbook on Blackboard
bb_activity_percentile_q1 / q2 / q3 / q4	Relative activity in Blackboard in each of the four quarters of the twelve week semester
teams_chat_interactions	Count of interactions on Microsoft Teams Chat
formative_quiz_attempts	Combined number of attempts at formative quizzes

4. Findings and Discussion

Exploratory non-parametric tests were executed in SPSS to seek out patterns of correlation and differences in the data.

A student's overall mark was found to be positively correlated with several influencing factors, including the number of hours that the student was active on Blackboard ($N=57$, $r_s = .474$, $p < .001$), the number of times that the 'Lecture Materials' section on Blackboard was accessed ($N=57$, $r_s = .493$, $p < .001$), and the number of times that a student attempted the formative quizzes ($N=57$, $r_s = .620$, $p < .001$).

Interestingly, the number of times that the 'Recordings' section on Blackboard was accessed did not impact performance. This can be explained by an observed range of types of study behaviours: some students who attended lectures also watched the video replays (those students mostly fared very well), but there were some who skipped lectures and just watched the videos (those students tended to perform relatively poorly).

The number of interactions on Microsoft Teams (i.e. questions and other posts in Chat) had a strong positive correlation on students' marks on the assignment ($N=58$, $r_s = .656$, $p < .001$) and also, but not to the same extent, on overall mark ($N=57$, $r_s = .542$, $p < .001$). This can be explained by the fact that many of the questions raised on Chat related more to the material assessed by the assignment than that assessed by the end-of-semester test. The students who asked those questions or otherwise contributed on Teams were highly engaged and therefore, in keeping with the findings of previous studies (Pardo *et al*., 2016, Hussain *et al.*, 2018), it was expected that they would perform better than less engaged students. Of course, some outstanding students did not interact at all on Teams, which can go down to personality differences such as introversion.

Similarly, the number of times that students accessed the 'Practical Exercises' section on Blackboard was found to have a strong positive correlation with their end-of-semester test mark ($N=55$, $r_s = .518$, $p < .001$), as did the number of times they accessed the textbook link ($N=55$, $r_s = .437$, $p < .001$). These are both examples of self-regulated learning behaviour.

An interesting finding was the correlation between activity at various points in the semester and performance on the end-of-semester test. The level of Blackboard activity for each student throughout the semester was broken into four quarters of three weeks each. Activity in the first quarter was found to be positively correlated with the test score ($N=55$, $r_s = .407$, $p < .01$) but the strength of this correlation fell in the second quarter ($N=55$, $r_s = .360$, $p < .01$) and again in the third quarter ($N=55$, $r_s = .342$, $p < .05$). In the fourth quarter, it was insignificant. What this suggests is that students who were consistently active throughout the semester fared better, whereas in the final quarter there was a mixture of last-minute "crammers" and "steady-does-it" students, with very different results achieved.

Two students who commenced the course did not complete and two others chose to defer. The latter pair was due to COVID-19 health-related issues and both subsequently passed. The former pair indicated at the beginning of the semester that they knew nobody else in the class (most students knew at least one other person), and their level of Blackboard activity in the first quarter was negligible. As it turned out, both students failed to complete not just this course but also several others. Given the early warning signs, these drop outs were predictable. Unfortunately, they were also unpreventable because of the underlying causes. Students who were in assignment teams with students that subsequently dropped out were discommoded to an extent, and this was taken into consideration by granting appropriate time and grading concessions on those submissions.

When looking at the content areas that males and females accessed, it was found that females accessed the on-line lecture materials ($N=59$, $U = 212$, $p < .01$), textbook ($N=59$, $U = 231$, $p < .05$) and formative quizzes ($N = 59$, $U = 224.5$, $p < .05$) significantly more often than male students, and that females spent a substantially greater amount of time engaging with materials on Blackboard ($N=59$, $U = 226$, $p < .05$). However, despite these gender differences in study approach, no difference was found as regards academic performance, as measured by assignment and end-of-semester test scores.

This study found that senior (final year) students had significantly higher performance than sophomore (second year) students on the end-of-semester test with mean GPA scores of 3.9 and 3.3 respectively ($N= 55$, $U = 553$, $p < .01$).

Surprisingly, students with no prior knowledge of the subject material actually fared better overall than those who had some previous exposure to the area ($N= 53$, $U = 235.5$, $p < .05$). This may be because of higher motivation of the newcomers to the subject area (who were mostly final year students) and possibly some degree of complacency amongst those with prior experience.

The programmes that students were enrolled in also gave rise to significant differences in scores. This can be explained by the varying academic entry criteria for the programmes. Not surprisingly, the students on programmes with higher entry standards (i.e. secondary school grades) fared, on average, better than those on programmes with lower entry bars.

To further explore the relationship between engagement and academic performance, a Structural Equation Model (SEM) was constructed using the Ωnyx environment (Onyx, 2022). The results of the SEM revealed that our data support the hypothesis that level of engagement impacts academic performance: χ^2 (6) = 60.002, CFI = 0.999, TLI = 0.995, RMSEA =.03. The resulting paths are shown in Figure 1. In earlier versions of the model, other variables were included but they were removed because of weak loadings and unacceptable impact on the model fit. As can be seen, the number of hours of Blackboard activity and the number of attempts at formative quizzes both loaded strongly onto the

'Engagement' latent variable, with statistically significant positive correlations of 0.72 and 0.87 respectively. The assignment mark and end-of-semester test mark both correlate positively with 'Performance', although the loading of the assignment mark was lower than expected. This may perhaps be because the assignment mark, unlike the other variables in this model, was not unique to each individual student (i.e. it was done as part of a team). Engagement had a strong positive correlation (0.76) with performance.

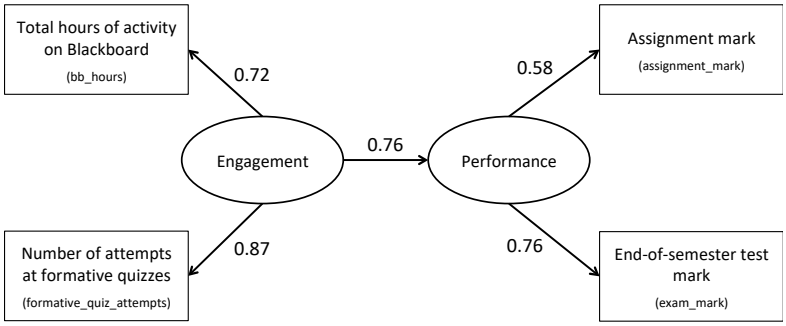

Figure 1. Structural equation model derived from learning analytics data.

5. Conclusion

The potential of learning analytics to provide teachers with valuable information pertaining to measures of academic engagement and performance is widely recognised (Koç, 2017; Kosasi *et al.*, 2020). Importantly, they also have the potential to provide students with personalised benchmarks of their own metrics so that they can stay on target to achieve their goals. For example, the findings of this study showed that levels of activity at early stages of the semester can impact overall performance, and that students who went 'the extra mile' on self-regulated activities fared better. A small number of students who were disappointed with their overall scores contacted the lecturer to enquire why they didn't do as well as they felt they would. In all such cases, an examination of the metrics discussed in this paper provided simple explanations. Had the students been easily able to see where they actually were, as compared to where they ought to have been or believed they were, they may have succeeded in achieving their ambitions.

The actual extent to which learning analytics are being purposefully used in universities across the world is unknown, but it is almost certainly the case that the majority of students and teachers are not using analytics to anywhere near their potential. Why is this the case? The Technology Acceptance Model (Venkatesh & Davis, 2000) tells us that perceived ease of use and perceived usefulness – which is affected by output quality, demonstrability of results, job relevance, and other factors – impacts actual usage behaviour. During the COVID-19 pandemic, educators hurriedly rushed to adopt on-line meeting and

collaboration technologies (e.g. Zoom, Teams, Slack) that, to be fair, were mostly not intended for the purpose of teaching and learning. However, as we move into the "new normal" of post-pandemic on-line and hybrid delivery, the ease with which useful and timely learning analytics can be generated must be a factor in the choice of educational technologies.

References

Cappel, J. J., & Gillman Jr, J. R. (2011). Teaching case: Jay's collectibles. *Journal of Information Systems Education*, 22(2), 111-116.

Hellas, A., Ihantola, P., Petersen, A., Ajanovski, V. V., Gutica, M., Hynninen, T., Knutas, A., Leinonen, J., Messom, C. & Liao, S. N. (2018, July). Predicting academic performance: a systematic literature review. In *Proceedings Companion of the 23rd Annual ACM Conference on Innovation and Technology in Computer Science Education* (pp. 175-199).

Hussain, M., Zhu, W., Zhang, W., & Abidi, S. M. R. (2018). Student engagement predictions in an e-learning system and their impact on student course assessment scores. *Computational Intelligence and Neuroscience*, Article ID 6347186. https://doi.org/10.1155/2018/6347186

Koç, M. (2017). Learning analytics of student participation and achievement in online distance education: A structural equation modeling. *Educational Sciences: Theory & Practice*, 17(6).

Kosasi, S., Kasma, U., & Yuliani, I. D. A. E. (2020, October). The Mediating Role of Learning Analytics to Improve Student Academic Performance. *In 2020 2nd International Conference on Cybernetics and Intelligent System (ICORIS)* (pp. 1-6). IEEE.

Maass, W., Parsons, J., Purao, S., Storey, V. C., & Woo, C. (2018). Data-driven meets theory-driven research in the era of big data: Opportunities and challenges for information systems research. *Journal of the Association for Information Systems*, 19(12), 1.

Onyx (2022). Ωnyx Structural Equation Modelling. https://onyx-sem.com/

Pardo, A., Han, F., & Ellis, R. A. (2016, April). Exploring the relation between self-regulation, online activities, and academic performance: A case study. In *Proceedings of 6th International Conference on Learning Analytics & Knowledge (LAK)*, Edinburgh, Scotland (pp. 422-429). ACM.

Pizarro, A. M., González, M. V., Tofful, C. M., Arrieta, M., & Britos, V. (2020). A proposal for a structural equation model to explain academic performance in e-learning. *Revista Produção e Desenvolvimento*, 6.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, 46(2), 186-204.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14637

Analysis of explicitation evidence in technical translation

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Abstract

The aim of this study is to contribute to Translation Studies in Higher Education by analyzing a parallel corpus containing German and Portuguese technical texts. Based on a text-linguistic perspective, we propose to explore in what way explicitation can be identified in the analysed text corpus, consisting of 15 user manuals from the field of electrical engineering. The corpus comprises 2100 aligned text segments, which were analysed in SketchEngine, a tool for corpus analysis. In the context of cohesion (Halliday & Hasan, 1976), and based on the transfer instances identified in the parallel corpus analysis, we aim at providing a categorization of explicitation for practical translation classes. In our study, we discuss four categories, namely overspecification, specification, implicitation, and under-specification, depending on a decreasing explicitation degree. In terms of quantitative analysis, the corpus revealed that most instances were attributed to both underspecification and specification. Although user manuals are a highly conventionalized text genre with little room for variation, we found that explicitation elements constituted an important device in the transfer process.

Keywords: *Explicitation; technical translation; user manuals; cohesion; parallel corpus.*

1. Introduction

Due to the importance of Specialized Translation in today's globalized world, the translation profession is more and more influenced by technology for a faster and more efficient transfer of specialized texts into different target languages. Translation training has therefore to take into consideration the study of different domains, such as scientific, technical, and legal translation, in response to a diversified professional reality. This study proposes to analyze technical texts as subject of one of the most representative fields - technical translation. Byrne (2006, pp. 1-2) claims that technical translation has long been considered "the poor cousin of 'real' translation", despite its "importance" and "overwhelming demand". Krüger (2014, pp. 13-14) argues in the same way, stating that "[s]cientific and technical translation, together with specialized translation in general, has therefore often been reduced to a simple, almost automatic transcoding process". Technical translation involves texts on "applied knowledge from the natural sciences" (Byrne, 2006, p. 3). Byrne (2006) argues in favour of a clear distinction between technical and scientific translation, in that "scientific translation relates to pure science in all of its theoretical, esoteric and cerebral glory while technical translation relates to how scientific knowledge is actually put to practical use" (p. 8). By acknowledging the role of technical translation, the next chapter will discuss its most representative text genre, the *user manual*.

2. Technical translation and the text genre user manual

In the scope of Specialized Translation, technical translation involves a wide variety of subject areas that belong to different types of industry, from the primary sector to human services. The industry produces a large volume of text types and text genres - operation manuals, user guides, patents, technical data sheets, among others - that the technical translator should be acquainted with. Such text genres describe products (instruments or machines) and give instructions on their functionalities.

According to Reiss's typology (2000/1971), based on Bühler's tripartite model of the linguistic sign, the author proposes a prototypical text type classification, suggesting a specific translation method for each text type. Reiss differentiates among *informative*, *expressive* and *operative* texts, also adding a *multi-medial* text type, a so called "hyper type" (Reiss, 2000, p. 164) that refers to verbal, other than written texts. The basic communicative function of informative texts is of descriptive nature, consisting in a transfer of content. However, as Reiss puts it, texts often do not belong to just one category, but rather are composed of different types that may overlap. This is the case with user manuals, which apart from transmitting information, also have an operative function. Once the text type is determined, the translator has to define the text genre, being intended as "the classification

of a given text according to specifically structured sociocultural patterns of communication belonging to specific language communities" (Reiss, 2000, p. 165). The determination of a text genre is insofar a decisive factor in the analysis process, as it may differ from one language to another, implying diverging text convention patterns (p. 165). Therefore, the translator has to assure for the selection of the adequate target language text pattern. The present study aims at analyzing *user manuals*, being characterized by the use of domain-specific vocabulary and specific text patterns. Informative texts seek to transmit information in a precise and objective manner. When translating informative texts, translators are required to establish functional equivalence, thus, trying to convey "sense and meaning in order to maintain the invariability of the content" (Reiss, 2000, p. 167). On the other hand, operative texts require that the target text produces the same effect as the source text (Reiss, 2000). User manuals are therefore a good example of a textual genre, in which content description and receiver-oriented instructions are combined, revealing "a high degree of directedness as a result of the shared special interests [...] that exists between particular groups of senders and receivers" (Neubert & Shreve, 1992, p. 41).

3. The role of cohesion in specialized texts

In order to be able to apply the textual approach for the purpose of analyzing explicitation in user manuals, we first have to conceptualize the seven key criteria of text introduced by Beaugrande & Dressler (1981), being *intentionality, acceptability, situationality, informativity, coherence, cohesion*, and *intertextuality*.

> The standards of textuality [...] are all relational in character, concerned with how occurrences are connected to others: via grammatical dependencies on the surface (cohesion); via conceptual dependencies in the textual world (coherence); via the attitudes of the participants toward the text (intentionality and acceptability); via the incorporation of the new and unexpected into the known and expected (informativity); via the setting (situationality); and via the mutual relevance of separate texts (intertextuality) (de Beaugrande & Dressler, 1981, p. 14).

When applied to the field of Translation Studies, Neubert & Shreve (1992, p. 70) consider that "the principle of textuality can be used to define the conditions under which a L_1 text and its L_2 counterpart can be said to be textually equivalent". In order to produce a textually equivalent target text, the translator has to be aware of the specific elements of textuality. According to the authors, the textual surface triggers "chains of references to knowledge frames", by which the reader is able to recognize the "textness" of a specific document (Neubert & Shreve, 1992, p. 70).

Due to its importance in establishing "textness" (cf. Neubert & Shreve), the feature of cohesion has been widely studied in oral and written discourse. The most influential approach

in the systematization of cohesive devices was presented by Halliday & Hasan (1976), who characterized the concept of cohesion as

> a semantic one; it refers to relations of meaning that exist within the text, and that define it as a text. Cohesion occurs where the INTERPRETATION of some element in the discourse is dependent on that of another. The one PRESUPPOSES the other, in the sense that it cannot be effectively decoded except by recourse to it (Halliday & Hasan, 1976, p. 4).

Within the context of cohesion, we aim at studying explicitation in technical translation. The notion of explicitation has been widely studied and explored, giving rise to a variety of different approaches (Vinay & Darbelnet, 1995/1958; Nida, 1964; Krüger, 2014, among others). Within the field of Translation, explicitation "is the reformulation as a tentative TT [target text] solution of a segment of the ST [source text] conveying implicit information which the translator sees as problematic for the end-readers" (Scarpa, 2020, p. 218). Explicitation can be represented through different categories, in accordance with a specific approach. Our analysis is based on the following main categories: a) overspecification, b) specification, c) implicitation, and d) underspecification.

Overspecification refers to the transmission of information into the TT that can be considered redundant, leading to an overemphasis of content. The second category of specification renders the TT more specific than the ST, providing the reader with detailed information and thus contributing to a better understanding of the communicative situation. Implicitation occurs when the information given in the TT is less explicit than in the ST, "relying on the context or the situation for conveying the meaning" (Vinay & Darbelnet, 1995, p. 344). The last category of underspecification refers to situations in which the TT omits part of the ST information. In terms of classification, these four categories can be represented in a continuum of an increase in the degree of explicitness.

underspecification ---> implicitation --> specification --> overspecification

Figure 1. Increasing degree of explicitation.

4. Method and corpus design

On the basis of the analysis of an aligned parallel corpus, the present study aims at analyzing evidence of explicitation in technical texts. Widely used in translation studies, a parallel corpus is "typically made up of source texts in language A and their translations in language B" (Saldanha & O'Brian, 2013, p. 68), providing insights into transfer procedures through comparison. The analysed text corpus consists of 15 user manuals retrieved from the German website *https://www.manualslib.de/*, offering free access to a variety of user manuals. In an

initial phase, the German and the Portuguese texts were aligned in Memsource, a Translation Management System. In a second instance, the aligned segments were processed in SketchEngine for corpus analysis. Each aligned bilingual segment was manually checked for evidence of explicitation. The assignment of a segment to one of the four categories was not always obvious, since these categories are situated in a continuum with blurred limits. In the following, we intend to illustrate each category providing examples from the corpus analysis.

a) Underspecification

German ST	**Portuguese TT**
(1) Vergewissern Sie sich, dass das Elektrowerkzeug ausgeschaltet ist, bevor Sie es an die Stromversorgung **und/oderden Akku anschließen, es aufnehmen oder tragen.**	(1') Certifique-se de que o interruptor está desligado quando insere a ficha na tomada.
(2) Das Gerät ist nicht für den gewerblichen **oder industriellen** Einsatz konzipiert.	(2') Os nossos aparelhos não são concebidos para uso comercial.

Examples (1) and (2) provide evidence of ST information content, which is not reproduced in the TT. Such omission represents an underspecification, which might have consequences for the correct operation of a device. Examples (1) and (2) may reveal a culture-specific background. Technical knowledge and exact explanations are highly appreciated by German readers, being associated with signs of product quality and expertise.

b) Implicitation

German ST	**Portuguese TT**
(3) Wenn Sie mit einem Elektrowerkzeugim Freien arbeiten, verwenden Sie nur Verlängerungskabel, **die auch für den Außenbereich** geeignet sind.	(3') Ao utilizar a ferramenta eléctrica ao ar livre, use uma extensão de fio adequada.
(4) Wir garantieren **während der Garantiezeit**: [...]	(4') A garantia abrange: [...]

Examples (3) and (4), assigned to the category of implicitation, are insofar interesting that the German ST is more explicit than the Portuguese TT, representing a common feature of

technical texts. By repeating words and phrases, the ST tends to create more redundancy, guaranteeing that the information is fully transmitted. The Portuguese segments, although shorter, transmit the same message.

c) Specification

German ST	**Portuguese TT**
(5) Rissige Sägeblätter oder **solche, die ihre Form verändert haben**, dürfen nicht verwendet werden.	(5') Discos de serra que apresentem rachaduras ou **tenham dentes deformados** não deverão ser utilizadas
(6) Ein Werkzeug oder Schlüssel, der **sich** in einem drehenden Geräteteil **befindet**, kann zu Verletzungen führen.	(6') O facto de uma chave ou uma ferramenta de regulação **ficar presa** na peça em rotação da ferramenta eléctrica pode causar um acidente.
(7) Verwendung einer Staub-absaugung kann Gefährdungen durch Staub verringern	(7') O emprego deste tipo de dispositivos pode evitar perigos **causados pela produção** de poeiras.

Segments (5), (6), and (7) contain more specific information in the TT, providing the reader with additional information concerning operation details. Example (6) illustrates a more general description of the situation by using the verb *befinden* in the ST, whereas the TT (*ficar preso*) reveals that the object is stuck, which may lead to a malfunction of the electric device.

d) Overspecification

German ST	**Portuguese TT**
(8) Benutzen Sie kein Elektrowerkzeug, dessen Schalter defekt ist.	(8') Não utilize a ferramenta elétrica, se não conseguir **ligar e desligar** pelo interruptor.
(9) Während des Ladevorgangs kann der Akku-Tacker nicht benutzt werden!	(9') A ferramenta eléctrica não pode ser utilizada durante o processo de carga; **ela não está com defeito se não funcionar durante o processo de carga**.

In examples (8) and (9), units of information are added to the TT; these are no longer mere translations, but adaptations. Whereas the ST does not specify the problem, the TT makes use of redundant information, running the risk that it will not be accepted by the reader.

5. Results and Discussion

The corpus analysis revealed that the category of underspecification was the most represented, with 63 instances. This category was followed by 48 occurrences of specification, and 29 instances of implicitation. The least represented category, overspecification, only revealed 7 occurrences.

Table 1. Results of Corpus Analysis.

Type of explicitation	**T1**	**T2**	**T3**	**T4**	**T5**	**T6**	**T7**	**T8**	**T9**	**T10**	**T11**	**T12**	**T13**	**T14**	**T15**	**Total**
over-specification	0	1	1	0	0	2	0	0	0	0	0	0	2	0	1	**7**
specification	0	5	2	5	1	6	1	6	2	7	0	3	4	2	4	**48**
implicitation	1	4	3	0	1	3	4	2	1	3	1	2	1	1	2	**29**
under-specification	1	6	4	2	1	7	5	9	0	7	0	1	7	5	8	**63**

As far as underspecification is concerned, the corpus analysis revealed that explanations that could not be retrieved from the co-text were not transmitted in the TT. This kind of insufficient explicitation may have consequences for the correct usage of a product. When analysing the instances of specification, we observed the presence of content-related aspects, with the general information of the ST being specified in the TT. This is often done by the addition of detailed information which provides the reader with further knowledge. In the examples of implicitation, the adaptation to the target culture is achieved by eliminating source language details which contribute to the need for security in the ST culture. However, in the target culture, repetitions or duplications are perceived as disturbing elements. The instances of overspecification showed a minor presence in the analyzed corpus, revealing a less popular preference of explicitness in the TT.

References

Beaugrande, R. A., & Dressler, W. (1981). *Einführung in die Textlinguistik.* Tübingen: Niemeyer.

Byrne, J. (2006). *Technical Translation. Usability Strategies for Translating Technical Documentation.* Dordrecht: Springer.

Halliday, M.A.K. & Hasan, R. (1976). *Cohesion in English*. London: Longman

Krüger, R. (2014). *Exploring the Interface Between Scientific and Technical Translation Studies and Cognitive Linguistics. The Case of Explicitation and Implicitation* [Doctoral Dissertation]. University of Salford.

Neubert, A., & Shreve, G.M. (1992). *Translation as Text.* Kent State University Press.

Nida, E.A. (1964). *Towards a science of translating: With special reference to principles and procedures involved in Bible translating*. Leiden: E. J. Brill.

Reiss, K. (2000 [1971]). Type, Kind and Individuality of Text: Decision Making in Translation. In L. Venuti (Ed.) *The translation studies reader* (pp. 160-171). Oxon: Routledge.

Saldanha, G., & O'Brian, S. (2013). *Research Methodologies in Translation Studies*. New York: Routledge.

Scarpa, F. (2020). *Research and Professional Practice in Specialised Translation*. London: Palgrave Macmillan

Vinay, J.P. & Darbelnet, J. (1995 [1958]). *Comparative Stylistics of French and English. A methodology for translation*. Amsterdam/Philadelphia: John Benjamins.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14543

Assessing the impact of recorded lectures on learning effectiveness

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Abstract

Recorded lectures are a useful tool for pedagogical practice in tertiary education. This study provides a large quantitative analysis to examine the impact of using supplementary lecture recordings and empirically corroborates results from other fields. Our analysis examines impact on student academic performance which explores a facet that is complementary to similar studies in the existing literature. Our findings indicate that the usage of recordings is positively related to academic performance. Our results also demonstrate that the lowest performing decile of students have less motivation to use recorded videos and additional resources may need to be provided to improve the learning experience for these students.

Keywords: *Educational teahnology; Learning assessment; Teaching and learning experiences.*

1. Introduction

Recorded lecture videos are important study tools for study (Armstrong, Idriss, & Kim, 2011). Students can use lecture videos to review material at their own pace, and these systems are integrated into many university courses. With the support provided by this additional resourse, many students have changed their study strategies, increasingly relying on the online video resources as a substitute for attendance at lectures. Based on the existing research, having access to the video based lecture materials could improve students' learning experience (Brecht, 2012; Shih, 2010; Brame, 2016; Stohr, Stathakarou, Mueller, Nifakos, & McGrath, 2019). Although students' study behaviours might be highly influenced by the video content, the effectiveness of this video content depends on its design, structure, and provision of interaction (Zhang, Zhou, Briggs, & Nunamaker Jr., 2006; Brecht, 2012; Mitra, Lewin-Jones, Barrett, & Williamson, 2010).

Due to the pandemic, many universities have been forced to switch their teaching-and-learning mode from face-to-face to virtual delivery (Mohmmed, Khidhir, Nazeer, & Vijayan, 2020). Using recorded lecture videos are one of many ways to deliver contents virtually. Students are able to remain engaged with lectures and content albeit via a different modality which has proved to be effective in learning.. However, students who rely on such video content might also face challenges with their remote studies, such as lack of interaction, lack of motivation experience in using information and communication technology (Aristovnik, Kerzic, Ravselj, Tomaazevic, & Umek, 2020; Bezerra, 2020).

Several guiding principles have been established for effective use of videos in learning design (Mayer & Moreno, 2003; Clark & Mayer, 2016), most notably on the management of cognitive load. Homer et al. (2008) found that students with high visual preference experienced greater level of cognitive load under the learning by audio narration (i.e., without video), whereas students with low visual preference reported greater level of cognitive load under the video learning conditions. This finding suggests that individual preferences of learners are important in the design of multimedia learning.

Previous studies found that learning effectiveness and satisfaction can be improved through videos with interactive features (Zhang, Zhou, Briggs, & Nunamaker Jr., 2006; Ronchetti, 2010) that promote better engagement. Students indicated that their interactions with video-based lectures were similar with face-to-face instruction (Borup, West, & Graham, 2012). Hung et al. (2018) developed embodied interactive video lectures (EIVL) by embedding six types of interactive learning activities (engaging, prompting, experiencing, facilitating, demonstrating, questioning) in video lectures based on different scaffolding functions. The use of short videos can be advocated by the positive outcomes for student performance (Ali, 2019). Robertson and Flowers (2020) showed that the combination of video contents and PowerPoint slides is an effective studying approach. Hung et al. (2018) found that learners

under EIVL outperformed learners under other learning conditions in terms of both comprehension and retention.

However, the utilisation of the video content has also been suggested to have a negligible or even negative impact on the students' learning experience. Sykes (2012) stated that dedicated students can still perform well irrespective of video use. Williams et.al (2012) cautioned that the use of lecture recordings as a replacement for attending face-to-face lectures yields no additional benefit for students, and often has severe adverse effects on students' marks.

In comparison to reading-based content, video lectures feature high media richness and are better suited to the delivery of subjective and complex ideas, both in terms of learning performance and learning satisfaction (Sun & Cheng, 2007). Kizilcec et al. (2013) reported that different behaviours of video engagement by MOOC participants result in varying levels of overall learning experience. Wang and Baker (2015) found that students' interest and engagement with video content is crucial in predicting their completion of MOOC courses, whereas Sinha et al. (2014) documented that video clickstream interactions could predict dropping out from videos and courses. Giannakos et al. (2015) found that the peaks of video navigation activities correspond to discussions on assessment answers, whereas Li et al. (2015) reported a positive correlation between video interaction and perceived content difficulty.

In this article, we investigate the effectiveness of online video content as a complementary to the traditional lecture. We use a quantitative study to examine the impact of ECHO lecture recordings on learning outcomes based on pre-pandemic data. Specifically, we investigate the relationship between usage of ECHO and student academic performance. We consider not only the level of ECHO usage, but also frequency of use and its effect on academic performance. Our research taps into a large and previously unused student data set to explore any relationships between academic performance and video usage. We would naturally expect that increased usage to correlate positively with higher academic grades, but no studies have explored this hypothesis. Furthermore, if these recordings are indeed beneficial, an immediate avenue of inquiry is the extent to which they benefit students. The goal of this research is to quantify the true value of ECHO for learning experience.

2. Methodology

2.1. Data collection

To investigate the impact of the video usage on students' academic performance, we used data of 1,485 students who enrolled in a first-year finance course: ACST101 Finance 1A at Macquarie University in 2018 semester 1.

There were 13 teaching weeks in 2018 semester 1 and students were assigned 2-hour weekly lectures as part of their learning. These lectures were delivered face-to-face on campus and students were given unlimited access to the corresponding video-based lecture recordings for revision. The video usage data has been recorded for each student which shows their number of views as well as a viewing percentage for each recorded lecture. A binary Video Usage measure has been created to investigate students' engagement with this online content. For each weekly recorded lecture, each student is assigned a value of 1 if the student (i) viewed at least once, and (ii) viewed at least 50% of the recording; and a value of 0 if either of these two conditions do not hold. Over the course of 13 teaching weeks, the Total View measure for each student ranges between 0 to 13 inclusive. Students were required to complete several assessments for ACST101, comprising of 10 online quizzes, an Excel assignment, a class test and a closed-book final exam.

The improvements in students' academic performance is measured using the difference between their initial ranks and the subsequent final ranks in the student cohort. The average mark across the first three (online) quizzes is calculated for each student, and from this average their relative rank (percentile) is calculated. This measure of initial rank is used as a measure of their initial performance when entering the course. The students' final rank was calculated using their overall grade for the semester, and is intended as a measure of performance when exiting the course. A change in rank is then calculated for each student by subtracting the individual percentile at the start of the semester from the corresponding individual percentile at the end of the semester. A positive change in rank means that the student has improved relative to other students, whereas a negative rank change implies that the relative performance of the student has worsened.

2.2. Data analysis

We firstly plotted the distribution of the Total Views in **¡Error! No se encuentra el origen de la referencia.** and found that close to half of students have the Total Views less than 1. This implies that students might not have strong motivation to use the lecture recordings.

We further analysed the usage among different groups of students and found that the usage of online content is statistically significant correlation with students' academic performance. As stated before, we use the relative rank (percentile) generated from the first three quizzes to measure students' initial performance. We then grouped students into bottom 10%, middle 80% and top 10% based on their initial ranking and calculated the average Total View number for each group is 1.87 for bottom 10%, 3.49 for middle 80% and 3.31 for top 10%. We found that the middle 80% students have the highest average Total View number while the bottom 10% students have the lowest number. In other words, compared to middle 80% group, bottom 10% and top 10% are less motivated to use the online contents. Hence, we are interested to investigate the performance change for each group by the end of the semester.

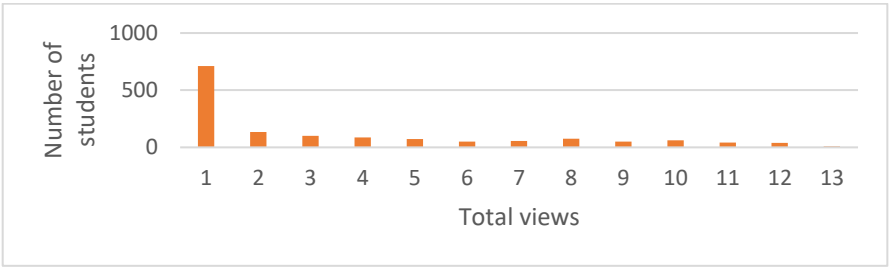

Figure 1. Distribution of Total Views.

3. Result

A linear model approach was applied to examine the effect of video usage on the performance of students, which is measured in terms of their ranking in the course in order to normalise for any course-specific effects. The results of the fit are given in **Table 1.**

Table 1. Average Total View number for different groups

All Students	Estimate	P-value
Intercept	-44.909	4.30e-05
Total Viewed	13.277	1.29e-09

We can see that usage of the videos has a statistically significant effect on the final ranks of the students.This approach was also applied to segments of the data set to examine how this effect changes depending on the initial ranks of the students, which is determined based on their performance on the first three quizzes of the course. The students were segmented into: Top 10%, Bottom 10% and Middle 80%. The results of the linear fit are given in Table 2.

Table 2: Coefficient estimates and p-values of the linear model for different segments

		Estimate	P-value
Top 10%	Intercept	-157.978	8.62E-12
	Total Viewed	8.444	0.051
Bottom 10%	Intercept	181.729	5.67E-12
	Total Viewed	3.283	0.613
Middle 80%	Intercept	-62.946	1.10E-06
	Total Viewed	16.834	1.79E-11

While all of the coefficients related to video usage are positive, it can be seen in Table 2 that this does not provide a statistically significant difference in both of the extreme deciles.

4. Conclusion

Our data has shown that, for this first year finance course, the usage of video recordings has a strong impact on a typical (in our case, someone in the middle 80%) student's academic performance. This aligns with our personal expectations and experiences in delivering this course, and conclude that providing lecture recording to augment traditional learning methods does indeed benefit most students.

However, these effects are not as clear in either of the extreme ends. For these extremes, our hypotheses are as follows. The students that start in the top 10%, in general, may simply be inherently strong enough that video usage has minor impact on their academic performance. Conversely, the students that start in the bottom 10%, in general, may be either inherently weak, broadly disengaged, or had serious ongoing external interruptions to their study to the point that, again, video usage has minor impact on their academic performance.

We also recognise that there are many other influencing factors impacting a student's performance, such as time spent on practice questions and attending tutorials, and that use of video recordings is not the sole deciding factor of a student's performance. However, we do not have useful data available on these other factors and cannot give any definitive comments here. It would also be very difficult to control for these factors.

We would also like to add a comment that the students in this data set would have, for the most part, already graduated, and so contacting them for more data would be highly impractical.

The immediate implications of our results here are that, again, recordings should not only be provided to students, but their use should also be encouraged. More broadly, it reinforces the idea that a student's engagement is pivotal to their learning and performance; additional engagement with the content provided in a course yields clear benefits.

Finally, we suggest a few possibilities for future research. The time delay between lecture recording being made available and the time it is viewed by the individual student may also turn out to be an important factor in predicting a student's performance. In light of online delivery resulting from the pandemic, this option is much more practical as the data is readily available (as compared to F2F delivery). The weekly quizzes and weekly lecture recordings could be analysed using time series methods. Like before, this idea is much more viable given online delivery and the associated extra data that can be collected. This analysis could also be repeated for a smaller second or third year course to see if the same effects are observed. Based on past teaching experience, we expect that a similar pattern would be observed, but

less extreme. This study could also be pushed further by adding additional multimedia content, and running a similar analysis on the additional content.

References

Ali, S. (2019). Impacts of watching videos on academic performance at university level. *European Journal of Education Studies*. Retrieved from https://academic.microsoft.com/paper/2952547676

Aristovnik, A., Kerzic, D., Ravselj, D., Tomaazevic, N., & Umek, L. (2020). Impacts of the COVID-19 pandemic on life of higher education students: A global perspective. *Sustainability, 12*, 8438.

Armstrong, A. W., Idriss, N. Z., & Kim, R. H. (2011). Effects of video-based, online education on behavioral and knowledge outcomes in sunscreen use: a randomized controlled trial. *Patient education and counseling, 83*(2), 273--277.

Bezerra, I. M. (2020). State of the art of nursing education and the challenges to use remote technologies in the time of corona virus pandemic. *Journal of Human Growth and Development, 30*, 141--147.

Borup, J., West, R. E., & Graham, C. R. (2012). Improving online social presence through asynchronous video. *The Internet and Higher Education, 15*(3), 195--203.

Brame, C. J. (2016). Effective educational videos: Principles and guidelines for maximizing student learning from video content. *CBE—Life Sciences Education, 15*(4), es6.

Brecht, H. D. (2012). Learning from online video lectures. *Journal of Information Technology Education, 11*(1), 227--250.

Clark, R. C., & Mayer, R. E. (2016). *E-learning and the science of instruction: Proven guidelines for consumers and designers of multimedia learning.* John Wiley \& Sons.

Giannakos, M., Chorianopoulos, K., & Chrisochoides, N. (2015). Making Sense of Video Analytics: Lessons Learned from Clickstream Interactions, Attitudes, and Learning Outcome in a Video-Assisted Course. *The International Review of Research in Open and Distributed Learning, 16*(1), 260-283. Retrieved from https://academic.microsoft.com/paper/1511916964

Homer, B., Plass, J., & Blake, L. (2008). The effects of video on cognitive load and social presence in multimedia-learning. *Computers in Human Behavior, 24*(3), 786-797. Retrieved from https://academic.microsoft.com/paper/2006343044

Hung, I.-C., Kinshuk, & Chen, N.-S. (2018). Embodied interactive video lectures for improving learning comprehension and retention. *Computers in Education, 117*(1), 116-131. Retrieved from https://academic.microsoft.com/paper/2766514629

Kizilcec, R., Piech, C., & Schneider, E. (2013). Deconstructing disengagement: analyzing learner subpopulations in massive open online courses. *Proceedings of the Third International Conference on Learning Analytics and Knowledge*, (pp. 170-179). Retrieved from https://academic.microsoft.com/paper/2012265254

Li, N., Kidzinski, L., Jermann, P., & Dillenbourg, P. (2015). MOOC Video Interaction Patterns: What Do They Tell Us? *Proceedings of the 10th European Conference on*

Technology Enhanced Learning, (pp. 197-210). Retrieved from https://academic.microsoft.com/paper/1812434695

Mayer, R., & Moreno, R. (2003). Nine Ways to Reduce Cognitive Load in Multimedia Learning. *Educational Psychologist, 38*(1), 43-52. Retrieved from https://academic.microsoft.com/paper/2126153334

Mitra, B., Lewin-Jones, J., Barrett, H., & Williamson, S. (2010). The use of video to enable deep learning. *Research in Post-Compulsory Education, 15*(4), 405--414.

Mohmmed, A. O., Khidhir, B. A., Nazeer, A., & Vijayan, V. J. (2020). Emergency remote teaching during Coronavirus pandemic: the current trend and future directive at Middle East College Oman. *Innovative Infrastructure Solutions, 5*, 1.

Robertson, B., & Flowers, M. (2020). Determining the impact of lecture videos on student outcomes. *Learning and Teaching, 13*(2), 25-40. Retrieved from https://academic.microsoft.com/paper/3045509907

Ronchetti, M. (2010). Using video lectures to make teaching more interactive. *International Journal of Emerging Technologies in Learning (ijet), 5*(2), 45-48. Retrieved from https://academic.microsoft.com/paper/2099420202

Shih, R.-C. (2010). Blended learning using video-based blogs: Public speaking for English as a second language students. *Australasian Journal of Educational Technology, 26*(6).

Sinha, T., Jermann, P., Li, N., & Dillenbourg, P. (2014). Your click decides your fate: Inferring Information Processing and Attrition Behavior from MOOC Video Clickstream Interactions. *Proceedings of the EMNLP 2014 Workshop on Analysis of Large Scale Social Interaction in MOOCs*, (pp. 3-14). Retrieved from https://academic.microsoft.com/paper/2963872107

Stohr, C., Stathakarou, N., Mueller, F., Nifakos, S., & McGrath, C. (2019). Videos as learning objects in MOOCs: A study of specialist and non-specialist participants' video activity in MOOCs. *British Journal of Educational Technology, 50*(1), 166--176.

Sun, P.-C., & Cheng, H. (2007). The design of instructional multimedia in e-Learning: A Media Richness Theory-based approach. *Computer Education, 49*(3), 662-676. Retrieved from https://academic.microsoft.com/paper/2170877245

Sykes, R. (2012). The Impact on Student Learning Outcomes of Video When Used as a Primary Teaching Tool in the Internet Hybrid Classroom. *Annual International Conference on Computer Games, Multimedia and Allied Technology.* Retrieved from https://academic.microsoft.com/paper/1968145673

Wang, Y., & Baker, R. (2015). Content or platform: Why do students complete MOOCs? Retrieved from https://academic.microsoft.com/paper/2181987516

Williams, A., Birch, E., & Hancock, P. (2012). The impact of online lecture recordings on student performance. *Australasian Journal of Educational Technology, 28*(2), 199-213. Retrieved from https://academic.microsoft.com/paper/2141794008

Zhang, D., Zhou, L., Briggs, R. O., & Nunamaker Jr., J. F. (2006). Instructional video in e-learning: Assessing the impact of interactive video on learning effectiveness. *Information & Management, 43*(1), 15--27.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14558

Digital skills of Valencian university students

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Abstract

With the outbreak of the COVID-19 pandemic, higher education changed overnight from face-to-face to e-learning. The tech shortcomings during the lock-down period were expected to affect students from the most disadvantaged stdents in a more negative way. The aim is to detect the strengths and weaknesses of Valencian university students in relation to the e-learning modality. A sample of 18,295 students from the five public Valencian universities, answered a four-sections online form: equipment, connection, experience and attitude. Results show that the Valencian university student community, in general, has sufficient equipment to follow e-learning, nontheless 2% do not have any computer, not even in shared use. Three out of four have a broadband conection, but 0.7% of the participants cannot afford Internet access. 50% self-assess as a medium-low competence, two points in a a five-level scale. Opinions reveal a strong preference for face-to-face teaching, although e-learning advantages are positively valued

Keywords: *Higher education; e-learning: digital skills.*

1. Introduction

Lectures and Professors have always made use of any technology available to them to enhance learning, but the advent of the digital age has significantly boosted this process of technification. Since the end of the 20th century, when platforms for online teaching began to become popular, e-learning has not stopped growing. In 2019, the global e-learning market reached $200 billion, and is estimated to grow by 8% per year until 2026 (Preeti & Saloni, 2020). However, growth estimates made before the COVID-19 era have been rendered obsolete, and surpassed by current market forecasts. The estimate made by Global Industry Analysts in the aftermath of the global global pandemic is that the value of the e-learning industry will exceed US$305.3 billion by 2025 (Wadhwani and Gankar, 2021).

With the outbreak of the COVID-19 pandemic, the situation practically changed overnight from face-to-face learning to e-learning. As a preventive measure, in March 2020 the academic authorities decided to suspend face-to-face teaching activities, leaving the universities to decide on the distance or blended learning systems that would allow them to continue teaching. Each university chose its own tools for teaching classes, enhancing its existing virtual campuses and, in many cases, opting for institutional videoconferencing platforms, such as *Microsoft Teams* or *Google Meet*.

The immediacy of the measure strained the universities' learning processes, making it difficult for students to adapt. University autonomy allowed schools and faculties to adopt various measures aimed at completing the academic year while maintaining the quality standards of education, and the Valencian higher education system demonstrated its resilience.

The tech shortcomings during the lock-down period affected students from the most disadvantaged families in a more negative way (Andrew et al., 2020; Hanushek y Woessmann, 2020). In order to guarantee equal opportunities and educational equity, the Valencian universities implemented mechanisms for inspection and attention to the most vulnerable population. One of the objectives was to identify this type of student body in order to provide them with support through the provision of equipment, connections and/or training.

2. Objectives

The main objective of this study is to detect the strengths and weaknesses of Valencian university students, especially new entrants, in relation to the e-learning modality.

More specifically, the objectives of this study are as follows:

1. Determine the hardware and software equipment of the student body.

2. To know the type and speed of connection available to them.
3. To describe the experience and knowledge of online teaching tools.
4. To know the predisposition of the students towards e-learning.

3. Method

3.1. Participants

The study population is made up of the undergraduate students of the five Valencian public universities enrolled in the 2020-2021 academic year. A total of 20,131 students participated in the study. The 1.82% (367 cases) decided to abandon before finishing the questionnaire. The sample filtering process included the identification of out-of-range responses, repeated cases and inconsistent responses, leaving the final number of valid cases at 18,295.

The final sample consisted of 11,907 women, representing 65.1% of the valid responses. The median age was 20 years, both for men and women. n

3.2. Procedure

After obtaining authorisation from the UMH's project evaluation body (Ethic Committee code DPS.DLI.01.20), fieldwork started on September and lasted until October 2020. In order to encourage participation, the following communication strategies were implemented:

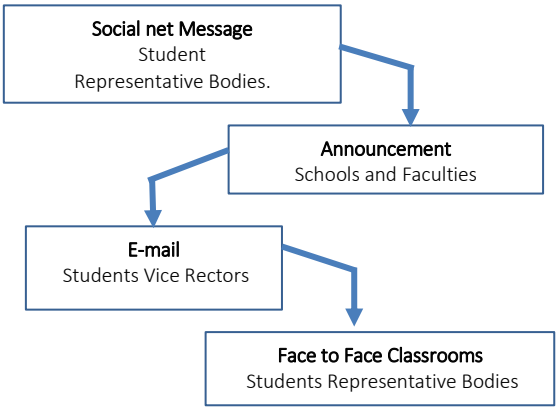

Figure 1. Communication strategies

3.3. Measures

All data were obtained through a single online form: Questionnaire on Equipment and Use of Information Technologies by University Students compounded by 39 items organized in four sections: equipment, connection, experience and attitude, in addition to a section on sociodemographic and academic information. To build the questionnaire we applied a five-

stages methodology: I. Documentation, II. Item bank construction, III. Selection of items / Panel of experts IV. First version, and Piloting and V. Final Version

4. Results

4.1. Equipment

The Valencian university student community, in general, has sufficient equipment to follow e-learning.

- 91.4% of the student body has a laptop for individual use. While 4.3% have a desktop computer as their only equipment.
- 4.3% reported having neither a desktop computer nor a laptop for personal use. This percentage is stable throughout the academic years. As an additional characteristic, six out of ten of these students live in the family home.
- It is estimated that approximately 2,000 Valencian university students (2%) do not have any computer, not even in shared use.

4.2. Internet Connection

In general terms, there are not excessive shortages in terms of the type of Internet connections by the student community.

- Three out of four students have access to broadband. Of those surveyed, 78.8% had fiber optics or ADSL. These results are consistent with those reflected by the Report on Digital Society (National Observatory of Telecommunications and the Information Society, 2019).
- 700 Valencian university students would not have any type of Internet access. 0.7% of the participants cannot afford Internet access. These results are in line with those presented in the report on the Survey on Equipment and Use of Information and Communication Technologies in Households (INE, 2019).
- Eight out of ten students have two or more gigabytes in their mobile data contract. Despite widespread access to mobile data, the availability of broadband means that the use of mobile data at home is low (28%).

4.3 Experience

Digital skills present marked differences mainly in terms of the gender and discipline of knowledge, above all.

- 18.6% of the student community considers that they have a high level of digital competence. The profile of a person with expert or advanced skills is a student in

the final years of a degree in Engineering and Architecture, preferably enrolled at the Universitat Politècnica de València.
- One out of two students rate their digital competence at user level, that in a five level scale corresponds to a medium-low competence.
- University education has a direct relationship with the level of digital skills. As one progresses through the academic year, the basic skills profile decreases, while the medium and high skills profiles increase.
- Men report higher digital competence than women (32.5% vs. 11.8%). It should be remembered that the measure does not reflect actual knowledge or competence, but rather their self-assessment, so it is worth asking whether women are more cautious in this regard.

4.4 Attitudes toward e- learning

Academic level is the main variable to classify the attitudes toward teaching in e-learning modality. First-grade students are significantly less motivated than advanced ones. In figure 2, blue color corresponds to high attitude towards using e-learning to teach, that increases as grades grow. In the higher grades, fourth grade and higher, women show a lower attitude.

Opinions reveal a strong preference for face-to-face teaching, although e-learning advantages are positively valued. This is probably due to the fact that face to face is percibed as major component of presential higher education courses.

- Students value positively the online evaluation. Overall satisfaction with the platforms, the lectures, the evaluation and the faculty is moderately positive, 3 points out of 5.
- The most highly valued advantages of e-learning are the opportunity to organize and save time, and the savings in transportation and accommodation.
- The main disadvantages of e-learning are: it makes it difficult to concentrate, negatively affects performance and sociability. Women and men rate it similarly.

5. Discussion

The aim of this study was to analyze the strengths and weaknesses of Valencian university students, especially new entrants, in relation to the e-learning modality. For this porpuse a sample of +18000 university students was surveyed on equipment, Internet connection, experience and attitudes toward e- learning.

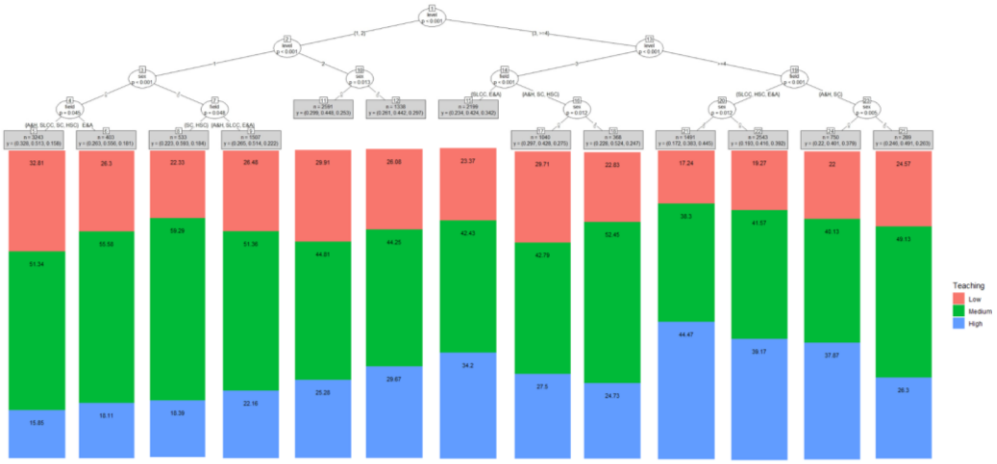

Figure 2. Attitudes toward teaching in e-learning modality.

The results show that practically all university students have sufficient equipment and connection to follow online teaching. It is noteworthy that 2% of the participants have no computer, not even in shared use and 0.7% cannot afford Internet access. What means a lower proportion than the general population. The Survey on Equipment and Use of Information and Communication Technologies in Households found that 3.2% of households do not have Internet connection (INE, 2021).

Regarding attitudes toward teaching in e-learning modality, there is a concern that e-learning difficults to concentrate, and negatively affects performance specially in first grade students. These findings are consistent with previous studies developed during the COVID-19 lockdown where first-year students were significantly less motivated during the learning process than older students (Stevanovic, Božic & Radovic, 2021).

The COVID-19 lockdown boosted the e-learning compulsory modality, and prevented from physical social interactions. This lack of face-to-face social activity could explain the difference in attitudes between lower and higher grades, assuming that first grades students are more interested in attending events such as meetings, classes, or even parties where they can meet their new classmates. This argument is in line with Giannoulas et al. (2021) that refers that e-learning prevents a satisfactory communication between students and students and teachers. However, the results are inconclusive, in that other studies show that there is a significant positive effect of COVID-19 lockdown on students' performance (Gonzalez et al, 2021).

E-learning offers an opportunity for individuals who find it difficult to take part in face-to-face education. Students appreciate the flexibility of e-learning to reconcile work, family and

education. It is the preferred option for older students many professionals who need the continuous training of postgraduate studies to update their knowledge in a constantly evolving market. E-learning has also provided an opportunity for those who live in remote areas and find it costly to attend face-to-face classes. In addition to the cost of tuition and materials, these students have to pay extra for travel, accommodation and living expenses.

References

Andrew, A., Cattan, S., Costa Dias, M., Farquharson, C., Kraftman, L., Krutikova, S.,Phimister, A., Sevilla, A. (2020) Inequalities in Children's Experiences of Home Learning during the COVID-19 Lockdown in England. *Fiscal Studies, 41* (3),653–683

Giannoulas, A., Stampoltzis,A., Kounenou, K. & Kalamatianos, A. (2021). How Greek Students Experienced Online Education during Covid-19 Pandemic, in Order to Adjust to a post-lockdown Period. *The Electronic Journal of e-Learning, 19*(4), pp. 222-232,

Gonzalez, T., de la Rubia, M. A., Hincz, K. P., Comas Comas-Lopez, M., Subirats, L., Fort, S., & Sacha, G. M. (2020). Influence of COVID COVID-19 confinement in students performance in higher education, *PLoS ONE 15* (10), e0239490 . https://doi. 10.1371/journal.pone.0239490

Hanushek y Woessmann, (2020) Education, knowledge capital, and economic growth. In Bradley and Green C. *The Economics of Education, Second Edition.* Elsevier. https://doi.org/10.1016/B978-0-12-815391-8.00014-8

INE. National Statistics Institute (2021). Survey on Equipment and Use of Information and Communication Technologies in Households. Dataset https://www.ine.es/dynt3/inebase/index.htm?padre=8320&capsel=8320

Preeti W., Saloni G. (2020) E-Learning market trends 2020-2026. *Global research report.* Retrieved from https://www.gminsights.com/industry-analysis/elearning-market-size

Stevanovic, A., Božic, R., & Radovic, S. (2021). Higher education students' experiences and opinion about distance learning during the Covid-19 pandemic. *Journal of computer assisted learning, 37*. 1682–1693. DOI: 10.1111/jcal.12613

Wadhwani P., Gankar S. (2021) E-Learning market trends. Global research report. Retrieved from https://www.gminsights.com/industryanalysis/ elearning-market-size

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14411

Ethanol in class and at home: guided inquiry-based learning

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Abstract

Guided inquiry-based learning centered on ethanol - used in the last eleven years in the first year of graduation in chemistry in a course created to stimulate critical thinking and integration in the university world - is presented and described. This ranges from the calculation of concentrations and the estimation of the rates of elimination and energies involved, to more controversial, as women and men characteristics, alcohol and diet paradoxes, societal issues, as binge drinking, and technological issues, as the working of the breathalizer. All these issues are discussed using scientific results and show in practice how science develops and can be used for students' daily life.

Keywords: *first-year graduation; ethanol; chemistry and society; education in chemistry.*

1. Introduction

October and May (last year made with restrictions in some countries and the year 2020 canceled everywhere) have traditional student festivals all over the World. The present material was used in the last eleven years in a first-year course of "Tutorial in Chemistry" of the graduation in chemistry. The classes were also online and blended in recent years. The course "Tutorial em Química" has 6 ECTS (European Credit Transfer System) and was planned to stimulate critical thinking and to integrate students into the university. The students have two types of lessons: (i) theoretical-practice (TP) ones, with two hours a week along the semester with problems and discussion, and (ii) tutorial contact in small groups (typically four) with senior professors. The evaluation is made by mini-tests and oral presentations in the TP and the evaluation of the small groups is chosen by the tutors, ranging from writing and discussing articles to delivering presentations. In October, before the traditional students' festivity ("Latada"), we have a special class dubbed informally as "alcohol class" where these subjects are discussed, namely calculation of concentrations, rates of elimination, how it works the breathalizer, drinking too fast, and social, even controversial issues, related with alcohol. It was used with 217 students since 2011.

In Portugal, and many other countries, the legal age to drink is 18 years, but in some countries, this age can be 21 years. Unfortunately, there are common problems with young people (see, e.g., Engs, 1990; Nyström, Peräsalo & Salaspuro, 1993; Miller & Weafer, 2009). Alcohol can be also a dangerous drug (Nutt, King & Philips, 2010). A larger number of fatalities in traffic are due to alcohol misconduct. Nevertheless, class and take-home discussions involving alcohol consumption (Nutt, King & Philips, 2010; Maio Clinic Staff, 2020) are in this work directed towards critical thinking and social issues that can be tackled using scientific methodologies.

In this paper, we present and describe guided inquiry-based learning (see, e.g. Gaddis & Schoffs et al. 2007) centered on ethanol to several matters, in particular to General Chemistry and Chemistry and Society. Due to the emotional involvement of the subject, this approach is expected to reinforce learning and provide issues that due to their nature originate meaningful knowledge that lasts for life (see, e.g, Chatterjee & Duraiappah, 2020). In the next section, we detail the methods and results and in the final section, we state the main conclusions.

2. Results

The first issue is the calculation of concentrations (see, e.g, O'Conner, 1981). Students are informed (some of them already know) about the alcoholic content of several beverages and asked to calculate the typical mass of ethanol of normal portions. Then, giving the body mass, the average volume of blood, and water content of a human body, the concentration of ethanol

in the blood it is asked to be calculated and compared with tables of intoxication effects. Students are also asked to be critical about the obtained values. Students that calculate the concentration based on the average blood volume are puzzled by the non-familiar result and are led to discover that the volume to use must be the body water content. But, why? The students can find explanations for this mystery and others (DeLorenzo, 2000; Ferriols-Pavico, 2002). They may find other ones as the relations between alcohol and fatigue (Dawson & Reid, 1997; Williamson & Feyer, 2000). Those findings can be legitimate or wrong. Can be myths, can be outside their level of application, are simply bad interpretations, or fake news. Care must be taken, of course, as one of the advantages of this dialogue is to stimulate critical thinking at the same time that matter is learned, not to reinforce wrong or mythical ideas. To reinforce the way Science works is of utmost importance. (see Table 1 for a list of issues and questions discussed).

Table 1. Subjects, problems, and exercises proposed to students.

What is made in class:
Calculation concentrations of alcohol of common drinks
Use alcohol concentration to interpret values in news and daily life
Discuss critically articles and myths about alcohol
Calculate rates of elimination and values of energy
Discuss alcohol in terms of time without driving and diet aspects
Discuss how it works the breathalizer
See in practice how science works
What is referred to in class:
Intramolecular and intermolecular bonds and forces
Ethanol as a combustible and sanitizing agent
Historical, geographic, and interdisciplinary issues related with alcohol

We use real examples, and actual concentration calculations, to discuss the issue of binge drinking and social explanations and myths. It is now clear that the singer Amy Winehouse, unfortunately, died of alcohol misconduct (McLaughlin & Smith-Spark, 2011) and not from a "complex syndrome of alcohol abstinence" as previously disclosed (Parker-Pope, 2011). Based on the news data, students easily estimate the alcohol content and verify the results. This part of the guided inquiry is complemented with a discussion on the care that must be

taken with the news. Critical thinking is needed, plausible explanations must be confirmed with proofs.

Students are also asked to discuss if alcohol consumption can lead to overweight. Some of them already knew thin binge drinkers, others only know some fat drinkers, and they knew the labels (in Portugal we have the value of calories - in fact, kilocalories per gram - and an alert to the pregnant, the analysis of the label can also be made). Back to science, the calories of ethanol (around 7.1 kcal/g) are given for a certain portion. A calculation of this value can be made, and an explanation for alerting pregnant women can also be undertaken (if judge relevant). Alcohol is known to be highly caloric (the problem of feeling hot relating to ethanol being a vasodilator can be postponed) is known as the alcohol intake paradox (Jéquier, 1999) alcohol metabolism paradox (Shorey, 1999), or effect on nutrition paradox (Feinman, 2001; Aguiar, Da-Silva, & Boaventura, 2004). Most of the students see that heavy alcohol consumption can induce metabolic and behavioral changes. This can be more advanced and include the kinetics of drugs in the body (Calder, 1974) and biochemistry, saving lives with alcohol (Scala, 1973) and intoxication treatment (Breedlove, 1982). Of course, science is non-static and we had new treatments (Mégarbane, 2010). This can focus also on medicinal chemistry, the development of new medicines, and the nature of science. A trivial question is about drinking too fast (Ekelson, 1973). The warning appears naturally based on calculations.

Body fat percentage is sometimes considered the solution for the supposed mystery of the feminine part of humanity being more sensitive to ethanol than men (DeLorenzo, 2000; Ferriols-Pavico, 2002). Students are asked to be critical about this explanation. Some refer to the need for controlled studies, most of them pointing to volunteers with similar weights. The supposedly relevant psychological and sociological issues, as gender roles, and others appear naturally at this point. Again students are asked to be critical and scientific, not moral. Gender differences in alcohol consumption have already been studied (see, e.g., Engs, 1990; Nyström, Peräsalo & Salaspuro, 1993; Miller & Weafer, 2009) but the sexual behavior and chemistry can also be discussed, if judged relevant. A review (Jones, 2010) it was proposed the average value of 15 g/kg/h for moderate drinkers and 19 g/kg/h for binge drinkers. Those values can be used to discuss the transformation of variables, how it works in the scientific literature, the review system, what is a meta-analysis, chemical kinetics, and dimensional analyses, depending, of course, on the levels involved. The thermodynamics of drink driving (LaBianca, 1990; Thompson, 1997) are also referred to as average equilibrium constants based on Henry's law. In a more advanced course, critical analysis of statistical data (LaBianca, 1999), as well as analytical chemistry experimental determination of alcohol content (Lokken, 1975) and equipment used in the lab and daily life. Also, it is discussed the healthy effects of moderate drinking compared to the devastating effects of binge drinking

(Stockwell et al. 2016). This calls not to moralistic views but to a critical analysis of the literature and meta-analyses.

Of course, two hours of the class are not enough to touch profoundly most of these issues. The discussion of what originates "tears of wine" (Gugliotti & Silverstein, 2004). Ethanol can also be used for studying and teaching chemical bonding and intra- and intermolecular chemical bonds as usual. The question of 70% versus 96%, for example, may arrive, and this involves a lot of knowledge but in the end, experimental results show that the rates of evaporation are similar. So, why 70% is recommended? The historical and geographical issues can also be explored. In France, for example, alcohol in school was only prohibited only in 1956. Before that, wine is granted to all students at meals. Moreover, it is usual until recently to think of alcohol as a powerful substance. It was provided not also to students but also to workers. The working journey can include an amount of wine (in some countries of beer). How did this change? This is an inquiry that can also be followed depending on the degree of interdisciplinary that can be intended in the project. There are connections to history, geography, and others, it depends on the Country. In Portugal, both guided inquiry and interdisciplinary work are encouraged and taken as normal learning hours. Ethanol as combustible can also be studied and discussed (Pietro, 2009). In fact, after calling attention to a common substance one can teach and discuss most of the subjects scientifically. Most of these subjects are explored in this class.

3. Conclusions

Ethanol can be used in a series of subjects, concentrations calculation, thermodynamics and chemical equilibrium, chemical kinetics, critical thinking, everyday chemistry, observation, and analyses of the literature. It can be used also in interdisciplinary projects involving biology, historical, geographic, and philosophical issues. This molecule and the material based on it is very familiar to the students, and during the inquiry, some ethical issues are raised, creating an emotional discussion and, hopefully, more permanent learning.

Acknowledgments

The Coimbra Chemistry Centre (CQC) is supported by Fundação para Ciência e a Tecnologia (FCT), Portugal, through projects UIDB/00313/2020 and UIDP/00313/2020.

References

Aguiar, A. S., Da-Silva, V. A., & Boaventura, G. T. (2004). Can calories from ethanol contribute to body weight preservation by malnourished rats? *Brazilian J. Med. Biol. Res.*, 37, 841-846. doi: 10.1590/S0100-879X2004000600009.

Breedlove, C. H. (1982). The chemical basis of emergency treatment for the ingestion of toxic alcohols. *J. Chem. Educ.*, 59, 1031. doi: 10.1021/ed059p1031.

Calder, G. V. (1974). The time evolution of drugs in the body: an application of the principles of chemical kinetics. *J. Chem. Educ.*, 51, 19-22. doi: 10.1021/ed051p19.

Chatterjee Singh, N. & Duraiappah, A. K. (Eds.) (2020). *Rethinking learning: a review of social and emotional learning frameworks for education systems*. New Deli: UNESCO MGIEP. Retrieved in January 30, 2022 from https://unesdoc.unesco.org/.

DeLorenzo, R. (2000). Four interesting mysteries with seemingly conflicting explanations. *J. Chem. Educ.*, 77, 475-476. doi: 10.1021/ed077p475.

Dawson, D. & Reid, K. (1997). Fatigue, alcohol and performance impairment. *Nature*, 388, 235. doi: 10.1038/40775.

Engs, R. C., & Hanson, D. J. (1990). Gender differences in drinking patterns and problems among college students: A review of the literature. *J. Alcohol Drug Educ.,* 35, 36-47. handle: 2022/17497.

Eskelson, C. D. (1973). Drinking too fast can cause sudden death. *J. Chem. Educ.*, 50, 365. doi: 10.1021/ed050p365.1.

Feinman, R. D. (2001). Ethanol metabolism and the transition from organic chemistry to biochemistry. *J. Chem. Educ.*, 78, 1215-1220. doi: 10.1021/ed078p1215.

Ferriols-Pavico, J. Ma. (2002). DeLorenzo's four interesting mysteries verified. *J. Chem. Educ.* , 79, 1217-1219. doi: 10.1021/ed079p1217.

Gaddis, B., & Schoffstal. A. M. (2007). Incorporating guided-inquiry learning into the organic chemistry. *J. Chem. Educ.* 84, 848-851. doi: 10.1021/ed084p848.

Gugliotti, M. & Silverstein; T. (2004). Tears of wine. *J. Chem. Educ.*, 81, 67-68. doi: 10.1021/ed081p67.

Jéquier E. (1999). Alcohol intake and body weight: a paradox. *Am. J. Clin. Nutr.*, 173, 69-70. doi: 10.1093/ajcn/69.2.173.

Jones, A. W. (2010). Evidence-based survey of the elimination rates of ethanol from blood with applications in forensic casework. *Forensic Science International*, 200, 1–20. doi: 10.1016/j.forsciint.2010.02.021.

Labianca, D. A. (1990) The chemical basis of the breathalyzer. A critical analysis. *J. Chem. Educ.*, 67, 259-261. doi: 10.1021/ed067p259.

Labianca, D. A. (1999). Uncertainty in the results of breath-alcohol analyses. *J. Chem. Educ.*, 76, 508-510. doi: 10.1021/ed076p508.

Lokken, D. A. (1975). The determination of alcohol content of beer: a general and analytical experiment with high student interest value. *J. Chem. Educ.*, 76, 329. doi: 10.1021/ed052p329.

Mayo Clinic staff (2021). Alcohol use: weighing risks and benefits. Retrieved January 30, 2022 from https://www.mayoclinic.org/healthy-lifestyle/nutrition-and-healthy-eating/in-depth/alcohol/art-20044551.

McLaughlin, E. & Smith-Spark, L., C (2011). *Inquest: Singer Amy Winehouse died of alcohol poisoning*. Cable Network News (CNN). Retrieved in January 30, 2022 from https://edition.cnn.com/2011/10/26/world/europe/uk-winehouse-inquest/index.html.

Mégarbane, B. (2010). Treatment of patients with ethylene glycol or methanol poisoning: focus on fomepizole. *Open Access Emergency Medicine*, 2, 67–75. doi: 10.2147/OAEM.S5346.

Miller, M. A., Weafer, J., & Fillmore, M. T. (2009). Gender differences in alcohol impairment of Simulated driving performance and driving skills. *Alcohol Alcohol. 44, 586-593*. doi: 110.1093/alcalc/agp051.

Nyström, M., Peräsalo, J., & Salaspuro, M. (1993). Alcohol-use patterns in young university students in Finland. *Scandinavian Journal of Primary Health Care, 11, 151-156*. doi: 10.3109/02813439308994919.

Nutt, D. J., King, L. A., & Philips, L. D. (2010). Drug harms in the UK: a multicriteria decision. *The Lancet*, 376, 1558-1565. doi: 10.1016/S0140-6736(10)61462-6.

O'Connor, R. (1981). Bad booze. *J. Chem. Educ.*, 58, 502. doi: 10.1021/ed058p502.

Parker-Pope, T. (2011). *Amy Winehouse and the perils of alcohol withdrawal*. Retrieved in January 30, 2022 from https://well.blogs.nytimes.com/2011/08/03/amy-winehouse-and-the-perils-of-alcohol-withdrawal/.

Pietro, W. J. (2009). Ethanol as an alternative fuel for the automobiles: using the First Law of thermodynamics to calculate the "corn-area-per-car" ratio. *J. Chem. Educ.*, 86, 579-581. doi: 10.1021/ed086p579.

Scala, A. A. (1973). Saving a life with alcohol. *J. Chem. Educ.*, 50, 365. doi: 10.1021/ed050p365.2.

Shorey, R. L. (1979). Effects of ethanol on nutrition. *J. Chem. Educ.*, 56, 532-534. doi: 10.1021/ed056p532.

Stockwell, T., Zhao, J., Panwar, S., Roemer, A., Naimi, T., Chikritzhs, T. (2016). Do "Moderate" Drinkers Have Reduced Mortality Risk? A Systematic Review and Meta-Analysis of Alcohol Consumption and All-Cause Mortality. *J. Stud. Alcohol Drugs*, 77, 185-98. doi: 10.15288/jsad.2016.77.185.

Thompson, R. Q. (1997). The Thermodynamics of drunk driving. *J. Chem. Educ.*, 74, 532-536. doi: 10.1021/ed074p532.

Williamson, A. M. & Feyer, A.-M. (2000). Moderate sleep deprivation produces impairments in cognitive and motor performance equivalent to legally prescribed levels of alcohol intoxication. *Ocup. Environ. Med.*, 57, 649-655. doi: 10.1136/oem.57.10.649.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14583

Teaching Data-Enabled Design: Student-led Data Collection in Design Education

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Abstract

As design practice becomes increasingly connected, designers are increasingly engaging with data practices in their day-to-day work. To facilitate this practice, design education needs to embrace data design. In this paper, we introduce a Master-level elective course around the Data-enabled Design methodology. This challenge-based learning activity aims to teach how to use data as a creative material while addressing real-life design challenges from selected industrial partners. In this article, we demonstrate how our master students learn how to prototype, conduct data-enabled interviews, adapt their prototypes, and introduce design interventions via a multi-step approach, leveraging their growing knowledge and skills around contextual data. We share how we use a strong collaboration with our industrial partners and a predefined data infrastructure to help our students use data for sharing valid research findings and presenting experiential interventions.

Keywords: *Data-enabled design; design education; design thinking; data design.*

1. Introduction

Design practice is continuously changing as new technology is being developed and societal challenges change. A design curriculum evolves with emerging technology and needs to address and invoke impact in society. As teachers in design-related education, this means that we create engaging learning activities that fit the open-ended nature of current societal needs and curriculuar learning objectives. Recent trends around big data, smart homes and artificial intelligence have opened up completely new design spaces and design challenges, such as human-AI collaboration, trust between humans and AI and the quantified self movement. Existing approaches to designing with data reach from data-driven design, to data-informed design (King et al, 2017) and data-enabled design (van Kollenburg and Bogers, 2019). To introduce students to Data-enabled Design (DED), the first edition of the DED course was set up in 2019. Currently, three editions of the course have taken place with a total of 91 students spread over three years. In this paper, we wish to share insights into the educational challenge of creating a course where fast-paced, open-ended, student-led data collection can result in valid research findings and experiential interventions. We introduce the course setup and the learning outcomes and analyse student work. Finally, we reflect on educational insights and possible improvements for the course and data design education more generally.

1.1. Data-enabled Design

Data-enabled Design (van Kollenburg and Bogers, 2019) describes a situated design practice aimed at using data as a creative material for designing intelligent ecosystems. Intelligent ecosystems are a dynamic composition of interrelated products, services and people. By collecting data and using artificial intelligence, these systems learn to understand their users and to adapt to them based on their interactions. The term DED describes a design process that consists of a research-oriented contextual step and a design-oriented informed step. The *research-oriented contextual step* draws from modern ethnographic practices and is meant to gain an understanding of the everyday context. In this step, design researchers engage participants to gain contextual insights into the relevant design space. Through building and distributing design probes, objective and subjective data are collected. The design team then uses this data to conduct *data-enabled interviews.* The contextual step typically lasts 3-4 weeks and involves 6-8 participants. Afterwards, using the collected data for the *design-oriented informed step* allows design teams to introduce *interventions* into participants' contexts. This step can be conducted with the same participants as the contextual step, but often a new group of participants is recruited in order to test the assumptions from the contextual step against a fresh pool of participants and their contexts. The informed step is more reactive, not only gathering data but also providing real-time feedback on the data. This step typically lasts 3-4 weeks and involves 10-12 participants. In recent work, we have also explored how to scale up and expand DED for other contexts (Noortman et al, 2022).

1.2. Department of Industrial Design at Eindhoven University of Technology

The educational program at Industrial Design at Eindhoven University of Technology (TU/e) has a strong challenge-based learning character (Johnson et al, 2009), as we strive to create societal relevance for the students' projects and courses from the first year onwards. The focus of the department is on designing and creating intelligent systems, products and related services. Students are educated to actively reflect on their work, as well as their vision on design (Hummels and Frens, 2009). This means that the curriculum is very dynamic and adapts quickly to new societal and technological trends. The students often work with emerging technology and adopt new methodologies and techniques. In response to this continuous innovation, new courses are often set up and courses are rarely taught in the exact same way in consecutive years. To fit into the growing need for designers who fluently engage with data (Lovei et al, 2019), we created a course where students collect, analyse and use data as a creative material for the design process.

2. Data-enabled Design course

In the course, students follow a shortened version of the DED process compared to the drawn-out version that is applied in design practice and industry. In line with challenge-based learning, the course uses examples from design practice as real-life use cases for the students to engage with the methodology. Additionally, the course has a strong focus on collaboration with stakeholders from industry that are active in the development and the application of the methodology (specifically Philips Experience Design and to a lesser extent Novo Nordisk). These partners participated by formulating the design challenges, and by giving guest lectures.

The uniqueness of this course in the program is the engagement with participants early on in the course. The students select one of the challenges provided by the industrial partners, create a prototype for a design probe and deploy it in a participant's context *(research-oriented contextual step)*. This data collection is student-led and open-ended. Students appreciate the high speed and the tools provided to them, including the pre-defined data infrastructure. Throughout the course, students use collected data and conduct data-enabled interviews with participants. They use these findings to select new participants and deploy redesigned prototypes in their context *(design-oriented informed step)*. In the final session of the course, students reflect on their process and present their achievements to the teaching team and industrial partners.

2.1. Course content

The aim of the DED course is to teach students about the role of data in a design process, and how data can be used as a creative material. The content of the course can be divided into

three main topics: designing and prototyping context-specific data trackers, data collection and analysis, and designing a contextual intervention that makes creative use of data. Students receive various tools to help them throughout the course, including a prototyping toolkit with microcontrollers and sensors, access to the OOCSI connectivity middleware (Funk, 2019) and access to a research data management platform to store sensor data and host datasets for analysis.

During the course, we emphasize the need for detailed information about the type of data being collected and gaining informed consent from study participants prior to data collection. Later lectures cover how to analyse the data, with a special focus on how to use the quantitative data as input for the so-called *data-enabled interviews*. By discussing data visualisations with participants in these interviews, students are encouraged to find the deeper qualitative explanation of the quantitative data.

One of the core elements of the DED methodology is to remotely adapt prototypes while they are situated in the target context. This way, the prototyped data collectors can respond to the collected data in real time and allow student teams to carefully craft and deploy interventions. This is a means to try out more and more dynamic design iterations compared to a traditional design process. The informed step means that students are challenged to come up with design interventions that offer a creative response to the findings from the contextual step–using collected data as a creative material in their open-ended design process.

2.2. Course set-up

The DED course is an elective course in the Industrial Design Master program that is open to students from across the TU/e. The course is aimed at teaching knowledge, skills and attitude related to the DED methodology, which is more widely used within Philips Experience Design. The course is hands-on: students follow theoretical lectures alongside a design research group project. Like most Industrial Design elective courses, the course introduces new theory such that the students learn new methods to apply in their semester-long design projects.

There are no prerequisites to register for the course. Nevertheless, students are expected to have prior knowledge of general design research methodology and to be familiar with basic technology prototyping. Students are deliberately mixed in teams to support a broad variety of personal learning goals and styles in the group assignments.

In total, 91 students participated in the course in 2018/2019 (22 students), in 2019/2020 (23 students) and in 2020/2021 (46 students). Slightly different design cases were covered in the different editions of the course. The first two years, the design case was centered around air quality. The third edition offered three different design cases: sugar (focused on diabetes), home environment and mood (mental health).

3. Course outcomes

Due to the open-ended nature of the course, the outcomes are versatile. Students in the course and Master program are encouraged to direct their own development, and thus also encouraged to explore the parts of the DED methodology that fit most naturally with their vision on design and the designers that they want to become. In grading the course, we do not compare outcomes between teams and instead focus on a team's ability to creatively use the collected data for presenting research findings, and to consistently design a final intervention that meaningfully uses data. To discuss the merits of our chosen approach to design education, we present the students' course deliverables and analyse how different teams engaged with data in their projects. We aim to identify how the learning experiences in the course shape the outcomes. Figure 1 shows four representative projects, which is a selection out of a total of 25 projects.

"The Knot": Abstract data visualization for co-responsibility of diabetes patients and their social support system

"Air quality dashboard": combining self-reported productivity and air quality in the working-from-home domain

"Not the FBI": A home notification system that communicates about air quality through smart lights

"Bon Voyage": A toolkit for ludic engagement with indoor climate data

Figure 1. Examples of student outcomes in the course

Overall, we see some general themes in the types of projects that students pursue. The largest group of teams (9 projects) focused on data visualization and physicalization, like *The Knot*, where the design challenge is seen as one where data is physically brought into a space to encourage reflection by its users. The main aim of these projects is commonly described as *'raising awareness'* (T18-01, T19-01, T19-05, T19-07, T20-03, T20-04). These projects are product-focused and generally aim to solve contextual issues that the teams identified based on the collected data during the contextual step.

Another large group of teams (7 projects) focused more specifically on facilitating end-user awareness and insights into data, and managing processes associated with that data, such as the *Air quality dashboard*. These projects typically resemble a dashboard and provide users with graphs and numbers, as well as suggestions on actions they might take. In some cases, data that was interpreted as unwanted behavior would result in a detracting intervention (T18-07, T20-07). Generally, these dashboard designs made it easy to *'continuously [develop the solution] further, while it remained in the everyday setting of the participants'* (T18-03).

These projects were system-focussed, and clearly aimed at sense-making, reflection and analysis of collected data.

There were a few projects (4 projects) that took a similar approach to the dashboard teams, but provided an additional layer through contextual automation. After an initial learning phase, their prototypes would provide a practical implementation into everyday routines such as automatically opening windows when the air quality is low (T18-05) or seamlessly embedding notifications about air quality into the home through smart lights (T20-06, *Not the FBI*). What set these projects apart from the previous category are the first steps towards intelligence in the ecosystem, where one element responds to another autonomously and without user intervention.

There were a few teams (3 projects) that took the data they collected in the initial phases as input for new data processes, e.g. to *'promote exploration and help create new connections'* (T19-02, *Bon Voyage*) or to *'[create] conscious awareness of mood over a long period of time through self-reflection'* (T20-09). In these cases, the resulting design would encourage users to engage with data in new ways, and invite researchers to look at contextual data from new perspectives. These designs were more creative explorations of data, with a stronger focus on qualitative data and interpretation, and the teams were research-focussed, ready to push the boundaries of data collection and to use that data creatively.

Finally, there were two teams with an entirely different approach to data. These teams organized focus groups to collect extra data (T20-08) or mainly used the data to improve the data collection process, rather than use it to come to design solutions (T20-10).

4. Discussion

Over the past three editions of the course, we have been impressed by students' achievements. We set out to design a course that helps students to iteratively and creatively engage with collected data in an open-ended, challenge-based design process. We provided a data infrastructure and close collaboration with industry to breach the gap between design education and design practice. At the same time, we took advantage of the flexible course structure to experiment with new technology, introduce diverse design challenges and emphasize different aspects of Data-enabled Design.

4.1. The role of data in the course

Data-enabled design places data at the core of the design process; consequently, learning about data collection and data analysis have a prominent role in the course. The main learning goal is to make sense of data and use it creatively in design, without letting go of design intention and intuition. Students are quickly able to collect and engage with data collected from participants' contexts using the tools provided. They are able to present research

insights based on data visualizations, descriptive statistics and data-enabled interviews. However, moving into hands-on design work towards meaningful contextual design interventions remained a challenge for most of the teams. The teams that were more successful in this regard were those with a balanced distribution of technical and design backgrounds. In the first edition of the course we saw the methodology stay close to its application in industry. In the second and third editions we saw students lean more towards abstract data visualization as a result of an emphasis in the lectures on finding the stories *behind* the data. This approach also opens up the need for a new perspective to the methodology, with more creative exploration of the role of data for design practice.

4.2. Open-ended design cases

The design cases are deliberately kept open to allow students to "follow the data" and adapt to the unfolding challenge rather than a rigid design brief. The open setup was intended to allow for creativity and open interpretation of the data and design context, and consequently, we saw the last two editions strongly lean into topics around the pandemic and working from home. While the shifts in design direction were promising, they were often not congruent with collected data and derived insights. Students would often short-cut promising lines of data-led exploration by following their intuitive assumptions about a familiar context. And the crucial fork in the path only became apparent later when a course correction was no longer possible. Designing in open-endedness needs different educational interventions, often counter-intuitive to growing designers, who strive to converge fast and reduce uncertainty. A second critical aspect of open-ended design education in this course is the overlap between the different design challenges that we offered. Designing in this overlap invites for convergence across cases, mistaking the collected data and insights as similar and indicative of similar phenomena. This warrants more investigation, and preparing cases that are further apart, contributed by more diverse industrial partners.

4.3. Evolution of DED education

Moving forward, we see DED develop into two more specific strands, where one stays close to its current use in industry (focused on ecosystem design), and the other is more focused on the design research outcomes and innovating data collection practices (focused on design probes). Besides teaching the students how to apply the DED methodology, the course also serves as a venue for us as researchers to better understand and further refine and explore the methodology, especially outside of organisations with elaborate resources and infrastructure, such as our industrial partners. Taking the methodology outside of the industrial context allows for deeper exploration of the research possibilities with the methodology. A second aspect of evolving DED education is related to the support infrastructure that we provide, mainly connectivity and data collection technology, technical examples, blueprints, assembled kits and video lectures. Over the course sequence of three years, we have observed

that a good data infrastructure setup is as essential in the educational format as it is in industry. Especially the contextual step requires a fast pace, leaving mere days between kick-off and the first deployment of a working data collector in a target context. This is not something that we can expect students to develop in an entirely self-directed manner. This led to the development of a toolset for students to be used. By creating a stronger overlap between the design challenges and the provided creative technologies, the first encounter that the students have with "their" data is meaningful and naturally leads into the informed step with more intensive design action.

5. Conclusion

In this paper we have presented and reflected on three editions of the Data-enabled Design course. We set out to educate designer Master students on how to creatively use data in a structured process. More than 90 students so far went through their own Data-enabled Design process. We have seen different trends in the student projects, which we use to reflect on the further development of the methodology and the course. Going forward, we see opportunities to further refine the course by introducing more diverse design challenges, and providing a solid infrastructure that allows for even more meaningful interaction and design with data.

References

Bogers, S., Frens, J., Van Kollenburg, J., Deckers, E., & Hummels, C. (2016, June). *Connected baby bottle: A design case study towards a framework for data-enabled design.* In Proceedings of the 2016 ACM DIS conference (pp. 301-311).

Funk, M. (2019, May). OOCSI. Zenodo. http://doi.org/10.5281/zenodo.1321220

Hummels, C. & Frens, J. The reflective transformative design process. *Proc 27th Int Conf Ext Abstr Hum Factors Comput Syst - Chi Ea '09* 2655–2658 (2009)

Johnson, L. F., Smith, R. S., Smythe, J. T., & Varon, R. K. (2009). Challenge-*based learning: An approach for our time* (pp. 1-38). The new Media consortium.

King, R., Churchill, E. F. & Tan, C. (2017). *Designing with Data*. O'Reilly Media.

Van Kollenburg, J., & Bogers, S. J. A. (2019). *Data-enabled design: a situated design approach that uses data as creative material when designing for intelligent ecosystems.*

Lovei, P., Deckers, E., Funk, M., & Wensveen, S. (2020, July). *The Marios and Luigis of Design: Design Plumbers Wanted!*. In Companion Publication of the 2020 ACM Designing Interactive Systems Conference (pp. 197-201).

Noortman, R., Lovei, P., Funk, M. (2022). *Breaking up Data-Enabled Design: Expanding and Scaling up for the Clinical Context.* AI EDAM (in print).

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14619

Do Active Learning Classrooms make for Active Teaching?

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Abstract

This paper presents preliminary results from a research project at the University of Groningen where recently various Active Learning Classrooms (ALC) were created. It answers the research question "How do university teachers experience teaching in an Active Learning Classroom?". In total, 14 teachers participated in a survey which was conducted before and after their courses in an ALC. Results show that, in line with their expectations, teachers experienced their courses in ALC to be more active. It seems that the ALC indeed stimulated teachers to implement more active learning activities in their course, although teachers indicate they have not yet fully utilized the ALC. Therefore, we conclude it would be worthwhile to provide continuous didactic and technological support to teachers when adopting ALC in universities.

Keywords: *Active Learning; Active Teaching; Active Learning Classrooms.*

1. Introduction

In recent years, academic education has undergone a transition from traditional, teacher-focused education to innovative, student-focused forms of education such as active, collaborative and engaged learning. This development is based on new insights on learning processes and student learning success, which show that active involvement of students in the subject matter and learning in groups leads to better learning results and to processing the subject matter at a higher cognitive level than traditional education focused on reproduction (Finkelstein et al., 2016; Lasry et al., 2014; Talbert & Mor-Avi, 2019).

However, most classrooms are still designed for traditional education, where the teacher gives lectures by standing and speaking in front of the group, and the students sit in rows and listen. All resources available mainly serve to support the explanation by the teacher and thus the transfer of knowledge from teacher to student, rather than supporting active involvement of students in their learning process (Brooks, 2011). To facilitate the more student-focused forms of education, universities are investing in adapting existing and designing new learning spaces that enable active learning, so-called *Active Learning Classrooms* (Brooks, 2011; Lasry et al., 2014; Finkelstein et al., 2016). Active Learning Classrooms (ALC) are often characterized by a design and layout that encourages student participation and collaboration between students (Beery et al., 2013). The main characteristics of ALC are flexible positions of the teacher (in front, between, or behind the students), modular furniture (that facilitates different configurations and thus interactions, e.g. eye contact), online and offline possibilities to collect, present or exchange information in different ways such as digital screens and whiteboards (Finkelstein et al., 2016).

Although much research still needs to be done on the effectiveness and important characteristics of ALC, it is clear that the space in itself is not sufficient to activate students in their learning process: crucial in this regard are for example activating teaching strategies in which the teacher makes optimal use of the affordances of the space, prior experiences with teaching in such a space, and thorough course preparations (Beery et al., 2013; Thomas et al., 2018; Metzger & Langley, 2020; Lasry et al. 2014; Talbert & Mor-Avi, 2019). The relationship between active teaching and ALC is currently being investigated at the University of Groningen (The Netherlands) where recently various ALCs have been created. As a first step in better understanding this relationship, we try to answer the question "*How do university teachers experience teaching in an Active Learning Classroom?*". Their expectations and experiences are themed by their preparations, teaching strategies, assessment and room configurations of the ALC.

2. Method

2.1. Participants

During the 2020-2021 academic year, a total of 19 teachers who taught or were going to teach in the newly designed ALC were approached to participate in the study. Of those teachers, five dropped out for various reasons. A total of 14 teachers participated in the survey, 10 of which completed both the pre- and post-test. Two teachers only completed the pre-measurement and two teachers only completed the post-measurement. On average, they had 12 years of experience as a teacher ($M = 12.36$, $SD = 9.6$). One teacher had prior experience with teaching in an ALC and 10 teachers had some experience with different forms of active learning in academic education. The teachers were affiliated with five of the total of 11 faculties within the University of Groningen: Faculty of Arts, Faculty of Behavioral and Social Sciences, Faculty of Economics and Business, Faculty of Science and Engineering, Faculty of Spatial Sciences.

2.2. Instrument

In order to evaluate the experiences of the teachers with the ALC, a questionnaire was developed around central themes from scientific literature (Haines & Maurice-Takerei, 2019; Lasry et al., 2014; Kim et al., 2018; Hernández-de-Menéndez et al., 2019; Wright et al., 2019). These themes were "Preparations", "Teaching Strategies/Methods/Activities", "Assessment" and "Configurations/Technology". Some examples of the questions within these themes are presented in the *Results* section. The complete questionnaire can be shared upon request. Two versions of the questionnaire were developed for the pre- and post-measurement, respectively consisting of 20 and 13 questions (omitting the questions regarding general information in the latter). The pre-measurement focused on intentions and expectations about teaching in the ALC, the post-measurement focused on a reflection on the manifestation of those expectations. Both versions mainly consisted of open-ended questions.

2.3. Procedure

About a week before the start of each study period (four per academic year), teachers who would use the ALC that period were approached by email inviting them to fill in the pre-measurement of the questionnaire. About two weeks after completing each period, the same teachers were asked to complete the post-measurement. This happened for three of the four periods of the academic year 2020-2021. Due to practical matters, the teachers in the first period were only asked afterwards about their experiences. The questionnaires were distributed via Google Forms. It took approximately 25 minutes to complete each measurement.

2.4. Analysis

The responses to the open-ended questions were qualitatively analyzed by identifying emerging categories (e.g. hybrid teaching, technical facilities, obstacles), and subsequently structure the responses according to these categories to compare experiences of the participants. To enhance interrater reliability, the coding process was done independently by two researchers. Results are presented within the themes 'preparations', 'teaching strategies', 'assessment' and 'configurations of the ALC', in line with the structure of the questionnaire. We used quotes to illustrate the response of teachers.

3. Results

Twelve teachers were questioned about their preparations (pre-test) and experiences (post-test) with teaching in the ALC at the University of Groningen. Six of the twelve teachers made use of several ALC at the same time and close to each other, the other teachers used only one room. The rooms were all characterized by modular furniture, multiple whiteboards and varying technical facilities which could easily facilitate hybrid teaching. The extent of flexibility in configurations and technology did however differ between the rooms. The number of meetings per week within the ALC varied from one meeting of two hours per week to several full days spread over the period. The number of students present fluctuated between 16 and 32 students per meeting. Partly due to COVID-19 measures, almost all courses were given in hybrid form.

3.1. Preperations

At the pre-measurement, teachers were asked about their former experiences with active learning, and preparations for teaching within the ALC. All participating teachers were already experienced in making their courses more activating. Four out of twelve teachers mentioned that they were supported by an educationalist to adapt their course in alignment with the possibilities of the ALC. Teachers also mentioned that the focus was mainly on *discovering* possibilities within ALC: "*I had meetings with educational support to get a feel for all Active Learning Classrooms. We also had a practice session to try out practical aspects.*"

Sometimes more active forms of education were discussed in relation to the course design. One teacher answered the question "*Which teaching methods and activities are you planning on using?*" with "*I implement more project-based group work with mandatory preparation*". Other teachers mention that they made their course 'up-to-date', with some teachers indicating that they have adapted the course to the affordances of the ALC. An explicit link between the course design and the affordances of the ALC in terms of pedagogy and didactics was less mentioned, although two teachers used the ALC to facilitate "*Team Based Learning"*.

More specifically, the technical facilities of the ALC were mentioned by almost all teachers as a major affordance and central theme in their preparations. This was enforced by the introduction of COVID-19 measures by the university, which limited the maximum number of students in all classrooms. As a result, these measures created a need for hybrid education where some of the students were physically present in the ALC, while others participated online during the meetings. The technical facilities of the ALC allowed about half of the teachers to optimize this hybrid education: "*We use the ALC as a hybrid workshop, in which students can move around, work in subgroups and share (online) material in a context where offline and online students work together*".

In retrospect, as mentioned within the post-measurement, teachers consider their preparations to be sufficient. On a scale of 1 (inadequate) to 5 (adequate), the teachers scored an average of 4.1 on the questions "*To what extent were your preparations for education in the ALC sufficient?*". Three teachers scored a 3. They said the technology sometimes had startup problems. Also, they indicated they would have liked a little more educational support on a didactical level: "*I expected a little more support for my bachelor's lecture series with the new teaching methods that I wanted to develop*". Furthermore, some teachers stated that they used fewer affordances of the room than planned: "*I used Team Based Learning, which went well, but we did not use all the intended facilities* [of the ALC]" (e.g. the computer screens present).

3.2. Teaching Strategies

When asked about intended teaching strategies to activate students within the ALC ("*Which teaching methods and activities are you planning on using? Consider, for example, different teaching styles, methods, pedagogies and didactics, goals or activities.*"), teachers mainly mentioned activities to stimulate active learning among students, such as: discussion, Perusall [an online collaborative annotation program], presentations, or team-based learning sessions. Teachers indicated that the ALC facilitates these activities. Furthermore, about half of all teachers say "group work with coaching support from the teacher" is the core of their teaching activities, in which the teachers use a combination of teacher- and student-centered strategies. One teacher concretized this finding as follows: "*I use a mix of short lectures combined with students working in groups on exercises and projects using e.g. whiteboards, assignments due every week, and a final project - again in groups.*". All 12 teachers who filled in the pre-test indicated using a combination of several activities, aimed at a more active role for students during the meeting in the ALC.

According to all teachers, the activities mentioned stimulate at least some degree of active learning. Many of the intended activities consist of activating students, reflected in learning activities such as collaborative thinking, discussion, reflection or group assignments. This allows students to become more actively engaged with the course content. Not only during

meetings, but also before and afterwards: "*In principle the course is more active due to mandatory preparation, working in groups during and outside contact hours, and the weekly assignments*".

In retrospect, 11 of the 12 teachers confirm that the course as taught in the ALC indeed stimulated active learning among students: "*Indeed! The student evaluations also showed that students especially appreciated the more active parts of the course.*". Another teacher states the benefits from physical attendance in an ALC compared to online participation. "*As a teacher, it was satisfying to see that the Active Learning Classroom stimulated the learning process. The students taking the course online through Gathertown* [an online simulation program for physical classrooms] *seemed much less active.*" Another teacher mentions student engagement: *"As far as I can tell, students become more involved within the ALC, compared to only online teaching"*.

3.3. Assessment

Both formative and summative forms of assessment were mentioned when teachers were asked about the type of assessments used in their course ("*To what extent did you use the intended forms of assessment and/or testing?*"). The range was diverse: from online assessment via Blackboard [virtual learning environment and learning management system] used summatively, to weekly assignments with feedback and coaching during the meetings on site. The ALC particularly contributed to formative assessment for six of the twelve teachers who completed the post-test (*"during the tutorials in the Active Learning Room, students present a business case in groups, after which the summative test takes place in Blackboard"* and *"The ALC and its facilities foster more effective and efficient teamwork and inter-group discussions [which will be graded]"*), although they did not explicitly made this connection themselves. The other teachers mention that the ALC had no function in the assessment of the course.

3.4. Configurations of the ALC

Teachers who taught solely on-campus in the ALC mention the ability to switch between different configurations of the room as a major advantage in using the ALC, which was mentioned during the preparations as well as afterwards: "*I use the whiteboards, move tables and chairs A LOT during my meetings to facilitate different setups and exchanges. I also use the Polycam* [webcam for hybrid education]. *In addition, I ask physically present students to log in to Blackboard Collaborate via one of the screens present in order to work with online students in a break-out room*". Another teacher states: "*I am moving furniture to engage students in different setups"*. Teachers use the different configurations in accordance with their (intended) teaching strategies. There do seem to be differences between classrooms

when it comes to flexibility. One room in particular (the most advanced and well equipped ALC) offered many possibilities for quickly switching between room configurations.

In retrospect, teachers are positive about the use of the ALC. Start-up issues were mainly technical challenges arising from having to switch to hybrid education. In addition, the COVID-19 measures had a restrictive effect on education. Nevertheless, the intended use of different configurations of the ALC had been carried out according to plan: "*We used the ALC as intended. Furthermore, the students used the big screens/computers and whiteboards in the ALC even more than we expected"*. Although afterwards some teachers would have liked to make even more use of the technical facilities of the room. In addition, one teacher mentioned that they would have been able to switch between room configurations even faster if floor plans of different setups were available.

4. Discussion

This study presents a preliminary analysis of teacher experiences with the new ALC at the University of Groningen. The focus of this study is on how teachers prepare themselves and their course for teaching in an ALC, what their expectations were with teaching in such a space and to what extent those were met. With this study we aim to answer the question "*How do university teachers experience teaching in an Active Learning Classroom?"*

In line with their expectations, teachers experienced their courses to be more active when scheduled in an ALC, for example through the activities they chose to implement during their classes. Teachers indicate they felt that students showed more active learning in the ALC. Not only were the intentions of teachers focused on engaging students more actively with course content during meetings, the ALC also seems to trigger teachers to implement more active learning activities in their course design. This seems to be in line with findings from Talbert and Mor-Avi (2019) and Lasry et al. (2014), who all state that practices and beliefs from teachers are related to the positive effects of ALC. However, the analysis reveals that the courses included in this study already seemed to be somehow characterized by active forms of teaching and learning. Partly for this reason, the course designs of some teachers 'only' seem to have been adapted to the possibilities and facilities offered by the ALC. Also, due to COVID-19 measures, there was a strong focus on preparing hybrid education which probably influenced the experiences of teachers. Teachers indicate they have not fully utilized the possibilities of the ALC.

One interesting result is that most teachers did not yet consciously use the ALC for assessment purposes, whilst formative assessment plays a central role in active learning (Hernández-de-Menéndez et al., 2019). The relation between ALC and assessment deserves more attention in scientific literature and should be addressed in further research. Furthermore, teachers did experience differences between the various ALC at the University

of Groningen suggesting that the physical properties of the space can indeed influence the activity level in teaching and learning, opting for plenty of affordances through technology and furniture (Metzger, & Langley, 2020). Combined with the expressed desire of teachers to fully utilize the possibilities of ALC in their course, it seems worthwhile to provide continuous didactic and technological support to teachers when adopting ALC in universities.

References

Beery, T. A., Shell, D., Gillespie, G., & Werdman, E. (2013). *The impact of learning space on teaching behaviors. Nurse Education in Practice, 13*(5), 382-387. doi:10.1016/j.nepr.2012.11.001

Brooks, D. C. (2011). Space matters: The impact of formal learning environments on student learning. *British Journal of Educational Technology, 42*(5), 719-726. doi:10.1111/j.1467-8535.2010.01098.x

Finkelstein, A., Ferris, J., Weston, C., & Winer, L. (2016). Research-Informed Principles for (Re)designing Teaching and Learning Spaces. *Journal of Learning Spaces, 5*(1), 26-40.

Haines, K., & Maurice-Takerei, L. (2019). The Impact of New Collaborative Learning Spaces on Tertiary Teacher Practice. *Journal of Learning Spaces, 8*(2), 12-24.

Hernández-de-Menéndez, M., Vallejo Guevara, A., Tudón Martínez, J. C., Hernández Alcántara, D., & Morales-Menendez, R. (2019). Active learning in engineering education. A review of fundamentals, best practices and experiences. *International Journal on Interactive Design and Manufacturing, 13*(3), 909-922. doi:10.1007/s12008-019-00557-8

Kim, A. M., Speed, C. J., & Macaulay, J. O. (2018). Barriers and strategies: Implementing active learning in biomedical science lectures. *Biochemistry and Molecular Biology Education, 47*(1), 29-40. doi:10.1002/bmb.21190

Lasry, N., Charles, E., & Whittaker, C. (2014). When teacher-centered instructors are assigned to student-centered classrooms. *Physical Review Special Topics - Physics Education Research, 10*(1), 1-9. doi:10.1103/PhysRevSTPER.10.010116

Metzger, K. J., & Langley, D. (2020). The room itself is not enough: Student engagement in active learning classrooms. *College Teaching, 68*(3), 150-160. doi:10.1080/87567555.2020.1768357

Talbert, R., & Mor-Avi, A. (2019). A space for learning: An analysis of research on active learning spaces. *Heliyon, 5*(12), 1-19. doi.org/10.1016/j.heliyon.2019.e02967

Thomas, C. L., Pavlechko, G. M., & Cassady, J. C. (2018). An examination of the mediating role of learning space design on the relation between instructor effectiveness and student engagement. *Learning Environments Research, 22*(1), 117-131. doi:10.1007/s10984-018-9270-4

Wright, M. C., Bergom, I., & Bartholomew, T. (2019). Decreased class size, increased active learning? Intended and enacted teaching strategies in smaller classes. *Active Learning in Higher Education, 20*(1), 51-62. doi:10.1177/1469787417735607

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14612

Increasing engagement and student participation in Higher Education: insights from the University of Pisa during COVID-19

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Abstract

The emergency distance learning methods adopted to face the pandemic are connected to some inherent problems which concern the lack of social aspects, interactions, and motivation. These and other frequent issues threaten to stop the opportunities offered by the widespread use of educational technology. This paper examines how the Higher Education Institutions adapted to the evolution of the pandemic, compared to relevant insights from University of Pisa gathered during the academic year 2020/21.

Focusing on the communicative and socio-emotional aspects of the didactic event, we propose engagement tools – real-time interaction applications designed to increase active learning and motivation – as a feasible solution that might tackle some of the emerged teaching-learning issues. In this context, it appears that the potential of these versatile and easy-to-apply tools has not been fully exploited. Specific teacher training actions are therefore suggested.

Keywords: *Covid-19; educational technology; engagement tools; higher education, teaching-learning process.*

1. Introduction

Since the COVID-19 pandemic spread worldwide starting in late 2019, most Higher Education Institutions (HEIs) have faced serious challenges related to the sudden shift to distance learning. So far, many empirical data and feedback have been collected, analysed, and published to assess the extent of this radical change. Consequently, new methods and practices have been proposed aiming to overcome current problems and enhance the HEIs' responsiveness. In this paper we review and suggest solutions to some of the critical issues expressed by teachers and students from the University of Pisa (UNIPI) during the academic year 2020/2021. We aim to shed some light upon the evolving situation through a brief review on the state of the art of existing literature and comparing it to the recent results gathered at our university thanks to an online questionnaire. Several studies (e.g., Cesco et al., 2021) highlight a need for a more structured approach to organisational strategies and for plans to improve the future of digital education. At this stage – after year one of the pandemic – we are interested in finding out what practices have been put in place and with what results. There have been some flaws of distance learning at UNIPI. According to our academic community, "difficulties in increasing the sense of belonging through distance learning" were the most frequently expressed issues. This refers to a lack of participation, empathy, and effective communication during the teaching-learning process. We argue that a complete return to face-to-face is not a solution to these issues. Instead, the lessons learnt during the pandemic can act as a catalyst for innovation and enhancement of Higher Education (HE).

In this work we propose a feasible solution to foster the opportunities given by educational technology without the necessity of a radical disruption of the current methods. Considering the academic context, the extensive use of frontal teaching and the presence of large audiences do not facilitate the direct interaction between teachers and learners and among the learners themselves. In these cases, an interesting and easy-to-implement solution can be the use of so-called *engagement tools*, real-time interaction applications designed to increase active learning and motivation. They are suitable for all types of learning scenarios (face-to-face, hybrid, and distance), so, once planned and methodologically implemented, they can be used in every context. To support this idea, we examine the opportunities offered by these tools.

The above leads to two research questions:

- RQ1: In the context of HEIs, how has UNIPI adapted to the evolution of the pandemic? What actions have been put in place and how they affected education?
- RQ2: Have the teachers at University of Pisa had experiences in using the engagement tools? If yes, what were their practical experiences?

2. Methods

At the end of 2021, we distributed by email a voluntary online questionnaire on the use of digital tools and the application of innovative methods in our academic community. This was part of the European funded ENLIVEN project (https://www.enlivenproject.eu). Starting from September 2021 to November 2021, we collected 911 responses from students and 119 responses from teachers. The participants were asked to give their opinions on the 2020/2021 academic year's teaching-learning experience. This method comes with some limitations, the results describe only a high-level overview of the situation, whereas in-depth studies are generally not suitable for questionnaires. The respondents were from a broad spectrum of different academic fields, from the so-called "hard sciences" to humanities and social sciences, with a balanced distribution in relation to the total sample size. The data analysis was performed using collated data from all the responses and a separate analysis was also performed to compare answers given by the teachers and the students. The most interesting results from our quantitative and qualitative analyses are presented in the next sections.

3. Higher Education and the ongoing evolution of the pandemic

3.1. Emergency learning and teaching

The pandemic struck during the academic year 2019/2020. According to Farnell et al. (2021) this phase could be defined as emergency remote teaching. It was characterised by disruptiveness and by the adoption of distance learning overnight. UNIPI, like many HEIs from different countries, relied on lockdown and other measures of social distancing to prevent the spread of the virus (Crawford et al., 2020; de Boer, 2020). These led to a large number of strategies and ad hoc approaches adopted by the universities, mainly due to their unpreparedness to an event in such a scale (Crawford et al., 2020; Dietrich et al., 2020).

The literature review frequently mentions an inherent aspect of distance learning which concerns the lack of social aspects, interactions, and motivation (de Boer, 2020). This had indeed been identified by our own research to be the most pervasive and concerning problem. Almost 60% of our students and teachers considered it a critical issue emerged during the pandemic. Many other critical aspects were also shared by HEIs, e.g., running laboratory activities and internships, increase of stress and workload and difficulties in helping disadvantaged staff and learners (Dietrich et al., 2020; Cesco et al., 2021). On the other hand, Farnell et al. (2021) and de Boer (2020) showed that the overall experience of remote education was evaluated positively. This is also confirmed by the feedback obtained at UNIPI. The research shows that the most used form of distance learning was performed using video conferencing tools (Mičunović, Rako, & Feldvari, 2022). The adoption of videoconference platforms to mimic the in-presence class dynamics – since they enabled synchronous teaching sessions – was well received. Among the main difficulties was the lack

of interaction and the pacing of the course (Dietrich et al., 2020). According to Cesco et al. (2021) the adaptation of materials and methods to distance education has been mostly left to the initiative of individual teachers. This lack of coordination and institutional support can be explained by the time constraints. These findings can be contrasted with multiple initiatives of training and support done at UNIPI where the primary beneficiaries were the teachers. In our case over 95,8% of them received some sort of support, compared to 73,3% of students (Fig. 1a). In the case of teachers, this was mostly done with informative emails (80,7%) and written information published on the institutional website (61,3%). It might be argued that some more impactful forms of help, namely, video tutorials on the use of platforms (60,5%) and online training sessions (21%), were not sufficiently offered. In particular, the latter were focused on opportunities and the paradigm of distance teaching. These would be especially important in terms of methodological changes, much needed when a course delivered face-to-face suddenly becomes mediated through digital means. It seems that, since these initiatives were open to all, but the participation was voluntary, many teachers decided to opt-out. According to Farnell et al. (2021), providing extensive and structured training for the new learning models is one of the priority recommendations.

3.2. The medium-term impact on teaching and learning

A year after the start of the pandemic new assets (primarily vaccines) and strategies have been developed to gradually adapt to the "new normality" (Cesco et al., 2021), a phase where people and activities coexist without completely renouncing to face-to-face social situations. It seems that this change of context is already visible by considering the results collected at UNIPI. In the academic year 2020/2021, only 5,2% of our students and teachers had no prior experiences with courses being delivered online, 10,5% experienced distance learning for less than a year and 84,3% had more than one year of experience. Hence, we could argue that approximately a year after the start of the pandemics, distance education is no longer a complete novelty. According to our survey, 86,4% of courses were delivered remotely and 12,6% using a hybrid model. Lastly, less than 1% were provided in presence. Since the courses were largely in distance learning, it is worrying to see that 21% of teachers have not adapted the courses' content nor the structure of teaching to the new context, 66,4% made small adjustments to fit the online mode, while 12,6% made significant changes in their teaching (Fig. 1b). A failure to adopt new methods could exacerbate the existing issues expressed by the community, namely, difficulties in increasing the sense of belonging through distance learning gained by participation, empathy, and effective communication. This problem was most frequently expressed by both students and teachers. Although distance education was generally rated positively, its duration and inherent problems may further discourage scholars and favour a complete return to traditional face-to-face education.

According to Eringfeld (2020), neither a fully online nor a complete return to face-to-face HE is desirable. Empirical evidence shows that some students that were not participative in

the physical classroom were more active when using digital tools, i.e., they used the chat to make questions (Dietrich et al., 2020; Huguet, Pearse, & Esteve, 2021). Highlighting the need for a more dynamic and interactive learning environment, Leoste et al. (2021) suggest a more extensive use of engagement tools.

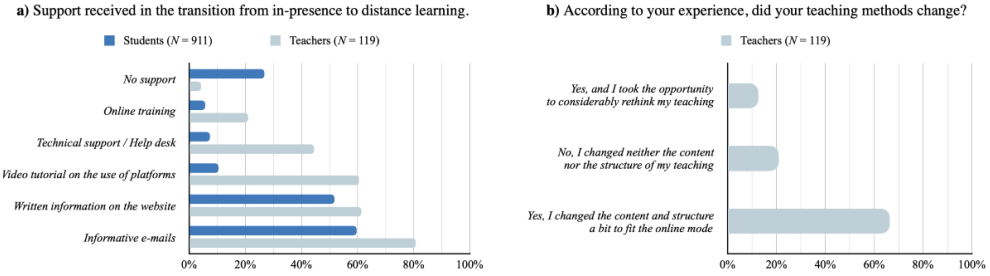

Figure 1. Survey results

4. Engagement Tools

According to Moore (2007), the teaching-learning process cannot take place without communication. The didactic event is a communicative event shaped through the ternary interaction between teacher, learners, and knowledge. It thus includes both a relational dimension between the subjects involved, and a content dimension, related to the object of communication (Sensevy & Mercier, 2007). University lectures are attended by a large number of students, making direct student involvement complex. Moreover, the shift to online teaching in many cases shows a decline in participation, empathy, and effective communication (see 3). Against this background, engagement tools can facilitate discussion, collaboration, feedback, and evaluation. They also enable the collection of qualitative and quantitative data to guide teaching and regulate its content and pace.

We distinguish between two macro-groups of engagement tools:

- Audience Response Systems (ARS), also known as Student Response Systems (SRS), enable the collection of feedback from students, and the implementation of formative and summative assessments. Examples include Mentimeter, Kahoot!, Quizlet, and various polling software.
- Collaborative tools ensure the synchronous interaction of several users and are generally aimed at the construction of shared knowledge. Examples include interactive boards such as Jamboard, Miro, Mural, Padlet as well as collaborative suites such as Google Workspace and Microsoft Office.

Lack of motivation can lead to lower learning outcomes and to a negative atmosphere in the classroom (Liu, Bridgeman & Adler, 2012). Engagement tools focus on student involvement and motivation in the teaching-learning process. They work on social-emotional aspects such

as empowerment, participation, comparison, competition, and collaboration (Humphrey et al., 2020), representing a form of educational technology intended to foster active and interactive learning (Sari, Ftriani & Saputra, 2019). They generate a safe and non-judgmental environment (Vallely & Gibson, 2018), stimulating students' attention and increasing knowledge retention (Lennox Terrion & Aceti, 2012). The anonymity provided by some of these tools, particularly ARS, facilitate the participation of shy and anxious students by consequently reducing their stress levels (Graham et al., 2007; Licorish et al., 2018). However, to prevent anonymity from flattening direct interaction, some scholars believe that these tools can anticipate activities based on dialogue and direct participation (Turkle, 2015; Moorhouse, 2017). It is risky to say whether engagement tools work overall. There is a wide variety of cases and there are many perspectives of analysis. The impact on students is not dependent on the tool itself, but on the way the teacher uses it during the didactic event.

4.1. Analysis of teachers' answers

A multiple-choice question was made to investigate teachers' use of engagement tools. Out of 119 respondents, 99 never used them and 19 did. Only 1 said the question was unclear. Answers indicate that 1 teacher used Mural, 1 Miro, 4 survey software, 4 Kahoot! and 5 Mentimeter, while 8 teachers stated others not on the list. However, 4 of these latter are not actually engagement tools (Dropbox, Google Drive, Microsoft Stream, Moodle), proving not only a lack of use of the tools, but also a lack of awareness of what they are.

Engagement tools were used by teachers who consider themselves to have high (67%) or very high (33%) digital skills, who have been using digital learning environments for more than three years (47%) or at least one year (40%), and who benefited from the university's technical support (100%), especially video-tutorials on the use of tools and platforms (93%). Although the sample is small (n = 15), these teachers are on average more digitally literate and interested in self-training than those who have not used them (+21% in high digital skills, +14% in the use of learning environments for more than 3 years, +35% in the use of video-tutorials). In addition, they claim to have only slightly modified their teaching proposal in terms of content and structure (87%) and to have used them in fully online (75%) or face-to-face (25%) courses. This may suggest that engagement tools are easy to integrate without disrupting teaching habits and confirms that they may be applied in all scenarios.

5. Conclusions

Our literature review shows some inherent issues of distance education. The lack of social aspects, interactions, and motivation may lead to reluctance in adopting future opportunities offered by educational technology. In a post-pandemic world, it will certainly be worth keeping the lessons learnt so far at HEIs. Notably, opportunities tailored to every individual, thus benefitting inclusiveness, may be empowered through an extensive and effective use of

the engagement tools. This solution is promising thanks to a limited need of investments and to the short amount of time necessary for training teachers and other actors involved in the teaching-learning process. The profile of the teachers using them suggests that it is advisable to work in general on the topic of digital literacy and at the same time to offer specific training paths, even self-directed, focusing on engagement tools. These courses should show not only the features of each tool, but also how they can be used at a specific stage of the teaching-learning process, how they can support a precise teaching or learning strategy, how they can meet specific disciplinary and/or cross-curricular learning goals and how they can be more or less suitable for a given target group.

References

Cesco, S., Zara, V., Toni, A. F. D., Lugli, P., Betta, G., Evans, A. C., & Orzes, G. (2021). Higher Education in the First Year of COVID-19: Thoughts and Perspectives for the Future. *International Journal of Higher Education*, *10*(3), 285. https://doi.org/10.5430/ijhe.v10n3p285.

Crawford, J., Butler-Henderson, K., Rudolph, J., Malkawi, B., Glowatz, M., Burton, R., Magni, P. A., & Lam, S. (2020). COVID-19: 20 countries' higher education intra-period digital pedagogy responses. *Journal of Applied Learning & Teaching*, *3*(1), 9–28. https://doi.org/10.37074/jalt.2020.3.1.7.

de Boer, H. (2020). COVID-19 in Dutch higher education. *Studies in Higher Education*, *46*(1), 96–106. https://doi.org/10.1080/03075079.2020.1859684.

Dietrich, N., Kentheswaran, K., Ahmadi, A., Teychené, J., Bessière, Y., Alfenore, S., Laborie, S., Bastoul, D., Loubière, K., Guigui, C., Sperandio, M., Barna, L., Paul, E., Cabassud, C., Liné, A., & Hébrard, G. (2020). Attempts, Successes, and Failures of Distance Learning in the Time of COVID-19. *Journal of Chemical Education*, *97*(9), 2448–2457. https://doi.org/10.1021/acs.jchemed.0c00717.

Eringfeld, S. (2020). Higher education and its post-coronial future: utopian hopes and dystopian fears at Cambridge University during Covid-19. *Studies in Higher Education*, *46*(1), 146–157. https://doi.org/10.1080/03075079.2020.1859681.

Farnell, T., Skledar Matijević, A., Šćukanec Schmidt, N. (2021). *The impact of COVID-19 on higher education*. European Commission — Directorate-General for Education, Youth, Sport and Culture. https://data.europa.eu/doi/10.2766/069216.

Graham, C. R., Tripp, T. R., Seawright, L., & Joeckel, G. (2007). Empowering or compelling reluctant participators using audience response systems. *Active Learning in Higher Education*, *8*(3), 233–258. https://doi.org/10.1177/1469787407081885.

Huguet, C., Pearse, J., & Esteve, J. (2021). New tools for online teaching and their impact on student learning. *Proceedings of the 7th International Conference on Higher Education Advances.* HEAd'21, València, Spain, 163–170.

Humphrey, N., Lendrum, A., Wigelsworth, M., & Greenberg, M. T. (2020). *Social and Emotional Learning*. Routledge.

Lennox Terrion, J., & Aceti, V. (2012). Perceptions of the effects of clicker technology on student learning and engagement: a study of freshmen Chemistry students. *Research in Learning Technology*, *20*. https://doi.org/10.3402/rlt.v20i0.16150.

Leoste, J., Rakic, S., Marcelloni, F., Zuddio, M. F., Marjanovic, U., & Oun, T. (2021). E-learning in the times of COVID-19: The main challenges in Higher Education. *Proceedings of the 9th International Conference on Emerging eLearning Technologies and Applications*. ICETA 2021, Kosice, Slovakia.

Licorish, S. A., Owen, H. E., Daniel, B., & George, J. L. (2018). Students' Perception of Kahoot!'s Influence on Teaching and Learning. *Research and Practice in Technology Enhanced Learning*, *13*(1). https://doi.org/10.1186/s41039-018-0078-8.

Liu, O. L., Bridgeman, B., & Adler, R. M. (2012). Measuring learning outcomes in higher education: Motivation matters. *Educational Researcher, 41*(9), 352–362. https://doi.org/10.3102/0013189X12459679.

Mičunović, M., Rako, S., & Feldvari, K. (2022). *State-of-the-play of the use of OERs at European higher education institutions in the field of Library and Information Science during the COVID-19 pandemic*. DECriS.

Moore, K. D. (2007). *Classroom Teaching Skills*. McGraw-Hill.

Moorhouse, B. L (2017). Increasing in-class participation with online tools. *The Teacher Trainer Journal*, *31*(2), 16–17.

Sari, D. E., Ftriani, S. A., & Saputra, R. C. (2020). Active and Interactive Learning Through Quizlet and Kahoot. *Proceedings of the International Conference on Online and Blended Learning 2019.* ICOBL 2019, Yogyakarta, Indonesia.

Sensevy, G., & Mercier, A. (2007). *Agir ensemble: l'action didactique conjointe du professeur et des élèves*. PUR.

Turkle, S. (2015). *Reclaiming Conversation: The Power of Talk in a Digital Age*. Penguin.

Vallely, K. S. A., & Gibson, P. (2018). Engaging Students on their Devices with Mentimeter. *Compass: Journal of Learning and Teaching*, *11*(2). https://doi.org/10.21100/compass.v11i2.843.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14414

The influence of COVID-19 pandemic on students' screen time, learning, lifestyle, and well-being

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Abstract

The COVID-19 pandemic crisis has changed the lifestyle of people and learning process of students in different countries. The aim of the study was to find out the influence of COVID-19 pandemic on Latvia students' screen time, learning peculiarities, lifestyle, and well-being. The electronic survey of the basic school, secondary school and University of Latvia students was carried out in different regions of Latvia. The results of the survey suggest that the screen time of students and the time spent by students doing study home-works during COVID-19 pandemic crisis have increased. However, many students prefer to study on-line over face-to-face studies. The time spent on physical activities for majority of students during COVID-19 pandemic has not significantly changed. The well-being for many Latvia students during COVID-19 pandemic crisis has decreased.

Keywords: *COVID-19 pandemic; students; screen time; on-line studies; physical activity; well-being.*

1. Introduction

The COVID-19 pandemic crisis changed the lifestyles and learning processes of adolescents and young people. In many countries study process during the COVID-19 pandemic was carried out mainly using on-line methods. Even before COVID-19 pandemic the increased of screen time and reduction of daily physical activities among children, adolescents and young people have been proposed as potential risk factors for different health problems. Research suggests that high screen time is associated with negative influence on various health problems of young people, their mood disturbances, and psychosocial impairments (Bianco et al., 2019; Marques et al., 2019). Due to online learning and gathering restrictions during the COVID-19 pandemic crisis, students must spend even more time by working with computers, and these restrictions could lead to social exclusion. Although distance and online education has some advantages, it is not a substitute for traditional face-to-face education (Topkaya et al, 2021). It was found that distance learning and online communication for many students can lead to difficulties of understanding online lectures (Al-Jarf, 2020). Social exclusion can increase the vulnerability of adolescents and young people to mental health problems and risky health behaviours. Psychological outcomes of the COVID-19 pandemic especially influence children and adolescents (Yakşi et al, 2021). Studies show that girls are at increased risk of developing depression during the COVID-19 pandemic crisis (Tamás & Bettina, 2021). Increased risk of depressive symptoms is associated with increased screen time, alcohol, and drug abuse. Introduced anti-pandemic measures are psycho-traumatic factors that increase the experience of loneliness (Shpakou et al, 2021). The female students were also observed to have a greater physical inactivity tendency during the pandemic, in comparison with male students (Tetik & Koc, 2021). Reduced physical activity has negative effects on life quality and it creates physical and mental health risks. The high levels of anxiety and depression were found among students from North of England, and females scoring was significantly higher than males. Furthermore, distress was associated with lower levels of exercising and higher levels of tobacco use (Chen & Lucock, 2022). At the same time studies have shown more sustainable lifestyle of Spain college students during COVID-19 pandemic, which is associated with more hours of sleep during the week and lower sleep deb (Ramírez-Contreras et al, 2022). Improving the physical and psychological health of students during COVID-19 pandemic is important for public health (Öztürk et al, 2021).

Although different aspects of COVID-19 pandemic influence on people of different countries is much studied, its influence on Latvia students' lifestyle and their education is relatively unknown. The aim of the study was to find out the influence of COVID-19 pandemic on Latvia students' screen time, learning peculiarities, lifestyle, and well-being.

2. Methods

The study was performed in basic schools and secondary schools of Latvia, and different branches of the faculty of Education, Psychology and Art of the University of Latvia. During COVID-19 pandemic crisis (from the March of the 2020) the study process in majority of Latvia schools and Universities was done using mainly on-line learning methods. The electronic survey of the basic school, secondary school, and the University of Latvia students of pedagogy specialties about their opinion on the influence of COVID-19 pandemic crisis on students' screen time, learning (on-line learning during COVID-19 pandemic in comparison with face-to-face learning before pandemic), lifestyle (physical activities, sleeping time), and well-being was carried out. Google forms were used for this questionary. Altogether 235 students were surveyed. The results of the survey were analysed using SPSS statistical data processing program.

3. Results

The results of the survey showed that the screen time of Latvia students during COVID-19 pandemic crisis increased (see Figure 1). 44,7% of surveyed students admitted that the time spent at the screens significantly increased and 31,1% of surveyed students pointed out that the screen time slightly increased. Only for 22,1% of students the screen time haven't changed.

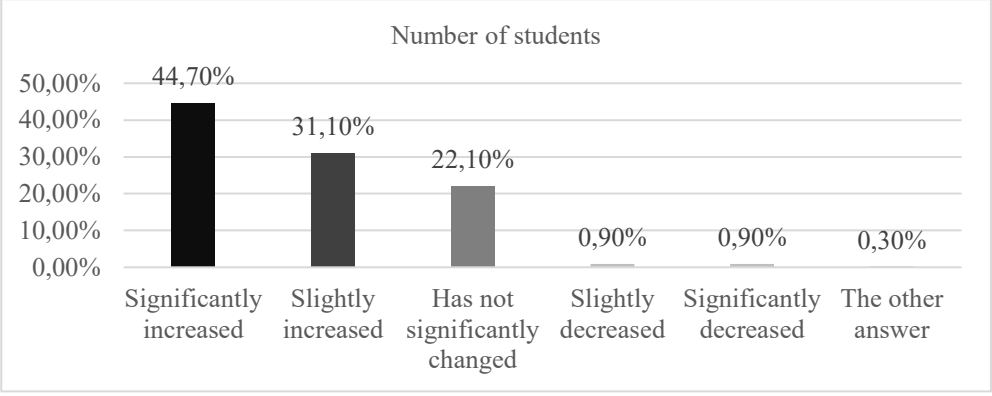

Figure 1. The impact of the COVID-19 pandemic crisis on students' screen time (in % from the number of respondents).

Before COVID-19 pandemic crisis many surveyed students spent at the computer less than 1 hour (23%) or 1-2 hours (37,4%) during day (see Table 1). During COVID-19 pandemic crisis 33,6% of surveyed students spend at the computer 3-4 hours and 23% of students spend at the computer 5-6 hours but 14% of students even 7-8 hours during day.

Table 1. Time spent by students during day at the computer before and during the COVID-19 pandemic crisis (in % from the number of respondents).

Variable	Before COVID-19 pandemic crisis	After COVID-19 pandemic crisis
Less than 1 hour	23	1,3
1-2 hours	37,4	13,2
3-4 hours	26	33,6
5-6 hours	6	23
7-8 hours	3,4	14
9-10 hours	1,7	7,2
More than 10 hours	1,7	5,5
The other answer	0,8	2,2

Time spent by Latvia students doing study home-works during COVID-19 pandemic crisis also have increased (see Table 2). Before crisis 12,4% of surveyed students spent by doing study home-works less than 1 hour and 37,8% of students spent 1-2 hour during day. During COVID-19 pandemic only 3,4% of surveyed students spend less than 1 hour by doing study home-works and 29,9% of students spend 1-2 hours, but 46,2% of students spend 3-4 hours, 10,7% of students spend 5-6 hours and 8,5% of students even more than 7 hours during day.

Table 2. Time spent by students during day doing study home-works before and during the COVID-19 pandemic crisis (in % from the number of respondents).

Variable	Before COVID-19 pandemic crisis	After COVID-19 pandemic crisis
Less than 1 hour	12,4	3,4
1-2 hours	37,8	29,9
3-4 hours	30,9	46,2
5-6 hours	8,2	10,7
More than 7 hours	3,4	8,5
The other answer	7,3	1,3

Despite the long time spent at the computer, many students still prefer to study on-line over face-to-face studies (see Figure 2). 50,6% of the surveyed Latvia students answered that they

prefer on-line studies and only 11,2% of students noted that they prefer face-to-face studies. 17,2% of surveyed students for some subjects prefer face-to-face studies and for some subjects prefer on-line studies. 13,7% of surveyed students like combining face-to-face studies with on-line studies. During COVID-19 pandemic crisis there were periods in Latvia when lectures were managed on-line but laboratory works and seminars - face-to-face. Some students (5,2%) admit that they like face-to-face studies but due to many responsibilities prefer on-line studies. Thus, due to the high workload, online studies for many students are more suitable than face-to-face studies.

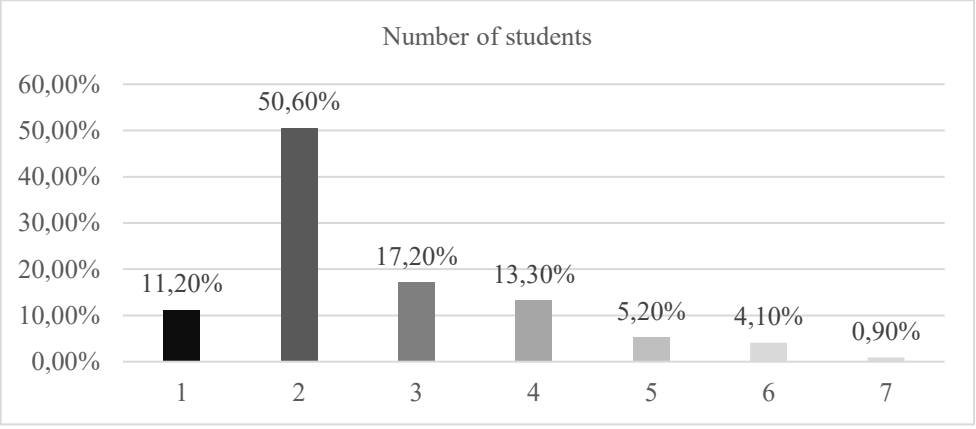

Figure 2. The study process that students prefer: face-to-face or on-line (in % from the number of respondents). 1 - I prefer face-to-face study process. 2 - I prefer on-line study process. 3 - For some subjects I prefer face-to-face studies, for some subjects I prefer on-line studies. 4 - I prefer combining both ways of studies. 5 - I like face-to-face studies but due to my many responsibilities, I prefer on-line study process. 6 - I don't care. 7 - The other answer.

The time spent on physical activities for most of Latvia students during COVID-19 pandemic has not significantly changed (see Table 3). Nevertheless, the number of students who go into sports very little (less than 1 hour during week) has slightly increased during the COVID-19 pandemic crisis (from 22,6% to 27,9%) and the number of students who go into sports very regularly has decreased. Number of students who spend on physical activities during week 10-20 hours has decreased from 5,1% to 3,4% and the number of students who spend on physical activities during week more than 21 hour has decreased from 1,7% to 1,3%. Thus, it seems that students who have been physically active during the COVID-19 pandemic retain physical activity, but the opportunities to go into sports are reduced.

Table 3. Time spent by students during week on physical activities before and during the COVID-19 pandemic crisis (in % from the number of respondents).

Variable	Before COVID-19 pandemic crisis	After COVID-19 pandemic crisis
Less than 1 hour	22,6	27,9
1-2 hours	28,5	29,2
3-5 hours	26	25,3
5-10 hours	12,3	9,4
10-20 hours	5,1	3,4
More than 21 hour	1,7	1,3
The other answer	3,8	3,5

(in % from the number of respondents).

The well-being for many Latvia students during COVID-19 pandemic crisis has decreased (see Figure 4). 32,6% of surveyed students declared that their well-being is slightly decreased but 13,7% of students noted that their well-being has significantly decreased. 44,2% of students answered that their well-being has not significantly changed. Probably, despite the possibility of partially maintaining a typical lifestyle and adapting to on-line study process, various factors related to the COVID-19 pandemic crisis have affected the lives and well-being of many students.

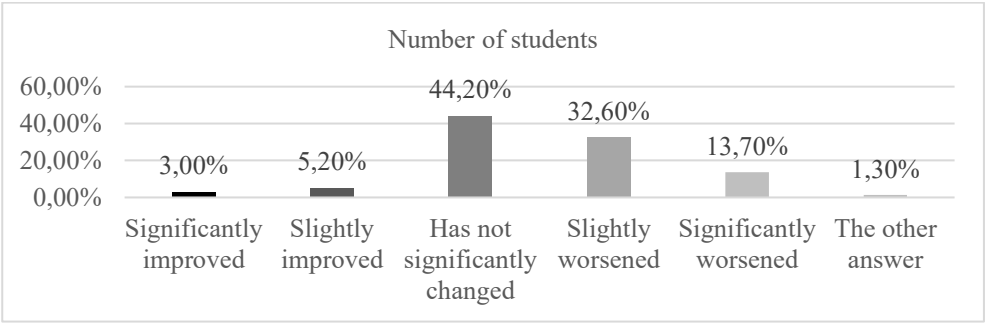

Figure 4. The impact of the COVID-19 pandemic crisis on students' well-being (in % from the number of respondents).

The research was done in the framework of the Latvian Council of Science Fundamental and Applied Research Project No lzp-2019/1-0152 “Comprehensive Assessment and Support Program to Reduce Screen Time Related Health Risks in Adolescents”.

Conclusions

The screen time of Latvia students and the time spent by Latvia students doing study home-works during COVID-19 pandemic crisis have increased. Many Latvia students prefer to study on-line over face-to-face studies. The time spent on physical activities for most of Latvia students during COVID-19 pandemic has not significantly changed, the number of students who go into sports very little has slightly increased but the number of students who go into sports very regularly has decreased. The well-being for many Latvia students during COVID-19 pandemic crisis has decreased. It seems that in future on-line studies will become more popular in comparison to face-to-face studies.

References

Al-Jarf, R. (2020). Distance learning and undergraduate Saudi students' agency during the Covid-19 Pandemic. *Bulletin of the Transilvania University of Brasov, Series IV: Philology & Cultural Studies,* 13(2), 37-54. doi: 10.31926/but.pcs.2020.62.13.2.4.

Bianco, A., Napoli, G., Di Pasquale, M., Filippi, A.R.; Gómez-López, M., Messina, G., Iovane, A., & Tabacchi, G. (2019) Factors associated with the subjective health complaints among adolescents: Results from the ASSO Project. *Journal of Human Sport and Exercise*, 14(2), 443-455. doi:10.14198/jhse.2019.142.16.

Chen, T., & Lucock, M. (2022). The mental health of university students during the COVID-19 pandemic: An online survey in the UK. *PLoS ONE,* 17(1), Article number e0262562. doi: 10.1371/journal.pone.0262562.

Marques, A., Demetriou, Y., Tesler, R., Gouveia, É.R., Peralta, M., & de Matos, M. G. (2019). Healthy Lifestyle in Children and Adolescents and Its Association with Subjective Health Complaints: Findings from 37 Countries and Regions from the HBSC Study. *International Journal of Environmental Research and Public Health,* 16(18), 3292. doi: 10.3390/ijerph16183292.

Öztürk, N., Öter, E., & Abacıgil, F. (2021). The relationship between the activity level, internet addiction, and depressive symptoms of university students during the coronavirus disease-2019 outbreak cross-sectional study. *Meandros Medical & Dental Journal*, 22(3), 324-331. doi: 10.4274/meandros.galenos.2021.70457.

Ramírez-Contreras, C., Zerón-Rugerio, M.F., & Izquierdo-Pulido, M. (2022). Life before and after COVID-19: The 'New Normal' Benefits the Regularity of Daily Sleep and Eating Ro-utines among College Students. *Nutrients,* 14(2), Article number 351. doi: 10.3390/nu14020351.

Shpakou, A., Klimatckaia, L., Skoblina, N., Baj-Korpak, J., Skarbaliene, A., Fedorciv, O., Krestyaninova, T., Znatkova, A., Kuzniatsou, A., & Cherkasova, J. (2021). The prevalence of loneliness among university students from five European countries during the Covid-19 pandemic. *Journal of the Higher School of Economics,* 18(4), 871-887. doi: 10.17323/1813-8918-2021-4-871-887.

Tamás, B., & Bettina, P.B. (2021). Sedentary lifestyle may contribute to the risk of depression during the Covid-19 pandemic. *European Journal of Mental Health,* 16(2), 99–119. Doi: org/10.5708/EJMH.16.2021.2.5.

Tetik, S, & Koc, H. (2021). The Relation Between Physical Activity and Life Quality on Students of Sports Sciences During the Covid-19 Pandemic. *Journal of Sport Sciences Researches,* 6(2). doi: 10.25307/jssr.961228.

Topkaya, Ö., Benli, A., & Cerev, G. (2021). Online Distance Learning During Covid-19 Pandemic: An Empirical Analysis Over the Students' Opinions. *Journal of Economy Culture & Society,* 64, 207-231. doi: 10.26650/JECS2021-862821.

Yakşi, N., Eroğlu, M., & Özdemir, M. (2021). Covid-19: Predictors of Depression and Anxiety Among High School Students. *Cyprus Turkish Journal of Psychiatry & Psychology (CTJPP),* 3(3), 192-202. doi:10.35365/ctjpp.21.3.20.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14577

Towards a framework for interdisciplinary collaborative online learning spaces

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Abstract

This paper presents the findings from a longitudinal, inter-institutional Design-Based Research (DBR) study that commenced in 2020 with a focus on developing design principles for interdisciplinary collaborative online learning. The draft design principles as presented at HEAd'21 were further refined during the first iteration of the project and an updated framework is presented in this paper. The conceptual framework draws on elements of Future Learning Spaces (FLS) and sociomateriality to better understand and contextualise the design principles as it applies to pedagogy, space-time activities and technology. The Interdisciplinary Collaborative online Learning (ICoL) framework focuses attention not only on the practical decisions made by academics in the learning space but also maps the underlying theoretical decisions that influence and shape the learning experience.

Keywords: *interdisciplinary collaborative online learning; future learning spaces; sociomateriality; design principles.*

1. Introduction

To ensure a responsive learning experience for our students, we embarked on a three-year-long Design-Based Research (DBR) study to redefine interdisciplinary collaborative online learning spaces. The study was prompted by complexities arising in Higher Education (HE) learning environments, the realities of our own socio-eco-cultural contexts in South Africa and further challenges posed by COVID-19.

In this paper, we continue to develop the draft design principles as presented at HEAd'21 (Authors, 2021) by incorporating the concepts of Future Learning Spaces (FLS) and sociomateriality. Both these concepts assist in shifting our thinking to the call for continuously being mindful and adaptable to dynamic changes (Klimek & Klimek, 2021).

The paper is structured around a short literature overview of the two main concepts namely FLS and sociomateriality followed by introducing the design-based research (DBR) method that was applied. The outcome is the development of the Interdisciplinary Collaborative online Learning (ICoL) framework with its four associated design principles.

2. Literature Review

2.1. Sociomateriality

Sociomateriality as a theoretical framing offers an opportunity to consider highly complex and embedded concepts within the online learning space such as socio-cultural, human and non-human entanglements and power-communication dynamics. Engaging with and designing for such concepts in the online learning space has proven to be challenging (Carvalho & Yeoman, 2021; Klimek & Klimek, 2021) but necessary if one seeks a learning space that not only prepares students for the world of work but also to be responsible and responsive global citizens.

The emerging literature on sociomaterial theories of learning (Fenwick *et al*., 2011, 2012) is specially equipped to deal with recent shifts to the 'hybrid' and 'inter/transdisciplinary' lines of inquiry (Fenwick & Edwards, 2019). Such lines of inquiry move away from a linear and overly predetermined understanding of both learning and teaching, to an entangled space where the social and material render each other capable - or incapable.

The significant interplay between the social and material has long been ignored within learning in general and online learning in particular to the detriment of the student as a future professional (Carvalho & Yeoman, 2021). Sociomateriality provides an opening in the learning space to engage with the socio-eco-cultural setting by being context-specific and context-sensitive.

2.2. Future Learning Space

The sudden transformation to digital/online learning environments during the COVID-19 pandemic heightened the complexity and uncertainty that reside in the design of learning spaces. The Horizon Report 2021 calls on Higher Education Institutions to exert agency over the future of their institutions by anticipating alternative futures for higher education (Pelletier *et al*., 2021). Within these alternative futures, we explore the design of Future Learning Spaces (FLS) and what this may entail in post-pandemic hybrid spaces and times. These transformative space-time entanglements demand innovative, creative and experimental pedagogical models and within this construct, the iterative refinement of design principles.

Future Learning Space (FLS), incorporates the future of work (authentic collaborative learning that mirrors work environments), new theories on learning that enable knowledge building, and advanced tools and technologies that support learning in new and transformative ways (Hod, 2017, as cited in Tietjen *et al*., 2021). Within such spaces, it is important to understand the sharing of knowledge and how to create opportunities for participatory practices and the adoption of innovative pedagogical models for FLS.

From sociomateriality and FLS, we engage further with the elements of pedagogy, space-time and activities (Tietjen *et al*., 2021) and technology to better understand and contextualise the design principles proposed.

3. Method

Design-Based Research (DBR) as a methodology aims to increase the impact, transfer, and translation of education research to improve practice. Within a DBR study, the emphasis is on theory building within an iterative process to develop and refine design principles that guide, inform, and improve both practice and research in educational contexts (Anderson & Shattuck, 2012). Design research foregrounds innovativeness, responsiveness to evidence, connectivity to basic science, and dedication to continual improvement (Mckenney & Reeves, 2020).

A DBR study is longitudinal and consists of a collection of sub-studies that are reported separately. In this paper, the updated design principles from the first iteration as part of Phase 3 of the overall DBR study are discussed as it pertains to the Interdisciplinary Collaborative online Learning (ICoL) Framework. The framework depicts the pedagogy, space-time activities and technology affordances for a FLS that will be implemented during the second

iteration from February 2022. Figure 1 provides an overview of the phases of the larger DBR study with the blue block indicating the next phase of the project.

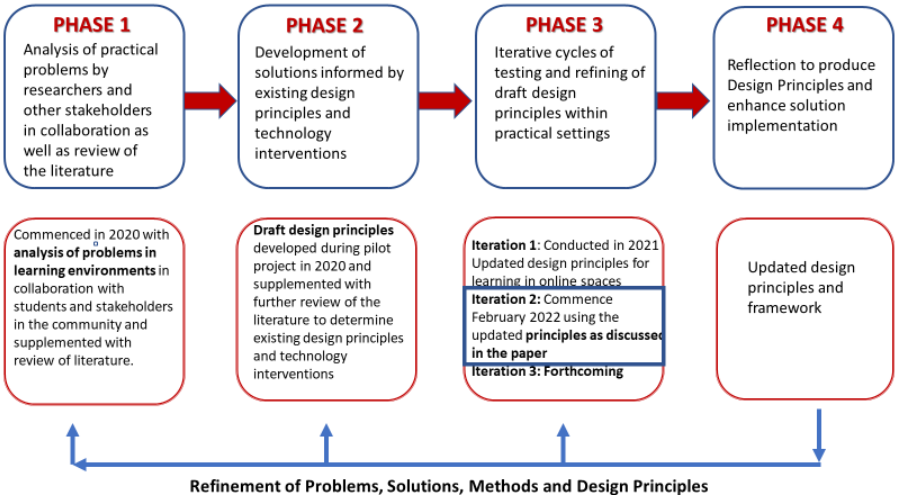

Figure 1: Design-Based Research Process (Source: Adapted from Reeves, 2006)

4. The ICoL Framework and its Four Design Principles

The four design principles as refined during the first iteration are further developed and refined in this section in preparation for the second iteration in 2022. The concepts of pedagogy, space-time activities and technology (affordances and tools) are applied to define the learning space.

4.1. Context-sensitive learning

The first design principle focuses our attention on two pedagogical drivers, namely embodiment and awareness of diverse contexts and perspectives. Embodiment recognises continuous reconfiguration of social systems where students are exposed to continuous movement across physical and virtual spaces (Tietjen *et al*., 2021). This provides a special challenge in the online learning space as the human body is represented by 'avatars' lacking certain essential human qualities with which students make themselves known to their peers and express themselves. One way for students to make themselves known is by tapping into their own local lived (embodied) knowledge in the learning activities we design.

Consideration should also be given to diverse contexts and perspectives, shaped by different socio-eco-cultural influences and disciplinary realms. We do not submerge the vast socio-eco-cultural differences in our student body but rather apply them to enrich the learning space.

Space-time activities should apply principles of responsiveness, agency, ubiquity and connectedness. Activities need to emphasise (i) cooperation and collaboration; (ii) group and community work; (iii) discussion and dialogue; (iv) self-determination (v) valuing 'difference' (vi) trust and relationships reflected through weak and strong ties; (vii) reflexivity at the core of processes; and (ix) the use of technology to connect and mediate learning activities (Carvalho and Yeoman, 2018).

4.2. Co-constructing knowledge

Collaborative online learning approaches provide an opportunity to foreground student engagement as a key element of co-constructing knowledge (Gourlay & Oliver, 2018). Within the online space, this requires the use of multiple platforms for engagement, regular peer and facilitator feedback and the pacing of project deliverables to allow enough time for groups to collaboratively consider and incorporate existing and new knowledge and feedback.

Another pedagogical consideration is the co-constructing potential of both the human and non-human actors in the learning space. Sociomateriality provides an opportunity to focus attention on the students-facilitators-communities-learning tools-technology entanglements.

Space-time activities should acknowledge and design for all the differing 'contributors' (human and non-human) to the learning event. The space-time activity concept is essential in this case where we have to think about creating continuous opportunity via differing spaces (personal vs. public vs. professional, range of online platforms), at differing times (synchronous vs. asynchronous, class time vs. out-of-class times) and representing space-time in scaffolded, collaborative learning activities.

4.3. Socio-technical and socio-cultural entanglements

Socio-technical refers to the intra-action between the human and technology within the learning space whereas socio-cultural refers to the complex human and socio-economic-cultural setting. Within this context, it is important to shift from a humanist view to engage with the complexity of socio-technical-cultural entanglement and how to conceptualise the cognitions between human and technical participants (Hayles, 2017). Against this backdrop, we further grappled with this entanglement and the underlying pressures of social inequalities, the digital divide, connectivity issues, vulnerabilities and differing worldviews.

The learning needs to take place in a continuous meandering flow of activity and unfolding through a process of zooming in and out (Nicolini, 2009). By zooming out to a macro level to recognise the histories, cultures, and communities within which both the participant and the emergent activity resides and zooming in to the micro level to consider the local context (Tietjen *et al*, 2021).

Space-time activities need to be designed in a fluid and adaptable way to acknowledge the changing nature within a bigger framework of the macro elements. The activities need to incorporate student reflections and peer/facilitator feedback on group platforms and as individuals in blogs with opportunities for feedback from peers and scaffolding from facilitators. A further consideration is to provide the opportunity for groups to recalibrate, pivot or change. The project follows an Agile methodology with short sprints to accommodate change and flexibility with a focus on the process and not the outcome. Students follow a process that incorporates design thinking to develop prototypes and the creation of a minimum viable product (MVPs). Assessments and rubrics need to be co-created to enable flexibility in zooming in and out of the bigger reality.

4.4. Relationality and agency

Both relationality and agency manifest through a shared learning experience where both responsibility and power are being shared. Relationality has specific significance as we have to design the learning space with several intra-actions in mind such as individual students as part of a peer group, students and technology, students within their respective socio-cultural settings or communities and student groups with facilitator and external roleplayers. This principle shares many similarities with principles 4.2 and 4.3 and illustrates the entangled nature of the collaborative interdisciplinary online learning space.

Agency can be developed by tapping into different kinds of existing knowledge, as mentioned above, be it disciplinary, technological or lived community knowledge. Sobko *et al* (2020) provide guidance when suggesting that a focus should be on sharing agency where no single actor (human or non-human) has preference over the other.

Learning activities should focus attention on shared ownership of the learning process by providing ample opportunity and freedom for student groups to collaboratively decide how they want to engage and showcase their work.

The four design principles with their associated pedagogy, space-time activities and technology affordances and applications are illustrated in the ICoL Framework, figure 2, below.
In summary, the ICoL framework provides guidance in thinking with FLS and sociomaterial elements when designing a learning space. The next phase of this study is to test the successes and challenges both students and academics experienced within this complex learning space.

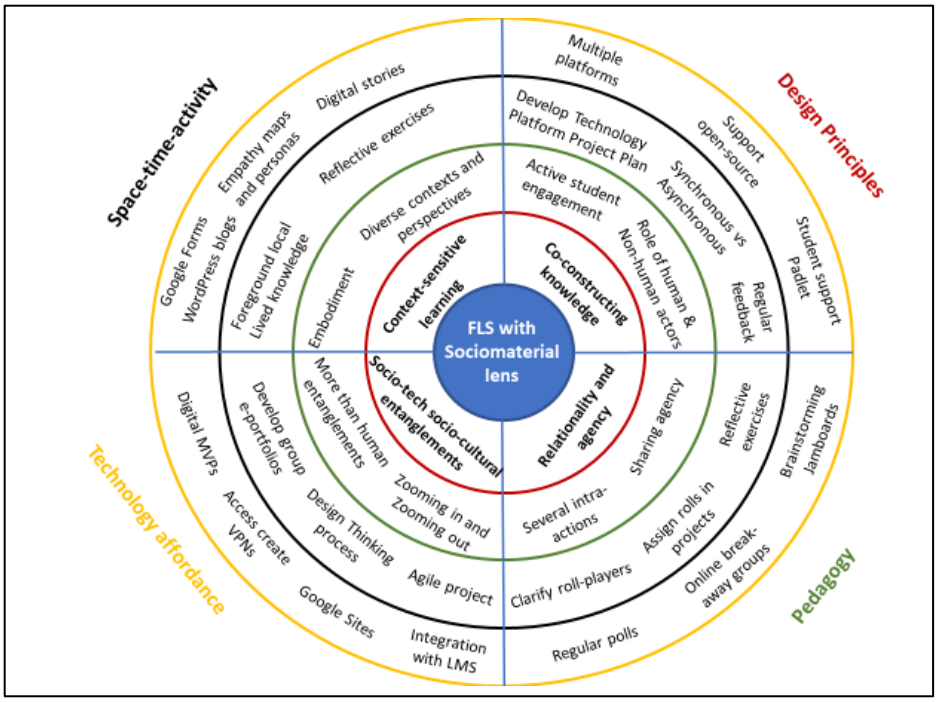

Figure 2. Interdisciplinary Collaborative online Learning (ICoL) Framework

5. Conclusion

Within the context of the highly complex and entangled real-world challenges faced by students and added pressures within HE, further amplified by COVID-19, we embarked on a process of developing a framework to guide interdisciplinary collaborative online learning. This process took the shape of a three-year-long DBR inter-institutional project between the departments of urban planning and information systems.

Although the resulting framework draws heavily from educational theory, it also suggests possible applications by matching design principles to pedagogy, space-time activities and technology affordances.

While the higher education future is highly technology-driven, we argue with this framework for the foregrounding of design principles that encapsulate and afford an opportunity to engage with contextual complexity. This contextual complexity needs interrogation by our students as it defines the reality of the world of work that awaits.

References

Anderson, T., & Shattuck, J. (2012). Design-Based Research: A Decade of Progress in Education Research? *Educational Researcher*, *41*(1), 16–25.

Carvalho, L., & Yeoman, P. (2018). Framing learning entanglement in innovative learning spaces: Connecting theory, design and practice. *British Educational Research Journal*, *44*(6), 1120-1137.

Carvalho, L., & Yeoman, P. (2021). Performativity of Materials in Learning : The Learning-Whole in Action. *Journal of New Approaches in Educational Research*, *10*(1), 28–42.

Fenwick, T., Edwards, R., & Sawchuk, P. (2011). *Emerging Approaches to Educational Research*. Routledge Taylor and Francis Group.

Fenwick, T., Jensen, K., & Nerland, M. (2012). *Sociomaterial Approaches to Conceptualising Professional Learning, Knowledge and Practice an introduction to a special issue of. February*.

Fenwick, T., & Edwards, R. (Eds.). (2019). *Revisiting actor-network theory in education*. Routledge

Gourlay, L., & Oliver, M. (2018). *Student Engagement in the Digital University*. Routledge Taylor and Francis Group.

Hayles, K. (2017). *Unthought The Power of the Cognitive Nonconscious*. The University of Chicago Press.

Hod, Y. (2017). Future learning spaces in schools: Concepts and designs from the learning sciences. *Journal of Formative Design in Learning*, *1*(2), 99-109.

Klimek, J., & Klimek, J. A. (2021). Management of the Teaching Process in Higher Education in COVID-19 Pandemic : Socio-Cultural and Economic Aspects. *European Research Studies Journal*, *XXIV*(4), 737–752.

Mckenney, S., & Reeves, T. C. (2020). *Educational design research : Portraying, conducting, and enhancing productive scholarship*. *February*, 82–92.

Nicolini, D. (2009). Zooming in and out: Studying practices by switching theoretical lenses and trailing connections. *Organization Studies*, *30*(12), 1391–1418.

Pelletier, K., Brown, M., Brooks, C., Mccormack, M., Reeves, J., Arbina, N., Grajek, S., Bali, M., Bulger, S., Dark, S., Engelbert, N., Gannon, K., Gauthier, A., *et al*. (2021). *2021 Educause Horizon Report. Teaching and Learning Edition*. In *Educause*. https://www.educause.edu/horizon-report-2020.

Reeves, T. C. (2006). Design research from the technology perspective. In J. V. Akker, K.

Gravemeijer, S. E. McKenney, & N. Nieveen (Eds.), *Educational Design Research* (pp.86-109). London: Routledge

Sobko, S., Unadkat, D., Adams, J., & Hull, G. (2020). Learning through collaboration: A networked approach to online pedagogy. *E-Learning and Digital Media*, *17*(1), 36-55

Tietjen, P., Ozkan Bekiroglu, S., Choi, K., Rook, M. M., & McDonald, S. P. (2021). Three sociomaterial framings for analysing emergent activity in future learning spaces. *Pedagogy, Culture and Society*, *00*(00), 1–20.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14445

The effects of students' perceived usefulness and trustworthiness of peer feedback on learning satisfaction in online learning environments

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Abstract

In this study, students' perceived usefulness and trustworthiness of peer feedback on learning satisfaction in the online learning environment were investigated using a pre-test and post-test research design at Wageningen University and Research. In total, 135 undergraduate students participated in this study. Students' peer feedback performance was observed in argumentative essay writing. A module called "Argumentative Essay Writing" was designed and students were asked to write an essay, provide peer feedback on peers' essays, and revise their essay based on the received feedback. Then students were asked to fill out the learning satisfaction and the attitude award to peer feedback surveys. The results showed that students' perceived usefulness and trustworthiness of peer feedback affect their learning satisfaction. This study adds to our understanding of the importance of the perceived usefulness and trustworthiness of peer feedback in online learning environments, particularly in the context of argumentative essay writing.

Keywords: *learning satisfaction; online peer feedback; perceived usefulness; perceived trustworthiness.*

1. Introduction

In recent years, educators have shown interest in using peer feedback as an effective learning strategy in online learning environments (Ching & Hsu, 2013; Shahali Zadeh et al., 2016). Peer feedback as a formative assessment tool (Tai et al., 2015), where students may use the feedback to enhance their work, may reduce some of the fears associated with giving negative feedback to peers. Using a positive criticism technique (Burgess et al., 2013) that provides a uniform format for constructive feedback could also help to alleviate some of the tensions that come with negative peer feedback. A review of the prior studies reveals that using peer feedback in higher education has brought benefits to students' learning (e.g., Noroozi et al., 2018; Reinholz, 2018), professional skills (e.g. Brill, 2016; Lowell & Ashby, 2018), improvements in writing performance (e.g., Huisman et al., 2018; Latifi et al., 2019, 2021), and learning satisfaction (e.g., Donia et al., 2021). Despite the benefits of online peer feedback, its application in higher education also faces some challenges. There has been some concern identified with regard to how students receive and use feedback (e.g., Noroozi & Hatami, 2019). According to studies, students prefer instructor feedback more than peer feedback (Kaufman & Schunn, 2011). This could be due to students' lack of trust in peers' competence in providing good feedback (Misiejuk et al., 2021). As a result, a lack of students' trustworthiness of feedback or not knowing useful feedback may be issued with students' learning and satisfaction with the learning process. Therefore, this study seeks to answer the following questions to address this issue:

1. To what extent students' perceived usefulness of peer feedback affects their learning satisfaction in online learning environments?
2. To what extent students' perceived trustworthiness of peer feedback affects their learning satisfaction in online learning environments?

2. Method

2.1 Study Design

This experimental study is a part of a bigger project that took place at Wageningen University and Research. As a part of a bigger project, for this study, one course from the environmental science domain was selected and a module called "Argumentative Essay Writing" was designed and embedded in the course at the Brightspace platform. The module was followed by the students in three consecutive weeks and for each week they were requested to complete a specific task. In the first week, students were asked to write an argumentative essay on one of the three provided controversial topics including (a) the long-term impacts of Covid-19 on the environment, (b) the role of private actors in funding local and global biodiversity, and (c) bans on the use of single-use plastics. In the second week, students were invited to provide feedback on the argumentative essays of two peers based on specific given criteria. In the

third week, students were asked to revise their original argumentative essay based on the two received feedback sets provided by their peers.

2.2 Participants

Although 135 undergraduate students took part in this study, only 79 individuals completed the module. About 69 percent of participants (N = 70) were female, whereas 31 percent (N = 31) were male. Participants were told about the research setup of the courses in order to comply with ethical standards. This study also received ethical approval from the Social Sciences Ethics Committee at Wageningen University and Research.

2.3 Measurements

2.3.1 Measurement of students' attitude towards peer feedback

The authors developed a questionnaire with a 19-item to measure students' attitude towards peer feedback. This questionnaire have been five-point Likert scale ranging from "strongly disagree = *1,"* "disagree = *2," "neutral = 3," "agree = 4"* through to *"strongly agree = 5*." This questionnaire entails four main sections including perceived usefulness of peer feedback, perceived motivation/enjoyment of peer feedback, perceived trustworthiness of peer feedback, and perceived fairness of peer feedback. The reliability coefficient was high for all four scales of this instrument (Cronbach $\alpha = 0.82$, 0.80, 0.76, and 0.84).

2.3.2 Measurement of students' learning satisfaction

A questionnaire designed by Mahdizadeh (2007) was adopted to assess students' Learning satisfaction with the learning experiences. According to the nature and objectives of the research, changes were made to this questionnaire. This questionnaire consisted of four main sections and 24 items in total on a five-point Likert scale ranging from "*almost never true = 1," "rarely true = 2," "occasionally true = 3," "often true = 4"* through to *"almost always true = 5*." The first section (5 items) assessed students' perceived effects of the domain-specific learning outcomes. The second section (6 items) assessed students' perceived effects of the domain-general learning outcomes. The third section (4 items) collected information on students' opinions on the ease of use of the module. The last section (8 items) assessed students' satisfaction with the learning task of the module. The reliability coefficient was high for all four scales of this instrument (Cronbach $\alpha = 0.84$, 0.84, 0.83, and 0.76).

2.4 Analysis

Descriptive analysis was used to investigate the students' perceived usefulness and trustworthiness of peer feedback and students' learning satisfaction. Also, the Simple Linear Regression test was used to answer the research questions. It was determined that the data were normally distributed ($p>0.05$) after assessing the scores using the Kolmogorov-Smirnov tests.

3. Results

RQ1: To what extent students' perceived usefulness of peer feedback affects their learning satisfaction in online learning environments?

The descriptive statistics for the survey are presented in Table 1. Over 50% of students reported that peer feedback helps them in writing an argumentative essay and improving the structure essay. The average score of students' perceived usefulness of peer feedback was 3.64 (SD=0.67). The results showed that students' perceived usefulness of peer feedback affects their learning satisfaction ($F(1, 77) = 13.30$, $p < 0.01$, $R^2=0.14$).

Table1. The affect students' perceived usefulness of peer feedback (n = 79)[a]

Item	Mean	SD	Agreement no. (%)[b]	Disagreement no. (%)[c]	Neutral no. (%)
Peer feedback was helpful for argumentative essay writing	3.96	0.85	62 (78.48)	5 (6.32)	12 (15.18)
Peer feedback was as valuable as teacher's feedback	3.12	0.92	32 (40.50)	22 (27.84)	26 (32.91)
Peer feedback helped me to better structure my argumentative essay	3.59	1.03	51 (64.55)	12 (15.18)	16 (20.25)
I learnt when I provided feedback to my peers' argumentative essays	3.83	0.74	60 (75.94)	5 (6.32)	14 (17.72)
I learnt when I received feedback from my peers on my argumentative essay	3.72	0.86	56 (70.88)	7 (8.86)	16 (20.25)

[a] Based on a 5-point Likert scale (Strongly disagree, disagree, neutral, agree, and strongly agree)

[b] Agreement = Agree, and strongly agree

[c] Disagreement = Strongly disagree, disagree

RQ2: To what extent students' perceived trustworthiness of peer feedback affects their learning satisfaction in online learning environments?

The descriptive statistics for the survey are presented in Table 2. Over 40% of students agreed that their peers are competent enough to provide reliable and constructive feedback. The average score of students' perceived trustworthiness of peer feedback was 3.56 (SD=0.61). The results showed that students' perceived trustworthiness of peer feedback affects learning satisfaction ($F(1, 77) = 12.26$, $p < 0.01$, $R^2=0.13$).

Table 2. The affect students' perceived trustworthiness of peer feedback (n = 79)[a]

Item	Mean	SD	Agreement no. (%)[b]	Disagreement no. (%)[c]	Neutral no. (%)
I think my peers had enough knowledge to provide reliable feedback on my argumentative essay	3.50	0.88	41 (51.89)	8 (10.12)	30 (37.97)
My peers evaluated my argumentative essay appropriately	3.75	0.78	57 (72.15)	7 (8.86)	15 (18.98)
I was willing to have my argumentative essay reviewed by learning peers	4.10	0.77	68 (86.07)	3 (3.79)	8 (10.12)
My learning peers were able to identify the mistakes and errors in my argumentative essay	3.65	0.86	52 (65.82)	7 (8.86)	20 (19.80)
I trusted my learning peers as much as teachers when it comes to feedback on my argumentative essay	3.80	0.97	20 (25.31)	31 (39.24)	28 (35.44)

[a] based on a 5-point Likert scale (Strongly disagree, disagree, neutral, agree, and strongly agree)
[b] Agreement = agree, and strongly agree
[c] Disagreement = strongly disagree, disagree

4. Discussion

Our findings showed that learning satisfaction is affected by students' perceived usefulness and trustworthiness of peer feedback. According to students' responses and survey data in this study, the majority of participants saw peer feedback as a useful learning experience and agree that engaging in peer feedback activities benefits them. Participants said that for peer feedback to be helpful, their peers' competence and their own perceived competence, as well as a safe and trustworthy setting were all necessary. According to the findings of various studies, peer feedback has an impact on students' satisfaction with peer feedback and their attitude towards peer feedback (Liu et al., 2001; Noroozi & Mulder, 2017; Saito & Fujita, 2016; Venables & Summit, 2003). The findings of this study showed that students' satisfaction with learning depends on their attitudes towards peer feedback. If students trust their peers' feedback and find it useful in their learning process, they will be satisfied with their learning process. Students who perceived peer feedback useful were more likely to accept it by acknowledging their mistakes, indicating that they want to change their material, and/or appreciating the effectiveness of the peer feedback (Misiejuk et al., 2021; Noroozi et

al., 2016). Several factors, such as the learner's self-confidence, previous training, and peer feedback experiences, as well as interpersonal relationships among peers, all contribute to the creation of this trusting environment (Bok et al., 2013; Eva et al., 2011) To enhance cohesiveness and optimal group performance, one method to build a trusting environment is to have students work together for an extended amount of time (Farland et al., 2013).

Despite the fact that the majority of participants in this study trust their peers' competency in providing them with meaningful feedback, some of the participants cited a lack of confidence and skepticism about peers' competency as the primary reasons for their unwillingness to participate in peer feedback practices. In previous studies (Burgess et al., 2013), the issue of competency was discussed, and training in peer feedback techniques was indicated as one viable way to enhance student confidence (Gielen et al., 2010; Prins et al., 2006). Students valued expert feedback more than peer feedback, which is consistent with the findings of other studies (Tai et al., 2015). As a result, in addition to peer feedback skills training, instruction on how students participate in cognitive processes such as critical thinking and self-assessment (Topping, 2016), while reviewing their peers' work may help to promote a positive attitude towards peer feedback. More research on peer feedback perceptions and responses to various aspects of peer feedback implementation is required. Learner attributes such as knowledge of the activity's goals, capacity to apply feedback criteria, and evaluation of the strengths and shortcomings of feedback (Sluijsmans et al., 2002) are all critical drivers of a peer feedback activity's success or failure. Future research could explore the impact of peer feedback activities on the skills and characteristics of students.

5. Conclusion

To summarize, students' perceptions and attitudes towards peer feedback demonstrated that perceived peer competence, perceived usefulness, and peer interrelationship are significant parts of a successful peer feedback activity and students' learning satisfaction. Then, educators who use peer feedback in classes should be aware of time management and other visible concerns with group dynamics, as well as create a trustworthy environment in which students can exchange feedback in a formative way. To address the issue of student competency, educators should involve students in the development of feedback criteria (Orsmond et al., 2006) and include those criteria in a feedback template (Gielen et al., 2010) for effective feedback exchange.

References

Barnard, R., de Luca, R., & Li, J. (2015). First-year undergraduate students' perceptions of lecturer and peer feedback: a New Zealand action research project. *Studies in Higher Education*, *40*(5), 933–944. https://doi.org/10.1080/03075079.2014.881343

Bok, H. G. J., Teunissen, P. W., Spruijt, A., Fokkema, J. P. I., van Beukelen, P., Jaarsma, D. A. D. C., & van der Vleuten, C. P. M. (2013). Clarifying students' feedback-seeking behaviour in clinical clerkships. *Medical Education*, *47*(3), 282–291. https://doi.org/10.1111/MEDU.12054

Brill, J. M. (2016). Investigating peer review as a systemic pedagogy for developing the design knowledge, skills, and dispositions of novice instructional design students. *Educational Technology Research and Development*, *64*(4), 681–705. https://doi.org/10.1007/s11423-015-9421-6

Burgess, A. W., Roberts, C., Black, K. I., & Mellis, C. (2013). Senior medical student perceived ability and experience in giving peer feedback in formative long case examinations. *BMC Medical Education*, *13*(1), 1–5. https://doi.org/10.1186/1472-6920-13-79/FIGURES/1

Ching, Y. H., & Hsu, Y. C. (2013). Peer feedback to facilitate project-based learning in an online environment. *International Review of Research in Open and Distance Learning*, *14*(5), 258–276. https://doi.org/10.19173/irrodl.v14i5.1524

Donia, M. B. L., Mach, M., O'Neill, T. A., & Brutus, S. (2021). Student satisfaction with use of an online peer feedback system. *Academy of Management Annual Meeting Proceedings,* https://doi.org/10.1080/02602938.2021.1912286

Eva, K. W., Armson, H., Holmboe, E., Lockyer, J., Loney, E., Mann, K., Sargeant, J., Eva, K. W., Armson, H., Lockyer, Á. J., Holmboe, E., Loney, E., Mann, Á. K., & Sargeant, Á. J. (2011). Factors influencing responsiveness to feedback: on the interplay between fear, confidence, and reasoning processes. *Advances in Health Sciences Education 2011 17:1*, *17*(1), 15–26. https://doi.org/10.1007/S10459-011-9290-7

Farland, M. Z., Sicat, B. L., Franks, A. S., Pater, K. S., Medina, M. S., & Persky, A. M. (2013). Best Practices for Implementing Team-Based Learning in Pharmacy Education. *American Journal of Pharmaceutical Education*, *77*(8). https://doi.org/10.5688/AJPE778177

Gielen, S., Peeters, E., Dochy, F., Onghena, P., & Struyven, K. (2010). Improving the effectiveness of peer feedback for learning. *Learning and Instruction*, *20*(4), 304–315. https://doi.org/10.1016/j.learninstruc.2009.08.007

Huisman, B., Saab, N., van Driel, J., & van den Broek, P. (2018). Peer feedback on academic writing: undergraduate students' peer feedback role, peer feedback perceptions and essay performance. *Assessment & Evaluation in Higher Education*, *43*(6), 955–968. https://doi.org/10.1080/02602938.2018.1424318

Kaufman, J. H., & Schunn, C. D. (2011). Students' perceptions about peer assessment for writing: Their origin and impact on revision work. In *Instructional Science* (Vol. 39, Issue 3, pp. 387–406). Springer. https://doi.org/10.1007/s11251-010-9133-6

Latifi, S., Noroozi, O., Hatami, J., & Biemans, H. J. A. (2019). How does online peer feedback improve argumentative essay writing and learning? *Innovations in Education*

and Teaching International, *58*(2), 195-206. https://doi.org/10.1080/14703297.2019.1687005

Latifi, S., Noroozi, O., & Talaee, E. (2021). Peer feedback or peer feedforward? Enhancing students' argumentative peer learning processes and outcomes. *British Journal of Educational Technology*, *52*(2), 768–784. https://doi.org/10.1111/BJET.13054

Liu, E. Z. F., Lin, S. S. J., Chiu, C. H., & Yuan, S. M. (2001). Web-based peer review: The learner as both adapter and reviewer. *IEEE Transactions on Education*, *44*(3), 246–251. https://doi.org/10.1109/13.940995

Lowell, V. L., & Ashby, I. V. (2018). Supporting the development of collaboration and feedback skills in instructional designers. *Journal of Computing in Higher Education*, *30*(1), 72–92. https://doi.org/10.1007/s12528-018-9170-8

Mahdizadeh, H. (2007). *Student collaboration and learning: Knowledge construction and participation in an asynchronous computer-supported collaborative learning environment in higher education*.

Misiejuk, K., Wasson, B., & Egelandsdal, K. (2021). Using learning analytics to understand student perceptions of peer feedback. *Computers in Human Behavior*, *117*. https://doi.org/10.1016/j.chb.2020.106658

Nelson, G. L., & Carson, J. G. (1998). ESL students' perceptions of effectiveness in peer response groups. *Journal of Second Language Writing*, *7*(2), 113–131. https://doi.org/10.1016/S1060-3743(98)90010-8

Noroozi, O., Biemans, H., & Mulder, M. (2016). Relations between scripted online peer feedback processes and quality of written argumentative essay. *Internet and Higher Education*, *31*, 20–31. https://doi.org/10.1016/j.iheduc.2016.05.002

Noroozi, O., Hatami, J., Bayat, A., van Ginkel, S., Biemans, H. J., & Mulder, M. (2020). Students' online argumentative peer feedback, essay writing, and content learning: does gender matter? *Interactive Learning Environments*, 28(6), 698-712. https://doi.org/10.1080/10494820.2018.1543200

Noroozi, O., & Mulder, M. (2017). Design and evaluation of a digital module with guided peer feedback for student learning biotechnology and molecular life sciences, attitudinal change, and satisfaction. *Biochemistry and Molecular Biology Education*, *45*(1), 31–39. https://doi.org/10.1002/bmb.20981

Orsmond, P., Merry, S., & Reiling, K. (2006). The Importance of Marking Criteria in the Use of Peer Assessment. *Assessment & Evaluation in Higher Education*, *21*(3), 239–250. https://doi.org/10.1080/0260293960210304

Prins, F. J., Sluijsmans, D. M. A., & Kirschner, P. A. (2006). Feedback for General Practitioners in Training: Quality, Styles, and Preferences. *Advances in Health Sciences Education 2006 11:3*, *11*(3), 289–303. https://doi.org/10.1007/S10459-005-3250-Z

Reinholz, D. L. (2018). Design of Feedback Forms and Support. *International Journal for the Scholarship of Teaching and Learning*, *12*(2). https://doi.org/10.20429/ijsotl.2018.120210

Saito, H., & Fujita, T. (2016). Characteristics and user acceptance of peer rating in EFL writing classrooms: *Language Teaching Research*, *8*(1), 31–54. https://doi.org/10.1191/1362168804LR133OA

Shahali Zadeh, M., Dehghani, S., Banihashem, S. K., & Rahimi, A. (2016). Designing and implementation of blending of problem solving instructional model with constructivism's principles and the study of its effect on Learning and creative thinking. *Journal of Innovation and Creativity in Human Science*, *5*(3), 83-117.

Sluijsmans, D. M. A., Brand-Gruwel, S., van Merriënboer, J. J. G., & Bastiaens, T. J. (2002). The training of peer assessment skills to promote the development of reflection skills in teacher education. *Studies in Educational Evaluation*, *29*(1), 23–42. https://doi.org/10.1016/S0191-491X(03)90003-4

Tai, J. H. M., Canny, B. J., Haines, T. P., & Molloy, E. K. (2015). The role of peer-assisted learning in building evaluative judgement: opportunities in clinical medical education. *Advances in Health Sciences Education 2015 21:3*, *21*(3), 659–676. https://doi.org/10.1007/S10459-015-9659-0

Topping, K. (2016). Peer Assessment Between Students in Colleges and Universities: *Review of Educational Research*, *68*(3), 249–276. https://doi.org/10.3102/00346543068003249

Tsui, A. B. M., & Ng, M. (2000). Do Secondary L2 Writers Benefit from Peer Comments? *Journal of Second Language Writing*, *9*(2), 147–170. https://doi.org/10.1016/S1060-3743(00)00022-9

Venables, A., & Summit, R. (2003). Enhancing scientific essay writing using peer assessment. *Innovations in Education and Teaching International*, *40*(3), 281–290. https://doi.org/10.1080/1470329032000103816

Yang, Y. F. (2016). Transforming and constructing academic knowledge through online peer feedback in summary writing. *Computer Assisted Language Learning*, *29*(4), 683–702. https://doi.org/10.1080/09588221.2015.1016440

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14621

Harnessing the potential of online learning in Italian Universities: form blended classes to MOOCs

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Abstract
In this paper some integrated teaching experiences conducted at the University of Padua and particularly one of the courses in the Archaeology area are presented here, in order to show numerous benefits that this kind of learning method can offer: flexibility, time and cost efficiency, more convenience for working students or those with other commitments, the ability to review content several times, greater accessibility for students with disabilities, and specially high degree of student engagement and interactivity . The characteristics of some teaching materials created or used exclusively online, for open and free teaching are described, including the impact they might have on lifelong learning, in the dissemination of our subject, and in the promotion of the territory at an international level.

Keywords: *Blended learning; MOOC; innovative learning.*

1. Introduction

The COVID-19 emergency, which began during the winter semester of 2020, has caused an unexpected epochal leap in the generalized use of online teaching tools. The crisis, and in particular the forced lockdown, made it possible to spread and experiment with remote teaching technologies that, although already in existence and widely tested at least since the 1990s, are now part of everyday life and academia. At the same time, however, the emergency has highlighted some significant issues in the teaching methods used in the university environment specifically in Italy but possibly also in other countries. In fact, the extraordinary technological development has rarely been accompanied by a methodological adaptation and teaching staff has generally been limited to re-proposing traditional face-to-face teaching through video conferencing. And as soon as the lockdown ended, in Italian Universities there has been an immediate return to face-to-face teaching based on frontal lessons in dual (face to face and synchronous streaming lessons) mode urged and made compulsory by most italian Universities (https://unipd.link/teachinguidelines).

The online teaching problems reported by faculty and students during the first months of the lockdown were mainly the lack of a humanized learning environment, the lack of a sense of community and student motivation and accessibility problems caused by the lack of equipment and a deficient internet network (for a specific survey relating to teachers of medieval archaeology: Usai 2021). But once the technical problems and the initial shock were resolved, students recognized numerous benefits which include: flexibility, time and cost efficiency, more convenience for working students or those with other commitments, the ability to review content several times, greater accessibility for students with disabilities, and more engaging and mostly very interactive learning activities. These same benefits were felt by teachers who were open to experimenting with online teaching. In addition, shifting to an online mode of teaching encourages educators to rethink their content and teaching methods, in order to more closely engage the new generation and to incorporate new data in the field, which in the case of archaeology have been considerable.

Although the risk posed by the COVID-19 virus is slowly waning, schools and universities cannot be complacent and must transform their teaching and learning processes in order to be capable of withstanding another crisis in the future. In this context, we present some integrated teaching experiences conducted at the University of Padua, which proved to be not only as much or more interactive than face-to-face lessons, but also much more effective in encouraging student learning and more flexible and therefore fostering inclusion. These do not exclude opportunities for in-person activities (especially laboratory work, archeological excavations, and other participatory initiatives that connect students and teaching staff with the physical locality), but allow better integration of both online and in-person modes of teaching. This is especially beneficial for a field such as archaeology, which requires significant economic and time resources. In addition, the characteristics of some teaching

materials created or used exclusively online for open and free teaching are described, including the impact they might have on lifelong learning, on the dissemination of our subject, and on the promotion of the local region at an international level.

2. From theory to practice

Following an initial post-lockdown period when teachers could choose their preferred teaching mode, many universities have now imposed a total return to in-person teaching, made more complex – even at times confusing – by a dual mode of instruction, with students both in the classroom and online. This was in theory introduced to accommodate those physically unable to come to class for various reasons, but in practice attendance can be based on personal moods, making it impossible for the instructor to know how many students will attend in the classroom or at home and therefore complicating the organization of teaching activities. In reality, this is a regression from the Italian university strategic agenda for didactic innovation (Berlinger et al. 2019) and the Digital Competence Framework for Educators (DigCompEdu), which promoted innovative methods in the planning and design of digital content and the incorporation of technologies into daily teaching, especially through blended methods. In 2021, this blended method was tested for the medieval archaeology course of the degree in archaeology at the Cultural Heritage Department of the University of Padua.

The course is typically held in the third year of the three-year course in archaeology (63 hours / 9 CTS) with an average of 90 students, and is mainly based on the handbook *Post-Classical Archaeologies* (Brogiolo, Chavarria Arnau 2020). The course deals with the period between the fifth and the fifteenth centuries and subjects relating to climate change, environmental transformations, diet and health, pandemics, migrations, fortifications, production and commercial exchanges, and changes in urban and rural settlements, religion and burial practices. All these subjects characterized the period between the end of the Roman Empire and the beginning of the Renaissance and have compelling parallels in the present, enabling numerous reflections and comparisons between past, present and future.

In the academic year 2019/2020, the sudden transition from a traditional face-to-face course in the classroom with a final written exam to an online course gave us the opportunity to totally transform our instruction, guided by three main objectives:

- To allow each student to adapt their learning path by following gradual stages, as their basic knowledge is very different and not very homogeneous–especially since students come to the course from different degree courses (mainly archaeology, cultural heritage, history, and tourism);

- To encourage active teaching and student participation, not only during lessons but also with participatory exercises;
- To change the assessment method, eliminating the final exam, to foster progressive learning through exercises that allow the instructor (and the students themselves) to monitor the progress of their knowledge.

To achieve these objectives, it was decided to use the Moodle platform and some of the integrated tools made available by the University of Padua, such as Padlet (an environment that allows the creation of shared digital bulletin boards), Wooclap (a platform that allows students to be involved in the classroom or in video conferences with questions and surveys), and Annoto (a tool that allows those who are watching a video lesson to annotate, either in shared or individual format).

The Moodle home page has been organized into:

- A collaborative area with participatory exercises to be carried out gradually for the duration of the course;
- Nine thematic sections with a duration ranging from 1 to 2 weeks, each containing the specific resources and activities of the topic dealt with.

The course (lasting six hours per week organized over three days) was organized following a more or less fixed scheme consisting of:

- Pre-recorded video lessons (with teacher questions and student comments / answers using video annotation);
- Readings;
- A live Zoom lesson (for discussions on topics, questions and answers and discussion of exercises or feedback);
- Exercises (once every two weeks);
- Alternatively, a Zoom meeting with an international specialist guest.

To an extent, the combination of activities of different types within each thematic block (video lessons, readings, exercises, discussions) was inspired by the format of a MOOC (see below) that we were planning concurrently.

The most significant innovations in the course were the exercises that replaced (by student choice) the final exam. Out of about 50 students, 45 followed this assessment method while the others preferred to attend a final exam. These exercises were carried out once every 15 days (in total, eight assignments were delivered) and their main objectives were to:

- Stimulate the student to reflect on lesson topics;

- Connect concepts from different lessons;
- Review the content of lessons through maps or tables;
- Search online for further information on lesson content.

All exercises were mandatory and had a specific deadline (approximately ten days).

These exercises allowed the students not only to learn content progressively, but also to develop other essential skills (teamwork, digital skills, synthesis skills, peer-review etc.)

Some (optional) participatory activities were also offered as relevant study tools, in particular two Padlets: one with a content timeline and another with a chronologically organized annotated list of the main protagonists of the period covered.

These assessments offer more flexibility by allowing the review of student progress throughout the semester, encouraging a more hands-on approach, and giving teaching staff the opportunity to make timely changes to teaching and learning methods (Eyal 2012).

Furthermore, the Moodle platform and the integrated tools used (in particular the analytics of video management and video annotation platforms) made it possible to:

- Track all student activities, allowing us to monitor the progress of assignments at any point in time;
- Check the students' improvement by comparing the results of the exercises and the number of times the video lessons have been viewed (comments or responses to the teacher with video annotations);
- Verify students' learning in an individualized manner and give a differentiated assessment based on the initial starting point.

Despite this new assessment method being more demanding than studying for a final exam, students reported a generally very positive experience when asked during the course itself and even after. A questionnaire (with both closed- and open-ended questions) was sent six months after the course ended to evaluate students' level of learning achievement, interactivity, and relationship with the teacher. Questionnaire results (43 students replied) revealed that:

- Students' perception of the level of learning achieved was very satisfactory;
- The new assessment methods made it possible to acquire skills which were valuable for their future educational or professional development beyond the course;
- The interactive relationship with the teacher was improved;

How much do you agree with the following statements?	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
I learned a lot during this course	0	0	2	23	18
The assessment methods were useful in acquiring new skills such as teamwork, digital skills, etc.	0	0	3	26	14
The teacher was able to establish rapport with the students	0	0	0	20	23

Figure 1. Questionnaire results

The students also noticed how this modality, supported by digital tools, allowed time flexibility for both the assimilation of the content (pre-recorded video lessons and readings) and the realization of the tasks. It also guaranteed entire weekly sessions dedicated to the discussion of the proposed topics, resolution of doubts and problems, debate among students and interaction with the instructor.

3. Youtube channel and MOOC experiences

Another benefit of the blended modality and the recording of lessons is the potential to use audio-visual content for a much wider diffusion, allowing even the those not enrolled in the course to follow the lessons, and therefore reinforcing the public nature of the University. Thus, from the beginning of the winter semester of 2020 and parallel to the upload on Moodle, the lessons were uploaded on the teacher's YouTube channel (https://unipd.link/amp-padova) and, in open format, on the Mediaspace channel of the University (https://unipd.link/channel-amp).

The relative success of this initiative then led to the production of a Massive Online Open Course (MOOC), thanks to a grant for innovative teaching from the University of Padua. This course is based on the handbook *Post-Classical Archaeologies* (Brogiolo, Chavarria Arnau 2020), as is the university course, but with a focus on issues that we considered of more global relevance: climate and environmental change, diet and health, migrations, and fortifications – all highlighting the innovative and multidisciplinary methods used by archaeologists today (from remote sensing to paleobotanical, stable isotope or DNA analysis, among many others).

Like a blended course, the MOOC "Enlightening the dark ages: early medieval archaeology in Italy" combines short readings with video lessons including high-quality images that echo traditional lessons with an instructor and slides (but in much more dynamic and condensed format); exercises (individual and participatory); videos of laboratories at the University of Padova; short lessons by specialists; and an end of course “trip” in the form of a video visit to one of the sites frequently cited in the course, under current excavation by University of

Padua archaeologists. Each “step” (which corresponds to a reading activity, video, or exercise) ends with an open forum in which students can leave comments or ask questions.

The course was uploaded to the international platform FutureLearn, which allows free registration, (https://unipd.link/enlightening-the-dark-ages) and the multimedia content was also uploaded to Mediaspace (https://unipd.link/channel-enlightening-the-dark-ages) in order to make all the video contents available also in creative commons CC-BY SA open content.

Launched on November 1, 2021 and with an "on-demand" format (allowing registration at any stage of the year), the course has currently been "attended" by about 1600 students. Students were aged from 18 to over 65, but with a clear majority of over 60s, demonstrating the potential of this educational format to boost lifelong learning or on-going training. Delivered in English, the course attracted students mainly from anglophone countries (United Kingdom, United States, Canada, Australia) but also in large numbers from Europe, Africa, and Asia. The global reach of the internet, and in particular the ability of students from different time zones to access material at an appropriate time of day (unlike webinars broadcast during European daytime or early evening and therefore after midnight in other time zones), allowed a significantly increased internationalisation of the teaching process. The course has received very positive feedback from attendees, who appreciated the innovative nature of the content, its multidisciplinary character, and the variety of exercises. However, the element that the students emphasized most strongly (and one important for an online course) was the strong component of interactivity between teacher-student and student-student, encouraged by the instructor through the “comments section” (answering student’s questions and fostering-acknowledging supplementary links to further material as students uploaded them in this section). Currently, more than 10,000 comments have been posted.

In response to the students’ enthusiasm, two informal live events were organized via the Zoom platform (Tea and Breakfast with Alexandra), to give students the opportunity to interact directly with the host, tutors, and technical staff who participated in the creation of the MOOC. Many students (although frequent online course attendees with a long-standing interest in history) revealed how the course was their first exposure to medieval archaeology and showed a strong interest in visiting the sites mentioned in person, highlighting the potential of MOOCs for the promotion of regional tourism.

4. Conclusions

The new teaching methods help teachers to re-formulate courses in novel yet effective formats that are more attractive to new generations. They also encourage teaching staff to experiment in the direction of more dynamic academic courses inspired by the MOOC structure (preparatory videos, readings, discussions and comments, exercises to assess the degree of understanding) and to develop more humanized MOOCs inspired by the dynamics of academic teaching (video lessons with slides in the background, video visits to laboratories and sites, question and answer sessions and options to comment on aspects of the content).

Online teaching is also an excellent tool for promoting lifelong learning by offering an opportunity for a large, interested group (often, but not always, over-60s) to increase their professional, cultural and even social resources by becoming part of an international community of learners. If done well, online teaching can be even more exciting and encouraging than traditional face-to face lessons. In both cases, interactivity is not determined by the environment (real or virtual) in which the content is delivered but by the capacity and strategies employed by the teaching staff.

Undoubtedly, the same strategies used within this sort of online course or MOOC can be used in a return to face-to-face teaching by uploading "preparatory" material (readings and video lessons) and discussing them in class, in order to deepen central concepts and assess comprehension through different kinds of exercises. This option (experienced in the spring semester of 2022), however, enormously increases the number of hours that students and instructors have to devote to the course. We think that the best strategy would be to combine online and in-person activities (blended learning) as already suggested by Singh, Steele, Singh 2021 among others.

References

Berlinger et al. (2019) (a cura di), Innovazione didattica universitaria e strategie degli atenei italiani. 100 contributi di 27 università a confronto.

Brogiolo, G.P., Chavarria Arnau, A. (2020), Archeologie PostClassiche. Temi, strumenti, prospettive, Roma.

Eyal, L. (2012). Digital assessment—the core role of the teacher in a digital environment. Educational Technology & Society, 15(2), 37-49 https://www.jstor.org/stable/jeductechsoci.15.2.37.

Ferranti, C. (2020). Emergency remote teaching con Moodle all'Università di Padova: una prospettiva sistemica. Conference proceedings MoodleMoot Italia 2020, p. 92-99.

Flynn-Wilson, L., & Reynolds, K. E. (2021). Student responses to virtual synchronous, hybrid, and face-to-face teaching/learning. I*nternational Journal of Technology in Education (IJTE)*, 4(1), 46-56. https://doi.org/10.46328/ijte.43

Hampsten, K. (2021). Embracing discomfort and resisting a return to "the good old days:" A call to communication educators. Forum: Pandemic pedagogy and student learning. Communication Education, 70(2), 208–210 https://doi.org/10.1080/03634523.2020.1857413

Singh, J. Steele, K., Singh, L. (2021). Combining the Best of Online and Face-to-Face Learning: Hybrid and Blended Learning Approach for COVID-19, Post Vaccine, & Post-Pandemic World, *Journal of Educational Technology Systems*, 50. 2 , 140-171

Martin, F., Wang, C., & Sadaf, A. (2020). Facilitation matters: Instructor perception of helpfulness of facilitation strategies in online courses. Online Learning, 24(1), 28–49. https://doi.org/ 10.24059/olj.v24i1.1980

Paul, J., Jefferson, J. (2019). A Comparative Analysis of Student Performance in an Online vs. Face-to-Face Environmental Science Course From 2009 to 2016, Front. Comput. Sci., 12 November 2019 https://doi.org/10.3389/fcomp.2019.00007

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14669

Students' perceptions of gained and lost value: a case study of a summer school that had to suddenly move online

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Abstract

In 2020, the early Covid-19 lockdown induced the abrupt migration of traditionally presential learning activities to online domains, as it was the case of inter-institutional summer schools. The following research corresponds to a case study in which our organization had to reformulate, in less than three months, one of its traditional summer schools while trying to keep the original goals. Through qualitative and quantitative surveys, we aimed at identifying the impact of our reformulation by analyzing students' perception of gained or lost value regarding four topics: a) online teaching, b) pre-recorded business cases, c) online social events, and d) technical solutions. With an emphasis in knowledge and learning experience, the analysis revealed that students' background and expectations may lead to identity and performance tensions. Our results may be of interest to those institutions which are currently turning traditionally face-to-face events into hybrid models.

Keywords: *Online learning; reformulation; Covid-19; assessment; perceived value; innovation education.*

1. Introduction

After Covid-19 was declared a pandemic by the World Health Organization (WHO) on March 11, 2020, the teaching-learning process of more than half of the world's student population was affected by the sudden shutdown of facilities. At short notice, educational organizations were pushed to take crucial managerial decisions to reconfigurate their traditionally face-to-face activities, including internships, conferences, and summer schools (Cullinane, McGregor, Frodsham, Hillier, & Guilfoyle, 2022). In this new normal, in the economic, social-political, and technological spheres of life, a vast number of solutions involved migrating to fully online platform systems to comply with the sanitary regulations.

The reconfiguration of the educational field, often defined as a "pedagogical shift" (Rafi, Varghese & Kuttichira, 2020), an "online transition" (Priyadarshini & Bhaumik, 2020) or "emergency remote teaching" (Watermeyer, Crick, Knight & Goodall, 2021), has been marked by strategic managerial decisions at organizational (e.g., funding institutions and partner universities) and individual levels (e.g., teachers, course designers and students). Generally, in this research we describe a case study in which our organization, a post-graduate unit at the University of Rennes 1, France, had to react, at the start of the pandemic in 2020, to reformulate quickly one of its most acknowledged educational activities in less than three months, i.e., a two-week international summer school on the topic of "smart cities", which would have normally hosted around 50 engineering students from all over Europe. Specifically, we assess the impact of the managerial decisions taken to pivot the event so that the goals of the European activity leading coordinator, the European Institute of Innovation and Technology (EIT-Digital), could be attained.

Managerial decisions in 'fast-changing environments' constitutes a large body of inquiry. In this context, some research has proposed the notion of "improvised decisions" (Kamoche & Cunha, 2001), which accounts for a resolutive action when no plans are available (Moorman & Miner, 1998). A key feature of this academic research is that 'improvised decisions' are often approached from the point of view of decision makers, i.e., how members behave (individually, interpersonally, organizationally) towards an unexpected situation.

While keeping distance from the so-called 'improvisation' perspective, in the present study we put emphasis on the *user* (students attending the educational activity), considered here as the stakeholder which is mostly affected by the managerial decisions of our organization. Although all summer-school-related stakeholders are in some way impacted by decisions (e.g., instructors, business case providers, etc.), students, as users, are particularly vulnerable since they have little or no formal negotiation power in decisions (Jamieson & Thomas, 1974).

To understand the impact of the organization's reformulation decisions on users, we analyze how the proposed (emergent) functionalities deployed in the abruptly-shifted-to-online

summer school were perceived by the students after they finished their learning activities. Such assessment is conceptualized and analyzed in terms of negatively or positively perceived value, i.e., if the online functionalities are positively assessed, then value is gained, while if some of its features are negatively evaluated, value is lost.

Among the quick reactive actions taken by our organization, four main decisions can be found: 1) defining and collecting pre-recorded business case presentations instead of having real time face-to-face conferences from experts; 2) offering online coaching sessions instead of presential workshops; 3) preparing online social events instead of presential socialization activities; and 4) using convenient technological solutions for delivering the activities.

In line with the four managerial decisions for reshaping an education event and with emphasis on students as users, we aim to learn about the impact of decision-making by exploring perceived value from two dimensions, i.e., didactics and pedagogics, where the former is related to knowledge production and content learning, and the latter is related to experience or learning conditions (Zambrano, 2016). The identification of students' value perception will allow us to acknowledge the impact of our organizational pivot by concretely mapping the possible 'tensions' at stake.

2. Theoretical background

In our case study, students' knowledge (didactics) and students' experience (pedagogics) are used as proxies to account for value perceived as gained or lost in the improvised activity.

The knowledge dimension suggests that student's prior or ongoing academic training may lead participants to give a certain value assessment (positive or negative evaluations) in relation to a reformulated event. This idea has its roots in at least three common claims found in the educational field: a) students' prior knowledge may affect learning performance (e.g., Johnson & Lawson, 1998); b) designing engaging lessons, taking into account student's interests, may encourage more active learning participation (Mandernach, Donnelli-Sallee & Dailey-Hebert, 2011); and c) differentiated instruction, according to students' background and readiness, may have a positive impact on student achievement (e.g., Hall, 2002). The second dimension to observe the perception of value is materialized in terms of students and teachers' interactional experience (i.e., involving the interactions of the different participants). Recent literature framed in the pandemic context has paid attention to experience mainly through three aspects which are commonly assessed by students or teachers: practices (Priyadarshini & Bhaumik, 2020; Hornsby, 2020), feelings (Priyadarshini & Bhaumik, 2020; Watermeyer et al., 2021), and accessibility (Dube, 2020).

3. Methodology

In the next section, we describe the methodology that will allow us to learn about the impact of our four reactive decisions.

3.1. Participants

The summer school event, organized by the Université de Rennes 1 and coordinated at a European level by EIT Digital, was held online in 2020. The general objective consisted in providing students with knowledge on innovation and entrepreneurship. Of the 26 participants who agreed attending the shifted-to-online version, two groups were distinguished: firstly, the 'Computer Science' group (CS), made up of 18 students, including those with an academic background in electronics and computer science; secondly, the 'Social Science' group (SS), composed of 8 students, including those with a background in management and human sciences.

3.2. Decisions

The first decision consisted in defining, selecting and collecting pre-recorded business case presentations to replace real time face-to-face coaching interventions. After contacting at least twenty international entrepreneurs, business cases ranging from +/- environmentally oriented and +/- practical, were recorded with Zoom, lasting around 25min. The second decision consisted in offering online coaching sessions instead of presential classes. In these training sessions, instructors strive for highly interactive discussions with students while participants have the possibility to interact among them effectively. Online courses were delivered 6 hours a day via online. The third decision consisted in preparing online social events instead of presential socialization activities. In normal times, social events (e.g., attending restaurants and visiting touristic hotspots) would have been one of the main motivations to attend the summer school. In the context of Covid-19, these social events were replaced by three online social events in which participants had the opportunity to play a game and solving trivia. Finally, the fourth decision consisted in choosing the most convenient and practical communication platform for administrating the learning activity. In the reformulated version of the summer school, Zoom was chosen for training sessions. The assessment of the four managerial decisions were explored through didactics and pedagogics.

3.3. Analysis of data

The 26 students, after the event, were asked to voluntarily answer two surveys whose data would undergo a process of identity anonymization. The first survey aimed to collect data about the learning experience while the second one, including quantitative questions using a 5-point Likert scale (1: Very Poor, 2: Poor, 3: Fair, 4: Good, 5: Excellent), aimed at collecting specific evaluations about the event, such as content, program and organization.

4. Results and discussion

We have aimed to learn about the impact of the decisions taken to reformulate an international summer school. To meet this general purpose, we have explored how students assessed the re-configurated event in relation to four managerial decisions: a) preparing pre-recorded business case presentations; b) offering online coaching sessions; c) preparing online social events; and d) defining the most convenient technological solutions. Students' assessment of the managerial decisions allowed us to identify some tensions mainly in relation to *identity* and *performance b*etween organization and users.

The assessment of the first decision related to pre-recording business cases helped us learn about identity and performing tensions in relation to didactics and pedagogics, respectively. Regarding the former, it is worth noting that prerecorded business cases, consisting in projects including IoT or artificial intelligence, were included in the activity to target student's disciplinary background. However, they were poorly assessed probably because they were too technical and context-dependent (i.e., based in Rennes). Instead, participants assessed business cases according to personal motivations that could not be anticipated by the organization, for example, solving environmental issues, such as transport problems (*Keolis is about an everyday-life topic, that is to say transportation. Something necessary and not to be left, and something that needs to be improved to have a better ecosystem*). This identity tension might be generated since the user was mainly considered as a "student", not as a conscious "citizen". In relation to the experience dimension, it was possible to find a performing tension, in which the strategy to maintain the original topic clashed, in some degree, with the business topics finally incorporated in the reformulation. As some users suggested, some business cases were considered unrelated with the overall topic of the summer school, i.e. Circular Data (*A huge difference in the name of the course and what I found in the brochure before enrolling led me to think that the course was focus mainly on creating a link between technologies and policies applying it to cities. The course had a totally different thematic good also, I learned a lot, but it differs from my initial expectations*). This tension may be due to the fact that the business case portfolio was finally conformed based on providers' availability during the pandemic crisis.

The assessment of the second decision related to the online training sessions helped us learn, from the didactics viewpoint, that coaches allowed students to take advantage of their backgrounds (i.e. academic identities). Interestingly, CS students claimed that their backgrounds allowed them to *analyze technical questions*, decide *projects' feasibility*, *apply the technical expertise to another field* while SS students claimed that their knowledge allow them to *use soft skills to quickly grasp the unknown contexts* [in relation to hypothetical scenarios], and *present and brainstorm in the creation process*. From pedagogics perspective, it was possible to find performing and identity tensions regarding experience and goals. In relation to experience, CS users claimed that it was difficult to work with classmates having

no "technical or scientific background" (*I did not expect most of the people from my team were from outside EIT. Many of them did not have technical scientific background, so it was difficult for them to participate; Most of the team members did not have a technical background, so it was difficult to communicate some of the ideas*). In terms of goals, CS students followed the summer school with the purpose of developing a business projection (*Personally from the summer school I am taking away lots of technical tips and tools which I could use to start a start-up as successfully as possible*) while SS participants took the summer school to learn new concepts (*It was fun to learn about the steps of developing a business idea*). Workload was negatively perceived by all participants (*I thought it wouldn't be tiring, was supposed to be a lot of fun while studying and doing a project. And the reality is we are going to build up our project from day 1 with intensive sessions every day*).

The assessment of the third decision related to social events accounted for two important *performing* tensions among participants from the didactics viewpoint. On the one hand, the organization considered social events as opportunities for students to meet new friends. With this in mind, short games and trivias were offered. In a normal context, however, social events are not just for "meeting people", but to do strategic networking. This performing tension led CS and SS students to think of social events as one more task to finish at the end of the day (*it is difficult to achieve the same level of interaction online as in real life*). From pedagogics, social activities that started some minutes late and took place late in the afternoon (after 5pm), were negatively perceived by both type of students.

Lastly, the assessment of the fourth decision related to the technical solutions allowed us to identify, from a didactics viewpoint, that students, given their academics backgrounds, felt pretty conformable with both Zoom and Moodle (*I've been using Moodle in the university for several years now, so I'm familiar with Moodle*). From a pedagogics view, however, participants admitted that they had to find alternative means, such as WhatsApp, Facebook, Telegram and Google Drive, to keep a more fluent communication with their partners. Finally, one common trigger of dissatisfaction among students (similar to that found by Cullinane et al., 2022) was related to the fact that they missed certain interaction elements of the physical version, such as meeting people from other groups (*there was no problem with teamwork and coaching on zoom although we couldn't interact much with people outside our group*), watching people's expressions (*of course it is not like real life so unfortunately for the coaches, it was difficult to see our reaction, even us when we present, we cannot see the reactions*), and networking (*although I think in general the whole experience was positive, I was missing some face to face networking and interaction after the sessions)*.

Based on our analysis and the tensions found among participants, Table 1 synthesizes the aspects that triggered a perception of gained and lost value according to the reformulation decisions regarding business cases, training sessions, online events and technological solutions. Gained value was identified when assessments ranged from "fair" to "good" (3-4);

and "good" to "excellent" (4-5). Lost value was identified when assessments ranged from "very poor" to "poor" (1-2); "poor" to "fair": (2-3); and "fair": (3).

Table 1. Perception of gained and lost value according to managerial decisions.

	Users' assessment (a selection)	
Decision	**Gained value** **(fair to good: 3-4; good to excellent: 4-5)**	**Lost value** **(very poor to poor: 1-2; poor to fair: 2-3; fair: 3)**
1. Business cases	• Inclusion of environment-related business cases	• Inclusion of technology-based cases • Inclusion of context-dependent cases • Inclusion of cases not related with the summer school topic (*circular city data*)
2. Training sessions	• Participation of engaging coaches • Sessions integrating computer science and social science knowledges	• Activities implying teamwork among students with no affinity among them
3. Online events	• Activities lasting not too long (1 hour approx.)	• Time of the day was too exhausting (after 5pm)
4. Tech. solutions	• Use of familiar tools (Moodle and Drive)	• Groupwork in Zoom prevented students from meeting people from other groups, watching people's expressions (cameras off), and networking • Use of Zoom's breakout rooms (difficult to come back if out for some reason) • Moodle as submission platform (instructors used email instead)

5. Conclusion

Our analysis allows us to understand the impact of our reformulation decisions and identify those aspects that triggered a positive assessment from CS and SS students, e.g., considering business cases related to solving environmental challenges, hiring engaging coaches able to integrate students with different backgrounds, organizing short social events, and using well-known platforms. Interestingly, our research also allows us to identify those performing and identity tensions leading to a perception of lost value, e.g., working with technology-based and context-dependent business cases, finding no direct link to the general topic of the event,

doing teamwork activities among students with no intellectual affinity; attending social events after 5pm, using Zoom breakout rooms for teaching; and using Moodle as an assignment submission platform. These results may be of interest to those institutions which are currently turning traditionally face-to-face events into hybrid models.

References

Cullinane, A., McGregor, D., Frodsham, S., Hillier, J., & Guilfoyle, L. (2022). Transforming a doctoral summer school to an online experience: A response to the COVID-19 pandemic. *British Journal of Educational Technology*, 53(3), 558-576.

Dube, B. (2020). Rural online learning in the context of COVID 19 in South Africa: Evoking an inclusive education approach. *REMIE: Multidisciplinary Journal of Educational Research*, *10*(2), 135-157.

Hall, T. (2002). Differentiated Instruction. Effective Classroom Practices Report, National Center on Accessing the General Curriculum, Office of Special Education Programs, U.S. Department of Education.

Hornsby, D. (2020, June). Moving large classes online: Principles for teaching, learning and assessment. In *Pedagogy for Higher Education Large Classes (PHELC20) Co-located with 6th International Conference on Higher Education Advances (HEAd'20)*.

Jamieson, D.W. & Thomas, K.W. (1974). Power and Conflict in the Student-Teacher Relationship. *The Journal of Applied Behavioral Science* 10(3): 321–336.

Johnson, M. A., & Lawson, A. E. (1998). What are the relative effects of reasoning ability and prior knowledge on biology achievement in expository and inquiry classes?. Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching, 35(1), 89-103.

Kamoche, K. & Cunha, M.P. (2001). Minimal Structures: From Jazz Improvisation to Product Innovation. *Organization Studies* 22(5): 733–764.

Mandernach, B.J, Donnelli-Sallee, R & Dailey-Hebert, A. (2011). Assessing course student engagement. *Promoting student engagement* 1(1): 227-281.

Moorman, C. & Miner, A.S. (1998). The Convergence of Planning and Execution: Improvisation in New Product Development. *Journal of Marketing* 62(1): 1–20.

Priyadarshini, A. & Bhaumik, R. (2020). E-readiness of Senior School Learners to Online Learning Transition amid COVID-19 Lockdown. *Asian Journal of Distance Education* 15(1): 244-256.

Rafi, A.M., Varghese, P.R. & Kuttichira, P. (2020). The Pedagogical Shift During COVID 19 Pandemic: Online Medical Education, Barriers and Perceptions in Central Kerala. *Journal of Medical Education and Curricular Development* 7.

Watermeyer, R., Crick, T., Knight, C., & Goodall, J. (2021). COVID-19 and digital disruption in UK universities: Afflictions and affordances of emergency online migration. *Higher Education*, *81*(3), 623-641.

Zambrano, A. (2016). Pedagogía y didáctica: esbozo de las diferencias, tensiones y relaciones de dos campos. *Praxis & saber*, *7*(13), 45-61.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14639

CAPuS e-learning platform for the Conservation of Art in Public Spaces

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Abstract

CAPuS - Conservation of Art in Public Spaces is a three year project co-funded by the European Commission under the Erasmus+ Knowledge Alliances Programme (www.capusproject.eu) inspired by the lack of specific actions aimed at the conservation of street art/urban art and of dedicated academic teaching modules and training activities. The project delivered an educational platform aimed at filling this lack. An "alliance" of 17 partners has developed a research methodology and conservation guidelines, which have been the basis for the design and implementation of the teaching platform. Two online open courses are currently offered: the self-learning course is addressed to students in conservation and restoration of Cultural Heritage and to professionals and operators in the field; the other is addressed to lecturers and provides materials, resources and strategies to prepare engaging and innovative lessons on the themes of the project.

Keywords: *Higher education; public art conservation education; Cognitive Activation; learning readiness; urban artworks; brain-based learning.*

1. Introduction

The CAPuS partnership is composed of 14 full partners and 3 associated partners based in 5 European countries and includes universities, academies, companies and research centers. They worked to formalize the strategies for the conservation of art in public spaces by involving - in the partnership and during the project – a variety of stakeholders: HEIs, companies, museums, local administrations, heritage protection bodies, professional conservators, artists and local communities. The CAPuS project started from the evidence that, especially in Europe, the conservation of urban art lacked of specific education initiatives and it was not yet included in academic programmes. In this context, the CAPuS project wanted to effectively contribute to the dissemination of knowledge to both students in conservation courses and to professionals already working in this field. For the conservation of artworks exhibited outdoors, specific aspects shall be considered: they are continuously subjected to the action of degradation agents, both anthropogenic (i.e., atmospheric pollution, vandalism) and natural (i.e., solar light and atmospheric agents), which normally cause their rapid degradation. In fact, urban artworks are often considered ephemeral by their own authors. However, where the artwork has assumed a value for the community, both as a memory or as a particular feature of a specific urban area, the need to preserve and protect it clearly emerges, as well as the need for new skills and knowledge to plan and implement conservation projects respectful of both the artwork and its socio-cultural context. All these aspects have been considered throughout during the project. Then, the challenge was how to transform the guidelines and protocols developed within the project's work packages (WPs) into education and training opportunities, and the effort yielded the CAPuS e-learning platform.

1.1. Objectives of the project

The CAPuS' objectives for conservation of art in public spaces were achieved by developing a working methodology based on:

- the analysis of the socio-cultural and historical artistic context of the artworks;
- the analysis of the needs expressed by the communities, by funding bodies of public artworks and by those responsible for their maintenance;
- the attention to economic, environmental and social sustainability criteria;
- the use of innovative technologies (for the analysis of the state of conservation) and materials (for the conservation intervention).

First, almost one hundred of murals and metal sculptures were selected, and their socio-cultural context explored (WP2). The techniques, materials and condition of each artwork were then examined (WP3), and products for specific conservation treatments identified (WP4). A conservation methodology for public works of art was then defined (WP5). Key

work packages (WPs) and key milestones are reported in a dedicated section of the CAPuS website (https://www.capusproject.eu/methodology).

Models to transfer the knowledge and experience derived from the project's activities to students, teachers and professional conservators were devised within the activities of WP6, which main outcomes was the CAPuS e-learning platform presented in this paper.

2. CAPuS

2.1. Didactic theories

The approach we referred to for the preparation of the e-learning modules is brain-based learning, using the components of learning readiness to produce meaningful learning (Trinchero, 2015). With learning readiness, we mean "the condition of mastery of the cognitive resources necessary to be able to acquire new ones; previous cognitive resources, even when present, must be appropriately "activated" in order to participate profitably in the process of building new resources " (Trinchero, 2015). The model applied to all the learning units is the following: it starts with cognitive activation (Merrill, 2002) by asking for the keywords on the subject and continues with the use of useful contents to evaluate, for example, the causes of the deterioration of the artwork. This requires the activation of all previous knowledge, the identification of usable knowledge, the exploration of the tools made available, and their download, so that they can be used and customized in their contents. (Hattie, 2013) (Hattie, 2016). In each unit the "Activity workflow" (Merrill, 2002), (Trichero, 2015) guides the student through the main steps of the learning process. Below, as an example, the learning sequence of section 4 in the self-learning course is presented. The topic is "degradation causes:

- Include your keywords in the word cloud for "degradation causes"
- Select the suggested question and download the "tools" inside
- Read the e-book
- Interact with the video
- Train your new skills
- Write your own answer and read the conclusion from CAPuS

The constant reference to the case studies investigated during the CAPuS project allows not only to provide all the information and knowledge useful to students, but also helps to identify and select the activities by keeping in mind the definition of a conservation project. This allows the student to transfer this knowledge to different case studies (Kou,2010). For the self-assessment of the contents learned, it was decided to propose a reflection on the topic. Multiple-choice tests have been excluded, as the questions posed do not actually have one certain answer.

2.2. CAPUs elearning platform

The CAPuS e-learning platform is a free moodle-based M.O.O.C. (Massive Open Online Course) that presents the research of the international Knowledge Alliance on Conservation of Art in Public Spaces (CAPuS) processed to be used by postgraduate students and lecturers in conservation and restoration of cultural heritage. By accessing the platform (registration required, https://elearning.unito.it/mooc/ also accessible from the project website http://www.capusproject.eu/capus-e-learning-platform/) users find two courses addressed to two different audiences: students find a self-learning course, whereas lecturers find materials and resources for their lectures.

The first course: "Are you student?". The self-learning course is intended for master's degree students in conservation and restoration of cultural heritage, but it can be of interest to professionals who wish to expand their knowledge in the conservation of art in public spaces. The course guides students to the know and understand the methodological approach. It starts from the understanding of the socio-cultural context of the artwork, the identification of stakeholders, the investigation of the constituent materials through scientific equipment, the assessment of the state of conservation of the artwork, the analysis of processes and causes of decay, the testing of materials and conservation treatments, the definition of the conservation intervention and of the maintenance plan.

The second course: "Are you lecturer?". The course for lecturers consists of six teaching units and a focus module on street art, with practical suggestions and teaching materials and tools for preparing lectures on the various aspects of public art conservation.

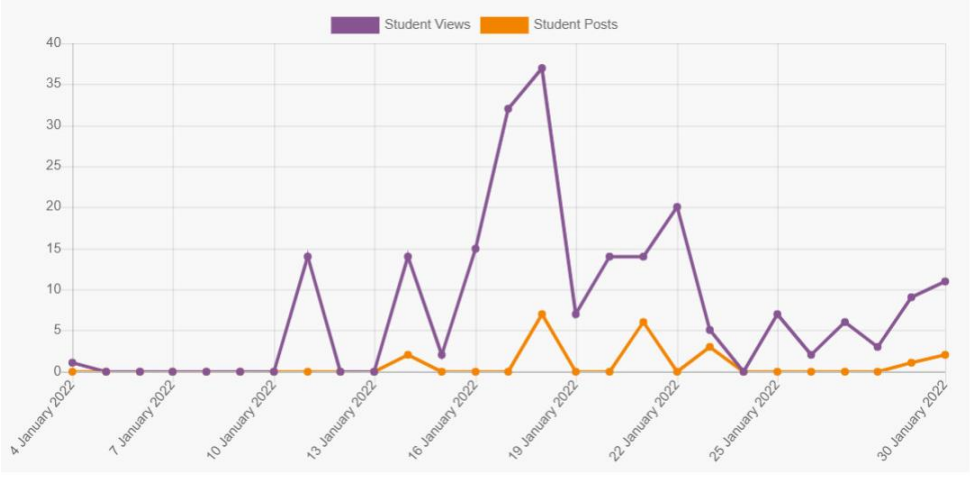

Figure 1. The graph of Self-learning course for student views (purple) and student posts (orange).

The project closed in June 2021, and we are now monitoring the data of registered users. In January 2022 the graph of student views and student posts of the self- learning course (fig.1) show a considerable increase. Overall, 64 users are currently enrolled in the course for students and 36 in the course for lecturers.

2.3. Key aspects in the design

The following key aspects in the design of the two courses offered in the CAPuS e-learning platform can be identified.

1. Development of a multidisciplinary approach for conservation of urban art. The field of conservation of cultural heritage is already multidisciplinary in itself, as it includes contents ranging from humanities to physics, chemistry, biology and engineering. The alliance among companies, professionals and universities made it possible to clearly identify the needs and expectations of stakeholders and to develop lectures and teaching materials useful for acquiring the skills required to future professionals in the conservation and management of public art heritage.

2. Identification and development of soft-skills, entrepreneurial skills, and digital skills. Pilot courses on different activities were designed and offered to HEI students during the project and feedbacks from teachers/researchers and students were collected in order to identify the most useful soft skills and entrepreneurial skills (i.e., flexibility, adaptability, communication, team working, business case and problem solving) and to assess how they were received by students. As regards digital skills, one of the teaching units in the CAPuS e-learning platform is about "Sharing of knowledge through digitalization and open-access of data", that is how to make research data and conservation-restoration documentation more accessible, visible, and impactful through open sharing. In this sense, an example is the Digital Repository of the public works of art studied within the Conservation of Art in Public Spaces project and accessible at https://www.capusrepository.unito.it/.

3. Exchange of knowledge on entrepreneurial skills and on innovative approaches to teaching and learning. This took place in all phases of the project, including learning mobility activities, and resulted in the co-definition of the topics to be introduced in the courses and in the coproduction of teaching materials. The contribution of the business partners was fundamental above all in the design and implementation of the lectures about: Stakeholders and their role in the conservation of Art in Public Spaces, Use relations with / Obtain the approval of decision-making bodies, Local policies for conservation of Art in Public Spaces, Technical tests and design of experiments, Safety and environment, Decision-making.

4. Researchers and lecturers from the academies consulted specialists in innovative teaching methodologies, and lectures were given to CAPuS partners at two project meetings. The idea behind these lectures was to involve all CAPuS partners in the preparation of the teaching modules from the very beginning of the project, showing some of the most innovative teaching techniques that would later be exploited in the preparation of the teaching modules. The aim was to encourage partners to produce - during their CAPuS activity - materials such as documents, photos, videos, interactive videos, web resources etc. suitable for later exploitation in the preparation of modules, and for exploring different teaching methods (i.e. lectures, demonstrations, group exercises, role-playing, group discussions) to optimize the combination of practice and theory according to a problem-based approach.

Here we will focus on the online course "Are you student?". The challenge for the design and implementation of the course addressed to students was to identify strategies and implement tools for:

- keep a modular approach in an inherently sequential process;
- guide the students along the path even without a reference teacher - according to a self-learning approach - by means of models and useful tools.

The first objective was addressed by adopting the workflow of a conservation intervention on works of art exhibited in public spaces as a methodological model of the course, as reported in section 1.1. A colour code has been set for the workflow: blue: knowledge; green: evaluation-research; orange: field activities, adding an introductory section, a tutorial section for navigation and a final one with additional resources that integrates the educational path. For each box associated with the methodological model, a “workflow” of self-learning activities opens up, which is however made modular through the proposition of single “stimulus-questions”. These questions divide the path into units, each focussed on one of the many aspects that are treated within the steps provided by the methodological model. Each unit is self-consistent, and can also be exploited individually, based on personal interests and previous knowledge. This strategy also allows us to tackle the second part of the challenge, by motivating and guiding the student's path with activities aimed at stimulating reflection on the various steps of the teaching unit, starting from the recognition of the incoming knowledge to the autonomous elaboration of a "response" to various initial questions. The presence of teachers / avatars is used to present activities and to focus the attention on the specific aspects

The model was initially assessed within the partnership with 13 people involved, to whom we asked to respond to the following questions:

- Is the instructional design of the course clear and easy to use?
- Is orientation within the course straightforward?

The course was then adjusted following the indications that emerged in the preliminary test.

Now, more information is deriving from the present users. Data collected can help us to respond to the following questions: is cognitive activation with "word clouds" successful? Was the choice not to ask question /quizzes, but to pose open questions/feedback at the end of each module a proper strategy? Is the multimedia of the course clear and easy for do conservation intervention on works of art exhibited in public spaces?

From the data collected, reported in Figure 2, it is evident that the work clouds has been significantly employed and, by considering that most viewed contents (modules 1-3) users tend to go straight to the point, by accessing the contents that are related to specific open questions.

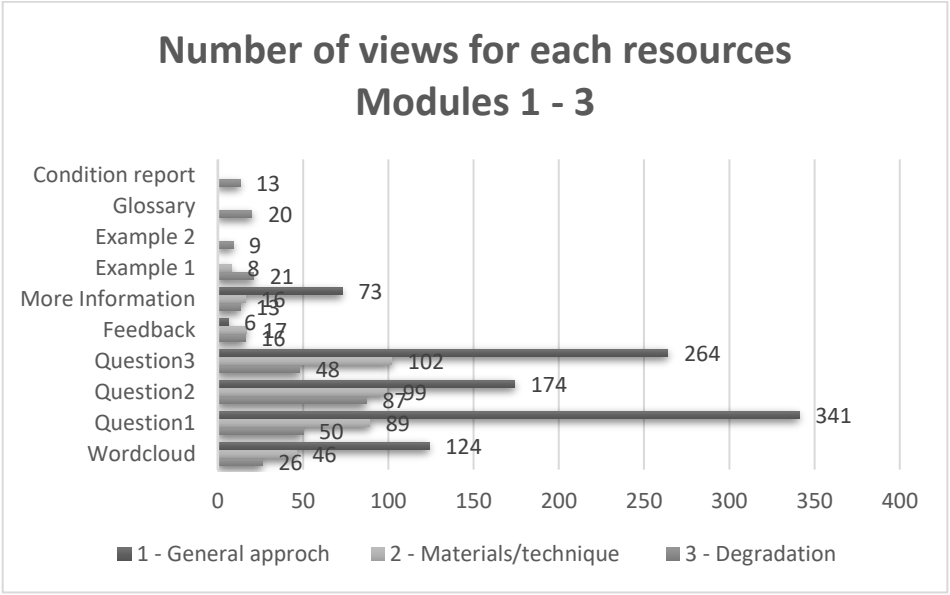

Figure 2. This is the number of views for each resources (module 1-3)

3. Conclusion

The CAPuS e-learning platform represents a unique experience, where the outcomes of a collaborative work carried out by a large and varied set of partners were then elaborated by a small operational core and offered to the public as e-learning courses. Through the e-learning platform, the CAPuS interdisciplinary and intersectoral Knowledge Alliance has

provided a free tool to transfer to a large audience the newly developed guidelines and protocols for the protection and conservation of contemporary art in public spaces.

Disclaimer

The CAPuS learning platform was created as part of the Conservation of Art in Public Spaces project (Co-funded by the Erasmus+ Programme of the European Commission, Project N° 588082-EPP-A-2017-1-IT-EPPKA2-KA).

References

Hattie, j., Yates, G.C.R. (2013). *Visible Learning and Science of How We Learn*. Routledge, London & New York

Hattie, J., Masters, D., Birch, K. (2016), *Visible Learning into action*. Routledge, London & New York

Kou, Y. C. (2010). *Interaction, internet self-efficacy, and self-regulated learning as predictors of student satisfaction in distance education courses*. Unpublished doctoral dissertation, Utah State University

Slavkin, M. (2004). *Authentic learning: how learning about the brain can shape the development of students*. Lanham, MD: Scarecrow Education Merrill, M.D. (2002), First Principles of Instruction. ETR&D, Vol. 50, No. 3, 2002, pp. 459

Schleicher, A. (2016). *Teaching Excellence through Professional Learning and Policy Reform: Lessons from Around the World*. International Summit on the Teaching Profession. Paris: OECD Publishing

Sweller, J. (1994). Cognitive load theory, learning difficulty, and Instructional Design. *Learning and Instruction*, 4(4), 295–312

Trinchero,R (2015*)* For a brain-based instruction: building the learning readiness through deliberate practice . *Form@re - Open Journal per la formazione in rete* ISSN 1825-7321 - DOI: http://dx.doi.org/10.13128/formare-17189 Numero 3,Volume 15, anno 2015, pp.52-66

Van Gog, T., Ericsson, K.A., Rikers, R. M., & Paas, F. (2005). Instructional design for advanced learners: establishing connections between the theoretical frameworks of cognitive load and deliberate practice. *Educational Technology Research and Development,* 53(3), 73–81.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14484

How to support cooperation in hybrid learning?

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Abstract

The aim of this study is to examine university students' view on the cooperation in hybrid learning and to find out the factors that influenced cooperation the most. The analysis revealed four main themes: communication, individuality, competences and cooperation settings. When talking about the importance of communication in cooperation, the learners emphasized the selection of communication channel and the importance of social interaction. In the theme of individuality, two themes emerged: individual and group characteristics. Among the competencies, learners highlighted the pedagogical competence of the teacher and the students' self-regulation skills. The tools and environment was considered important when setting up cooperation. The results of the survey revealed that learners in the form of distance learning, learners with a higher level of digital competence and learners in study groups with a stronger team sense are more positive about cooperation in hybrid learning.

Keywords: *Students' preferences; higher education; hybrid learning; survey, cooperation.*

1. Introduction

In recent years, the number of electronic courses and online learning applications have increased. Main effort today is on cooperation between learners and learners and lecturer, and not on the learning materials, as it was in the very beginning of e-learning (Ulmane-Ozolina, 2011). Satisfaction from the joint work and the awareness of the benefits of cooperation during online study shows among the reasons for the students' high level of feedback. But collaborative work skills and inclination to cooperation are not innate (Stoytcheva, 2018). They have to be known and built consciously. Cooperation in online learning creates ascending dynamics allowing for a stage by stage construction of outcomes. Learners and academics had to learn how to work online in a collaborative way. Cooperation in remote learning can facilitate students to learn concepts in depth and can improve learning outcomes through positive collaboration amongst students (Silalahi & Hutauruk, 2020). The online learning community is not just a group of people who have come together to gain some knowledge, but a community with a life and history of its own, where each person's opinion matters, decisions are made after discussion and there is an atmosphere of trust and respect due to the successful cooperation (Stoytcheva, 2017).

The aim of this study is to examine university students' view on the cooperation in hybrid learning and to find out the factors that influenced cooperation the most.

2. Background

In TTK University of Applied Sciences flexible learning is considered to be a simultaneous form of learning in which some learners are in the classroom and some at a distance. The need for hybrid learning arises if contact lessons are allowed, but in smaller groups. Even in situations where learners are forced to stay in isolation, hybrid learning is needed.

There are various drawbacks and advantages connected to hybrid learning and some aspects of them are related to collaboration during hybrid learning. Students make the decision to participate in hybrid learning on their motivations and needs (Park al., 2019). Hybrid learning is dependent on technology, the Internet, and various devices that not all potential beneficiaries can access (Sadeghi, 2019). Quality of hybrid learning is related to students' training, characteristics, and digital skills (Haznedar al., 2012). Hybrid learning limits physical interactions between learners, and these interactions are necessary for students' social development (Raes et al., 2020). The medium choice has also of great importance during hybrid lessons. Mumford and Dikilitaş (2020) emphasize that the medium can build a sense of community, and reduce the risk of a lack of communication and highlight the theme of the difficulties in the establishment of a social presence in online interaction. Communication between students and teachers occupies one of the key positions in the process of hybrid learning. According to Raad and Odhabi (2021) educators should

principally adopt active learning methods and this approach will promote interaction and collaboration between the instructor and learners. Hwang (2018) incites to allocate sufficient time to in-person interactions to allow for practical and hands-on sessions that are essential in technical and scientific disciplines. According to Priess-Buchheit (2020) when academics know how to communicate properly between the different groups hybrid learning transforms to a format with many advantages.

Based on the above, it can be pointed out that it is necessary to pay attention to these aspects in the research related to the implementation of hybrid learning.

3. Methodology

The qualitative survey was conducted among the students of TTK University of Applied Sciences to identify a further need for hybrid learning for learners, its causes and influencing factors of efficient communication and collaboration. This paper only concerns the influencing factors of efficient cooperation.

The survey was compiled using the Google Form tool and conducted in spring 2021. The survey was forwarded to all students of the university. In 2020\21, the total number of students was 2931, of which 570 students responded. The overall response rate was 19.45%.

First-year students responded to the survey most actively, followed by second, third and fourth-year students. Among the respondents there were more distance learners than full time learners. The respondents came from all institutes, with the largest number of responses coming from students in the fields of logistics, building construction, accounting, social work and production management. The highest number of respondents represented the younger age group, with fewer and fewer respondents from each subsequent age group. The highest response activity was amongst learners living in the capital city - Tallinn, followed by learners living in rural areas and then living in other cities.

The principles of qualitative thematic analysis were used to analyse open question answers (Creswell, 2012). Using thematic analysis it was possible to identify themes and patterns of meanings across the collected data in relation to the research question. As the researcher has to be familiar with the data, a careful reading was done identifying the patterns and relationships of the data in relation to the research question. Coding was done manually using data-derived semantic codes to present participants' experience in a more realist and descriptive way. Semantic codes were the emerging data (data quotes identified in the previous stage) which was labeled with a name that was derived from the data itself. When the codes were identified, they were included in the list of codes. Once the coding was completed, the patterns appearing within the data was identified to identify salient parts of the data. Both the frequency as well as how important a certain code is was considered to

answer the research question at the stage of identifying patterns in the dataset. To identify the broader patterns of the data, themes and sub-themes were identified. The sub-themes were considered as collections of ideas or aspects (codes) that were categorized under a specific theme. Identified themes were revised to be sure that all the themes match the research question, to cover everything and to point out differences according to the different perspectives. Finally, the themes were presented to answer to the research question. The findings were presented by integrating it with past literature. To explain the themes quotes from the data were presented.

4. Results

The analysis revealed four main themes: communication, individuality, competences and cooperation settings. All themes are discussed in more detail below. Topics are presented in order of emerging frequency.

4.1. Communication

Learners focused on communication the most when answering the survey. Three sub-themes emerged in this theme: video-enabled communication channels, social interaction between learners and information exchange with the teacher.

Under the conditions of hybrid learning, learners preferred **video-enabled communication channels** that allow direct communication to cooperate. This will help learners better understand each other and to refine quickly if necessary. The learners felt the need to work with the camera turned on so that everyone could see each other. When participating without a camera image, the learners felt that they were contributing less because they were engaged in other activities in the meantime. The Zoom environment was mentioned as a positive example, which allows one to communicate with text messages in the chat area as well as with a video image, and group work in smaller rooms. Outside the lectures, Messenger was used for collaboration.

Respondent 324: "Communication via a webcam is exactly the same as when meeting face to face. Does not feel isolated at all if many others participate from a distance. It would be inconvenient to participate alone from a distance."

In addition to group communication, **social interaction between learners** was also emphasised in order to keep active and strengthen the connection between learners. It can also be seen in a broader sense, i.e. according to the learners, active media use helps to feel socially involved during hybrid learning and does not cause difficulties in collaborating online, as the habit and skills to do so already exists. An example is Facebook, where students had their own groups through which both study and leisure-related topics were communicated.

Respondent 49: "We have a Facebook group where we can discuss all our things and the cooperation is very good both inside the group and with the teachers."

Both the importance of social interaction between students and right choice of medium were considered as important also in scholarly literature presented in the background section.

4.2. Individuality

Students' responses highlight individual and group characteristics, which had a supportive effect on cooperation in hybrid learning.

The most important **characteristic of the individual** is the attitude towards hybrid learning and cooperation in hybrid learning. Here, students were divided into three groups. First group includes learners who do not at all want to participate in hybrid learning. This group includes learners who have had prior dislikeble experiences or who prefer to participate in the classroom in any case.

Respondent 443: "In most cases, lectures are very well organized ... Communication is very important and technical tools do not replace it. If I have choosen full-time studies, I want contact learning and communication."

Second group is only ready to participate in the hybrid learning process for a short-term hybrid learning period. They also strongly prefer to study in the classroom, but are also willing in the short term to contribute to distance learning.

Vastaja 17: "If some students also attend on-site lectures, this should not be particularly negative. For me, hybrid learning would be especially good if, for example, surprises due to work do not allow me to be present or I am ill, but I can still listen to the lecture in another way. However, if possible, I would attend lectures on-site if possible."

Third group said that it didn't matter to them how teaching and cooperation takes place. These learners are experienced and skilled users of digital tools who also use digital tools for cooperation at work. This group is characterised by independence and courage, they are not ashamed to ask or discuss things. This group also includes more introverted personalities to whom face-to-face communication is less important. This group considered that hybrid learning and due cooperation has a number of values. Convenience and economy (in the meaning of time and money) were mentioned as the most important values primarily by distance learning students living further away from the university.

Respondent 17: "If some students attend on-site, this should not be very negative. For me, hybrid learning would be especially good if, for example, suddenness due to work do not allow me to be present or I am ill, but I can still attend in another way. However, as usual, if possible, I would attend on-site."

On the **characteristics of the group** a strong team feeling was mostly mentioned. Some respondents said that if they were freshmen and fellow students would still be strangers, cooperation in hybrid learning would certainly be more difficult than now that the group is being constantly in close contact. The freshmen confirmed that cooperation is complicated in hybrid learning as they do not yet know each other well and therefore distant cooperation seemed an unsafe choice. In addition, it was pointed out that cooperation is more complicated if only one student participates remotely, because of less attention the learner receives.

Respondent 490: "Since our course had been together for several years before, I did not feel any negative impact. Of course, it would be different in the first year."

4.3. Competences

The learner's self-regulation skills, the didactic competence of teacher and digital competence of teacher and learner emerged from the competences.

Students talked the most about their own **self-regulation skills**. In the opinion of learners, everything begins with motivation, it largely determines the result. Motivation is also linked to the goal: understanding what is being done and that it is necessary. Learners pointed out they needed more self-discipline and willpower when participating in hybrid learning. Online communication needed to focus more on understanding each other, and at times learners gave up and divided group work into rations instead of working together. This way, everyone worked individually and the efficiency of group work declined. The contributions were also unequal which caused ambivalent feelings like frustration, confusion and nonsense.

Respondent 158: "The co-operation is going very well and people are much more motivated to take part in group work, as they are given the opportunity to take part at least from a distance and take part in the lecture."

Respondent 401: "There is less co-operation, more division of tasks and more pecking at them."

Students' responses brought out the importance of the **didactic competence of the teacher**. Learners emphasised that the way in which the teacher has designed group work is critical in hybrid learning. Particular emphasis was placed on how teachers have taken into account remote participation, how teachers establish contact with learners and encourage learners. This creates the right mindset and sense of security for learners. Learners had noticed that in conditions of hybrid learning, group work requires more time and considered it important that teachers had already accounted for it. Also considered important was how lecturers sticked with time schedule during studies.

Respondent 46: "Cooperation depends on the lecturer. In some lectures, the cooperation has gone very well and there has been an opportunity to successfully conduct group work with classmates, and in these cases there has been no sense of isolation."

Didactic competence of the teacher in the conditions of hybrid learning was also emerged in the previous researches discussed in background section.

4.4. Cooperation settings

While carrying out lessons students needed an environment allowing them to concentrate and tools to participate.

Learners mentioned a comfortable, safe and quiet environment as **characteristics of an environment that allows concentration**. This was particularly emphasised by remote participants. Extraneous distractions reduced concentration and commitment. Some learners described the home environment as safer than the classroom.

Respondent 73: "Distant learning is convenient. Rather, the environment is quiet. It is definitely safer from a health point of view, because we come from different areas and it is relatively unsafe, the risk of infection is high."

To participate online **tools** such as a computer, microphone and camera were needed as well as internet access. Internet interruptions and non-connection of tools prevented participation and collaboration.

Respondent 457: "I am not bothered by this, but the big obstacle for me is the poor internet connection. Unfortunately, my motivation for this has gone down."

5. Conclusions

The qualitative analysis of collected data revealed four main themes which influenced cooperation in hybrid learning the most: communication, characteristics of the individual and group, competencies and cooperation settings. The results of this study are confirmed by the results of them discussed in background section.

The results of the survey revealed that learners in the form of distance learning, learners with a higher level of digital competence and learners in study groups with a stronger team sense are more positive about cooperation in hybrid learning.

Based on the results of the study following recommendations can be made to support cooperation in hybrid learning: before group work identify learner's digital and cooperation skills and, if necessary, address them before the actual group work starts; if the group is not well acquainted with each other, pay attention to socialisation of learners; start group work

in classroom so that learners can specify the taskwith the teacher and agree upon work process with each other.

The results of the study help to understand learners' view on cooperation in hybrid learning, to plan and conduct future studies in a student supportive way and plan training for teachers to improve hybrid teaching process.

References

Creswell, J.-W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th Ed.). Boston: Pearson.

Haznedar, Ö., & Baran, B. (2012. Eğitim Fakültesi Öğrencileri için e-Öğrenmeye Yönelik Genel bir Tutum Ölçeği Geliştirme Çalişmasi. *Eğitim Teknolojisi Kuram ve Uygulama*. https://dergipark.org.tr/tr/download/article-file/71817

Hwang, A. (2018). Online and hybrid learning. *Journal of Management Education*, 42(4), 557-563. https://doi.org/10.1177/1052562918777550.

Mumfor, S., & Dikilitaş, K. (2020). Pre-service language teachers reflection development through online interaction in a hybrid learning course. *Computers & Education,* 144. https://doi.org/10.1016/j.compedu.2019.103706.

Park, E., Martin, F., & Lambert, R. (2019). Examining Predictive Factors for Student Success in a Hybrid Learning Cource. *The Quarterly Review of Distance Education*, 20(2).

Priess-Buchheit, J. (2020). Synchronous hybrid learning in times of social distancing. A report and case study on benefits, trainer's challenges, and guidelines. *International Journal for Innovation Education and Research,* 8(10), 356–364. https://doi.org/10.31686/ijier.vol8.iss10.2689.

Raad, M. E. A., & Odhabi, H. (2021). Hybrid Learning here to stay! *Frontiers in Education Technology*, 4(2), 121-131. doi:10.22158/fet.v4n2p121.

Raes, A., Detienne, L., Windey, I., & Depaepe, F. (2020). A Systematic Literature Review on Synchronous Hybrid Learning: Gaps Identified. *Learning Environments Research*, 23(3), 269-290.

Sadeghi, M.A. (2019). Shift from classroom to distance learning: Advantages and limitations. *Int. J. Res. Engl. Educ*, 4, 80–88.

Silalahi, T. F., & Hutauruk, A. F. (2020). The Application of Cooperative Learning Model during Online Learning in the Pandemic Period. *Budapest International Research and Critics Institute (BIRCI-Journal) : Humanities and Social Sciences*, 3(3). doi: https://doi.org/10.33258/birci.v3i3.1100.

Stoytcheva, M. (2017). Collaborative distance learning: Developing an online learning community. *AIP Conference Proceedings*, 1910, 060009. doi: 10.1063/1.5014003.

Stoytcheva, M. (2018). Students' perceptions of online collaboration in a distance learning French language course. *AIP Conference Proceedings*, 2048(1), 020030. doi: 10.1063/1.5082048.

Ulmane-Ozolina, L. (2011). Technology use for collaboration in blended learning. *Problems of education in the 21st century*, 33, 83–91.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14231

ECTS, workload, and quality of higher education

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Abstract

The use of ECTS has facilitated student and graduate mobility within Europe and the comparison of study programs and courses. However, we have found thar the ECTS credit equivalence in hours, from 25 to 30, is oversized. We show that this workload associated with ECTS credit has a negative impact on the quality of education systems and on the health of students, and that it is a threat to the credibility of the ECTS system itself. We conclude that a review of the hours/credit ratio is necessary, and we propose this ratio to be 20.

Keywords: *ECTS credit; workload; academic calendar; Quality of Higher Education.*

1. Introduction

One of the the main actions of the EHEA (European Higher Education Area) has been the introduction of the ECTS system (European Credit Transfer and Accumulation System). ECTS is a learner-centred system for credit accumulation and transfer. Until ECTS was defined, in European universities there was no standard measure of student work time, including outside the classroom. Today, ECTS helps in the design, description and delivery of programmes, makes it possible to integrate different types of learning in a lifelong learning perspective, and facilitates the mobility of students by easing the process of recognising qualifications and periods of study.

ECTS credits express the volume of learning based on the defined learning outcomes and their associated workload. 60 ECTS credits are allocated to the workload of a full-time academic year. But the real workload can only be measured in working hours, so, it is essential to establish the ratio between ECTS credits and working hours. A right definition of this ratio is fundamental for the validity and usability of the ECTS system, as well as to guarantee the quality of higher education in Europe when courses are planned using ECTS as a measurement of workload.

The rest of this paper is organized as follows. First, we analyze the workload associated with the ECTS credit adoption. Next, we expose the risk to the health of students and to the quality of student learning that this adoption entails. Finally, we make proposals to correct detected problems.

2. ECTS workload

The reference document for the use of ECTS credits is the ECTS User Guide (European Union, 2015). This document does not have a normative nature, but it is the reference that European countries have followed when regulating the Bologna process in relation to student workload. This guide establishes that 60 ECTS credits correspond to the workload for an academic year. But it does not define what is the load in hours that an ECTS credit supposes. This task is left to the legislation of each country, and it cites that "*in most cases, workload ranges from 1,500 to 1,800 hours for an academic year, which means that one credit corresponds to 25 to 30 hours of work*". This equivalence of an ECTS credit with 25-30 hours of work is what we find in almost all European legislations and universities, with the exception of the British, which equate 1 ECTS credit with 20 hours of work (European Union, 2009, in Annex 5).

By assigning between 1,500 and 1,800 hours per academic year, regulations have taken the labour force statistics as a reference: when that equivalence was established, around 2003, the average time worked in the European Union was between 1,428 hours per year in the

Netherlands and 1,983 hours for Greece workers (OCDE, 2021). By 2020, these values have decreased to a minimal of 1,332 hours in Germany, and a maximum of 1,766 in Poland (see Table 2). However, taking that reference for academic workload, legislators have not considered that the academic calendar and the working days calendar are not the same.

2.1. Working days calendar

The number of days worked full time during a year varies depending on the legislation of each country and the worker's labor agreement. However, the European Union establishes that all workers will have a period of at least four weeks of paid vacation annually (European Union, 2003), leading to no major differences in European working calendars. The annual working days in a year is obtained by subtracting the not worked days from 365:

- Week-end days. They are 104.
- Bank holidays. It ranges from 9 to 14 (Eurofound, 2021).
- Paid annual leave. The average annual paid leave stood at 24.5 days in the EU27 in 2020 (Eurofound, 2021).

This results from 222 annual working days in Germany to 232 in Hungary, Poland, Ireland and Belgium.

2.2. Academic calendar

It does not seem easy to cope with the variety of lengths of the actual study period per academic year within Europe. However, one of the documents on which the ECTS Guide is based (Wagenaar, 2006), states that the university calendar in Europe lasts between 34 and 40 weeks, and that, when programmes are broken down, the differences in length prove to be much smaller than one would expect at first glance.

But using the week as a measure of time introduces a significant distortion in the total calculation for a year, since many weeks will contain less than 5 working days. It is more precise to use the same measure that we have applied to the working calendar, that is, the number of days actually available for study after removing vacations and holidays. In Rivadeneyra (2015) the academic calendars for 5 years in an European university are studied. Measured in weeks, it found that the academic year ranges between 35 and 39 weeks, depending on whether or not inter-term vacations are counted. This is in line with the range reported by Wagenaar (2006). But, in addition, Rivadeneyra (2015) also measures the number of days corresponding to those weeks, finding that they can be from 165.2 to 178.4 days, depending on whether inter-term vacations are counted or not. We will adopt these figures to calculate the daily load of a student.

2.3. Daily working hours

The most accurate measure of workload is the working day, obtained as a quotient between the hours worked in a year and the number of working days contained in that year. From the data collected on the duration of the working and academic calendars, in Table 1 we compare the daily workload for a student according to the ECTS criteria, and the load for an European worker. It shows that the load assigned to students is much higher than to workers. If it is accepted that the workload of a student should not be greater than that of a worker, we can affirm that the ECTS credit equivalence in hours, from 25 to 30, is oversized.

Table 1. Daily workload for students and workers.

	Annual working hours (min-max)	**Annual working days (min-max)**	**Daily working hours (min-max)**
European worker - 2020	1,332 – 1,766 (1)	222 – 232 (2)	6 – 7.61
Student	1,500 -1,800	165.2 – 178.4 (3)	8.4 – 10.89

Sources: (1) OCDE.Stat. (2021); (2) Eurofound, (2021); (3) Rivadeneyra (2015).

Table 2 shows the values in hours that the ECTS credit should have to equal the daily workload of a student to that of an European worker in 2020. It ranges from 16.52 hours per ECTS credit for a daily load equal to the European minimum (in Germany, with an average of 6 hours daily work), during the minimum academic calendar measured in Rivadeneyra (2015) (165.2 school days), and 22.62 hours per credit in case of the European maximum workday (Poland, 7.61 hours) and the longest academic calendar (178.4 days, assuming that on inter-term vacation days the student will work the same hours as on standard days included in the academic calendar).

Table 2. Hourly value of the ECTS credit to plan a daily workload similar to that of workers.

Daily working hours	**Annual working days (min-max)**	**Annual working hours (min-max)**	**Hours/ECTS credit**
6	165.2 - 178,4	991.2 – 1,070.4	16.52 – 17.84
7.61	165.2 - 178,4	1,257.17 – 1,357.62	20.95 – 22.62

3. Consequences

Great efforts are being made to correctly plan the workload required to students. In accordance with legislation, these schedules are made considering that an average student has to work at least 1,500 hours per year, which gives rise to weekly and daily loads well above that borne by European workers. For example, in Sánchez (2014), a scheduled workload of about 45 hours per week is considered appropriate in a Spanish university, planning up to 51 hours for some weeks. In other European countries things are not different. As a sample, in Komenda and Malisa (2011) an average of 50 hours per week is also planned. If we consider that European legislation expressly prohibits working weeks longer than 48 hours (European Union, 2003), we should conclude that it is not reasonable demanding our students to exceed this limit.

Anyway, it is not only a question of labor legislation (which is not applicable to students), it is also a question of the quality of the university system, or even student health. It is known that an excessive student workload hinders an adequate assimilation of concepts (Ruiz-Gallardo et al, 2011), and that it leads to superficial learning (Bachman & Bachman, 2006; Lizzio et al, 2002). Overload is also related to absenteeism (Cerrito & Levi, 1999), and academic failure (Cope & Staehr, 2005), being one of the main causes of drop out (Woodley & Parlett, 1983). Its consequences can be really harmful for students health, affecting their self-esteem and self-confidence (Chambers, 1992), or even producing anxiety and depression (Diaz et al, 2001).

On the other hand, measurements of the real effort put into by students (Jimenez-Munoz, 2015; Souto-Iglesias & Baeza-Romero, 2018) reveal that, in general, they manage to not comply with the schedules their teachers make, and they are carrying out their courses working fewer hours than planned. Perhaps it is just a natural defense mechanism to preserve their health, but aforementioned negative effects on the quality of learning are unavoidable.

This scenario is changing as the Bologna process is boosting the paradigm shift from teacher-centered to student-centered higher education. These new modes of learning and teaching, often involve a much closer control of the work done by students inside and outside the classroom. That is, these new methodologies provide teachers with tools that, to a certain extent, force students to really do the tasks planned in a course. So, in this emerging scenario students will not have as much freedom as they have been up to now to comply or not with the hours outside the classroom planned by the teacher. One of the publications that analyze the impact of this methodological change on the student's workload is Ruiz-Gallardo et al. (2011). Their results confirm the increase in student effort induced by the introduction of student-centered active methodologies: it measures an average increase of 266% in student effort after changing the methodology, and warns of

needing to monitor the actual hours that the student invests, just to detect and correct dangerous overload.

Another consequence of the explosive combination of new methodologies and oversized ECTS credits is exposed in Navarro et al. (2014). They measure the worsening of results in companion courses (in the same term) of those that introduce active methodologies. They have found that active courses cannibalize students' time, leading to a harmful side effect in companion courses, which are deprived of that student time. Navarro et al. (2014) defend that, to avoid this, all courses should implement these changes simultaneously. We think that, before it, the workload of every course should be redefined downwards.

4. Conclusions and proposals

The conclusions drawn from the above are the following:

1. The analysis of the academic calendar reveals that the ECTS credit is oversized. Only by requiring the student to work above the average for European workers, and, frequently, even above labor legislation, could schedules with 25-30 hours per credit be fulfilled.
2. Measurements of the effort of the students show that, in general, they are not performing the 25 or more hours planned for an ECTS credit. This is a risk for the credibility of the ECTS system.
3. The new teaching methodologies that monitor the student's work can force the student to perform the workload planned. The serious consequences on the quality of teaching and on the health of students that would have to approximate the effort made by the students to the 25-30 hours planned per credit will make clear the unfeasibility of this ratio.
4. If actions are not taken to correct this situation, we will find that each university or each center will face the reality of the infeasibility of the 25-30 hours/credit ratio in its own way. In other words, every institution will adopt its own credit/hours ratio, jeopardizing the usefulness of the ECTS system as a tool to facilitate the mobility between EHEA institutions.

Our proposals to correct this situation are:

1. In order to neutralize the risks for the EHEA, as soon as possible update current recommendations and legislation to associate 20 hours of workload with an ECTS credit.

2. In order to avoid damage to the quality of teaching and/or to the health of students, those responsible for university courses should plan considering 20 hours/credit, even without waiting for regulatory changes.

The proposed 20 hours/credit ratio is based on data in Table 2, as a mean value between the maximum and minimum collected in it. So, it is an hourly value of the ECTS credit that leads to a workload for students similar to that for workers. Furthermore, it is a value that has been already adopted in some European states (United Kingdom and Ireland).

References

Bachman, L., Bachman, C. (2006). Student perceptions of academic workload in Architectural education. *Journal of Architectural and Planning Research, 23(4), 271-304.*

Cerrito, P. B., & Levi, I. (1999). An investigation of student habits in mathematics courses. *College Student Journal, 33(4), 584-588.*

Chambers, E. (1992). Work-load and the quality of student learning. *Studies in Higher Education, 17(2), 141-153.*

Cope, C., & Staehr, L. (2005). Improving students' learning approaches through intervention in an information systems learning environment. *Studies in Higher Education, 30(2), 181-197.*

Diaz, R. J., Glass, C. R., Arnkoff, D. B., Tanofsky-Kraff, M. (2001). Cognition, anxiety, and prediction of performance in 1st-year law students. *Journal of Educational Psychology, 93(2), 420-429.*

Eurofound (2021), Working time in 2019–2020, *Publications Office of the European Union, Luxembourg.*

European Union. (2003). Directive 2003/88/EC of the European Parliament and of the Council of 4 November 2003 concerning certain aspects of the organisation of working time. *Official Journal L 299 , 18/11/2003 P. 0009 – 0019*.

European Union. (2009). ECTS Users' Guide 2009. *Luxembourg: Publications Office of the European Union. Doi: 10.2766/88064*.

European Union. (2015). ECTS Users' Guide 2015. *Luxembourg: Publications Office of the European Union. Doi: 10.2766/87192*.

Jimenez-Munoz, A. (2015). Flipping lectures: analysing student workload in EMI contexts. *Procedia-Social and Behavioral Sciences 212, p. 35-41*.

Komenda, T., Malisa, V. (2011). Implementing an ECTS-barometer for the optimization of student workload distribution, as demonstrated in an example from the Master degree programme Mechatronics/Robotics. *Global Engineering Education Conference (EDUCON), pp. 168-171*.

Lizzio, A., Wilson, K., & Simons, R. (2002). University students' perceptions of the learning environment and academic outcomes: implications for theory and practice. *Studies in Higher Education, 27(1), 27-52*.

Navarro, J., Canaleta, X., Vernet, D., Costa, N., Solé, X., Jiménez, V. (2014). Motivación, desmotivación, sobremotivación y daños colaterales. *XX Jornadas de Enseñanza Universitaria de Informática, Jenui 2014, pp. 467 – 474.*

OCDE.Stat. (2021). Average annual hours actually worked per worker. Online document, retrieved December 17, 2021, from https://stats.oecd.org/Index.aspx?DataSetCode=ANHRS#.

Rivadeneyra, J.M. (2015). ¿Es realista planificar 25 horas por crédito ECTS? *ReVisión vol. 8, nº 3, 45-53*.

Ruiz-Gallardo, J.R., Castaño, S., Gómez-Alday, J.J., Valdés, A. (2011). Assessing student workload in Problem Based Learning: Relationships among teaching method, student workload and achievement. A case study in Natural Sciences. *Teaching and Teacher Education, 27(3), 619-627*.

Sánchez Carracedo, F. (2014). Evidencias para acreditar una titulación de grado. *ReVisión vol. 7, nº 3, 2014*.

Souto-Iglesias, A., Baeza-Romero, M.T. (2018). A probabilistic approach to student workload: empirical distributions and ECTS. *Higher Education 76.6, p. 1007-1025*.

Wagenaar, R. (2006). Educational Structures, Learning Outcomes, Workload and the Calculation of ECTS Credits. https://www.unideusto.org/tuningeu/workload-a-ects.html.

Woodley, A., & Parlett, M. (1983). Student drop-out. *Teaching at a Distance, 24, 2-23.*

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14439

Do universities have a distinctive brand personality? The case of ECIU Universities

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Abstract

Brands increasingly adopt human qualities as a way to attract consumers. Brands must be physically attractive, intellectually persuasive, socially involved, and emotionally appealing, all while demonstrating a strong personality and moral foundation. Higher Education Institutions (HEI) are no exception, seeking their audiences through a distinctive and attractive brand personality. The main purpose of this paper is to identify the main brand personality traits of European universities, based on content analysis of institutional websites. Twelve universities from the European Consortium of Innovative Universities (ECIU) were studied. The results indicate the existence of HEIs with distinctive brand personalities while others present weak personality dimensions. The main conclusions point to the need for a focus on strategic brand management that includes a robust identity definition. The brand personality, an integral part of the institution's identity, must be communicated consistently across all points of contact and communication channels.

Keywords: *Higher Education Institutions Marketing; Strategic Brand Management; Brand Personality; Communication; ECIU.*

1. Introduction

In recent years, the ageing of populations and the consequent decrease in the number of prospective students has led Higher Education Institutions (HEIs) to face a more competitive context in their efforts to attract new students. In the European context, the Bologna Process has brought profound changes in Higher Education: by facilitating the mobility of students between study cycles, higher education has become more attractive, accessible and inclusive, but also more competitive. Felgueira and Rodrigues (2015) argue that this movement of students, along with increasing budgetary constraints, made the environment in HEIs quite turbulent. The communication paradigm has also changed drastically, forcing HEIs to make an effort to adapt to a new reality, characterized by more complex communication processes. Universities are therefore required to have a new way of relating to their main public (their stakeholders) in a highly competitive context that is no longer limited to national borders.

Based on the assumption that a website of an HEI is a gateway to different stakeholders and allows establishing a relationship with them, it is important to understand how this communication channel projects the institution's image and identity. The main objective of this paper is to investigate how brand personality is communicated by HEIs, using Aaker's (1997) five brand personality dimensions - sincerity, excitement, competence, sophistication and ruggedness - and Opoku et al., (2007) dictionary of terms. The main contribution of this research is to understand how HEIs are forming their brand personality through the language used in one of the main communication channels.

2. Theoretical background

Regarding the public of an HEI, Mainardes (2010) lists a broad set of players, mentioning, however, that the focus is still on some specific stakeholders, leaving in the shadows some groups that he considers critical. The most considered groups are students, faculty, management and administration, and accreditation agencies, while the least considered groups are the institution's employees, competitors, and the community, to name just a few. Prospective students are not passive "consumers"; on the contrary, to make the best choice about the course or institution they wish to attend, they seek to gather information about what each HEI has to offer. Knowing the reasons that lead candidates to make a certain choice is very important for the construction of an institutional positioning that meets these criteria of choice (Nicolescu, 2009).

Although Chapleo (2007) indicates that brand management in the higher education context has received limited academic attention, several subsequent studies have focused on best practices regarding the design and strategic management of branding in a variety of ways, such as brand value (Mourad et al., 2011), brand development (Garipağaoğlu, 2016), brand image formation (Wilkins & Huisman, 2014), and brand personality (R. Rutter et al., 2017).

According to Harris and De Chernatony (2001) , there is a greater demand for brand differentiation (of HEIs) through emotional factors rather than their functional characteristics. Importantly, the emotional value of the brand is perceived throughout the interactions with different stakeholders, either through personal contact or through what is communicated. Bulotaite (2003) states that university brands may have the potential to generate stronger feelings than most brands. From his perspective, the key to a successful branding process is the creation and communication of a unique identity. According to Kotler et al. (2017) more and, more brands are adopting human qualities as a way to attract consumers. Brands must be physically attractive, intellectually compelling, socially involved, and emotionally appealing, all while demonstrating a strong personality and moral foundation.

Regarding the concept of brand personality, the work of Aaker (1997) is widely recognized. According to the author, brand personality is the set of human characteristics that are associated with it. Considering that the existence of a brand with distinctive characteristics is a differentiation factor for HEIs, the strategy of analyzing how target audiences understand the brand will be very useful (Rutter et al., 2017; Watkins & Gonzenbach, 2013) and the same can be said about how it is being communicated.

It is safe to assume that today most companies and organizations have adopted an omnichannel digital communication strategy - a website and a varying number of social networks - through which they communicate with their audiences. According to Saichaie e Morphew (2016), HEI websites are a primary source of information for prospective students and it is through this channel that such institutions create their first impression. The message transmitted through the HEIs' websites is thus of utmost importance and should ensure that it is possible to infer their mission and what differentiates each institution (Schneider & Bruton, 2004).

3. Methodology

The study consisted on the content analysis of the websites of the twelve HEIs that were part of the European Consortium of Innovative Universities (ECIU) at the time of this study. The choice of these HEIs was due to the growing importance that this network of universities assumes in the European context since they seek to build an innovative pedagogical model that they need to communicate in a very diverse cultural context. Also, there are no other studies known to date that focus on members of the ECIU in this context. The collection and processing of the analyzed content went through four stages: i) the delimitation of the contents to be collected; ii) the collection and storage of the Website's content; iii) the analysis of the collected texts which resulted in positioning graphs of the HEIs in the Brand Personality Dimensions according to Aaker (1997), and iv) the analysis of the obtained data.

After a first exploratory analysis, it was found that it would not be feasible to proceed with a full analysis of the websites and therefore a selection of topics was made, namely: general presentation of the HEI, presentation of the mission, vision and values of the HEI, strategic vision, pedagogical model, reasons for choosing the university and academic life. These were considered to be those that best expresses what the HEI says about itself, that is, what the institution communicates as being its identity. We then proceeded to cross-reference the text files obtained, based on the written discourse collected from the respective websites, with the dictionary of terms (Opoku et al., 2007) corresponding to each dimension of the brand personality, using the WordStat9 tool. This brand personality dictionary is currently the only method to quantitatively assess brand personality through text analysis within the five brand personality dimensions of Aaker (1997). The method is unique in that the analysis provides a frequency count of dimensional synonyms within a text, which shifts the focus from consumers' perception of brand personality to what organizations as brands are saying about themselves (Rutter et al., 2018).

4. Results

In the absence of classification scales for the obtained values, the researchers adopted the following classification: i) dominant dimensions were considered those with values equal to or greater than 50% (highlighted in blue), ii) very relevant dimensions were considered those with values between 45% and 49% (highlighted in orange), and iii) relevant dimensions were considered those with values up to 30% (marked in grey). Table 1 shows the percentage values calculated according to the number of occurrences of the terms associated with each dimension of brand personality. The results show that almost all HEIs present dominant, very relevant or relevant brand personality traits.

The three brand personality dimensions with the most dominant or relevant occurrences are Excitement, followed by Sincerity and Competence. The Excitement dimension involves brands that are perceived as being imaginative, up-to-date, inspiring, edgy and spirited (Moura, 2021). Seven of the twelve HEIs show distinctive values in this dimension. Although none of the HEIs present this as a dominant dimension, two HEIs position themselves with very relevant values - the University of Dublin (49%) and the University of Stavanger (47%). In this dimension, the University of Hamburg registers the lowest value (20.63%). The Excitement dimension conveys a youthful attitude that intends to provide a fun and engaging experience to the consumer. Thus, there seems to be an effort to approach students (i.e., one of the main stakeholders of the HEIs) in the HEIs' discourse.

The sincerity dimension includes brands that are seen as practical and trustworthy, frequently because they follow ethical practices or are committed to the community (Moura, 2021). This is also a dimension of brand personality that is evident in five of the twelve HEIs under study.

Table 1 - % distribution of HEIs by Brand Personality Dimensions

	Brand personality dimensions				
IES	Excitement	Sincerity	Competence	Ruggedness	Sophistication
Aalborg	27.59%	37.93%	17.24%	10.34%	6.90%
Aveiro	24.73%	35.48%	29.03%	5.38%	5.38%
Barcelona	43.75%	29.69%	14.06%	10.94%	1.56%
Dublin	49.06%	13.21%	26.42%	7.55%	3.77%
Hamburg	20.63%	49.21%	25.40%	3.17%	1.59%
INSA	36.51%	17.46%	31.75%	-	14.29%
Kaunas	25.49%	15.69%	52.94%	1.96%	3.92%
Linkoping	26.60%	24.47%	25.53%	14.89%	8.51%
Stavanger	47.00%	22.00%	11.00%	12.00%	8.00%
Tampere	36.76%	22.06%	28.68%	5.15%	7.35%
Trento	32.50%	34.38%	26.88%	3.13%	3.13%
Twente	34.81%	21.48%	31.85%	6.67%	5.19%

As institutions that provide a service to the community, it is important to show themselves as transparent and trustworthy organizations. In this dimension, the University of Hamburg presents the highest value, with 49.21% of the occurrences of associated terms.

Competent brands are mainly seen as being well-organized and efficient, perceptions often grounded on the organization behavior in society (Moura, 2021). Only two HEIs show relevant values in this brand personality dimension, which is somewhat surprising considering the higher education sector and the association with higher-level studies. The University of Kaunas presents a dominant brand personality trait communication, with a value of 52.94% in this dimension.

When it comes to the Sophistication and Ruggedness dimensions, the values are low in all the analyzed HEIs. Sophisticated brands are the ones perceived by consumers as upper class and stylish, commonly associated with luxury products or services. The Ruggedness dimension includes brands seen as adventurous and athletic (Moura, 2021).

Looking at each HEI individually, only one of the institutions has a dominant brand personality dimension. This is Kaunas University, whose dominant dimension is Competence. At the opposite pole, Linkoping University shows an even distribution of values, meaning that no dimension stands out in relation to the others.

5. Conclusions and Future Research

In this study, based on the HEIs website content analysis, it is possible to identify brands that have dominant, varied as well as a fragile brand personality. According to Guttmann (2019), the most robust brands tend to highlight one primary and optionally one secondary brand personality dimension. Put in other words, HEIs have to set a clear direction as to what they want to communicate as their brand, departing from the idea that they can be everything to everybody.

The main contribution of this work is that it offers HEIs indications for building a brand personality that meets the institution's identity. The first step is to know yourself and define a path to follow. Is what the institution communicating in fact what it was intended to communicate as a brand? This study may provide some clues with implications for the strategic brand management of HEIs since it allows a diagnostic process and the design of communication strategies that help strengthen the intended brand personality through the discourse used.

This study integrates a broader investigation that also seeks to understand the perception of the studied HEIs regarding the brand personality they are communicating on their websites. To this end, a questionnaire was applied to representatives of the communication offices of the universities of the ECIU consortium, in particular to their employees involved in the strategic management of their respective brands, in order to clarify which personality traits, they consider to be those that best describe their HEIs. In future studies, besides the view of internal stakeholders, it will be interesting to explore the perception of external stakeholders, particularly students. Is the communicated brand personality understood in the intended way? Does the emotional response produced have results that can be translated into attracting students?

Beyond what HEIs say about themselves on a specific channel (i.e., institutional website), there is much more to explore. Currently, HEIs bet on a multiplicity of channels to communicate with their different stakeholders. A more complete study would consist of a comparative analysis of the communication of the brand personality in the various communication channels used by the institution. Given the multiplicity of stakeholders, should HEIs communicate differently in each channel in order to produce an emotional response that meets each specific audience?

References

Aaker, J. (1997). Dimensions of Brand. *Journal of Marketing Research*, *34*(3), 347–356.

Bulotaite, N. (2003). University heritage—an institutional tool for branding and marketing. *Higher Education in Europe*, *28*(4), 449–454. https://doi.org/10.1080/0379772032000170417

Chapleo, C. (2007). Barriers to brand building in UK universities? *International Journal of Nonprofit and Voluntary Sector Marketing*, *12*(1), 23–32. https://doi.org/10.1002/nvsm.271

Felgueira, T., & Rodrigues, R. G. (2015). Market Orientation of Teachers and Researchers in Higher Education Institutions: A New Approach. *Procedia - Social and Behavioral Sciences*, *174*, 3017–3024. https://doi.org/10.1016/j.sbspro.2015.01.1092

Garipağaoğlu, B. Ç. (2016). Branding in higher education: A case study from Turkey. *Higher Education Policy*, *29*(2), 254–271. https://doi.org/10.1057/hep.2015.24

Guttmann, B. (2019). *Explaining the Five Dimensions of Brand Personality*. https://medium.com/digital-natives/explaining-the-five-dimensions-of-brand-personality-a22cd04c43e2

Harris, F., & de Chernatony, L. (2001). Corporate branding and corporate brand performance. *European Journal of Marketing*, *35*(3–4), 441–456. https://doi.org/10.1108/03090560110382101

Kotler, Hermanwan, K., & Iwan, S. (2017). *Marketing 4.0 Moving from Traditional to Digital*. Wiley.

Mainardes, E. W. (2010). *Gestão de Universidades Baseada no Relacionamento com os seus Stakeholders*. Universidade da Beira Interior.

Moura, F. (2021). *Brand Personality: Understanding Aaker's 5 Dimension Model*. https://liveinnovation.org/brand-personality-understanding-aakers-5-dimension-model/

Mourad, M., Ennew, C., & Kortam, W. (2011). Brand equity in higher education. *Marketing Intelligence & Planning*, *29*(4), 403–420. https://doi.org/10.1108/02634501111138563

Nicolescu, L. (2009). Applying Marketing To Higher Education: Scope And Limits. *Management & Marketing*, *4*(2), 35–44.

Opoku, R., Abratt, R., Bendixen, M., & Pitt, L. (2007). Communicating brand personality: Are the web sites doing the talking for food SMEs? *Qualitative Market Research*, *10*(4), 362–374. https://doi.org/10.1108/13522750710819702

Rutter, R., Lettice, F., & Nadeau, J. (2017). Brand personality in higher education: anthropomorphized university marketing communications. *Journal of Marketing for Higher Education*, *27*(1), 19–39. https://doi.org/10.1080/08841241.2016.1213346

Rutter, R. N., Hanretty, C., & Lettice, F. (2018). Political Brands: Can Parties Be Distinguished by Their Online Brand Personality? *Journal of Political Marketing*, *17*(3), 193–212. https://doi.org/10.1080/15377857.2015.1022631

Saichaie, K., & Morphew, C. (2016). What College and University Websites Reveal about the Purposes of Higher Education. *The Journal of Higher Education*, *1546*(85), 499–530. https://doi.org/10.1080/00221546.2014.11777338

Schneider, G. P., & Bruton, C. M. (2004). Communicating with Multiple Stakeholders:

Building Effective University Websites. *Journal of Organizations Culture,Comunications and Conflict*, *8*(2), 73–80.

Watkins, B. A., & Gonzenbach, W. J. (2013). Assessing university brand personality through logos: an analysis of the use of academics and athletics in university branding. *Journal of Marketing for Higher Education*, *23*(1), 15–33. https://doi.org/10.1080/08841241.2013.805709

Wilkins, S., & Huisman, J. (2014). Corporate images' impact on consumers' product choices: The case of multinational foreign subsidiaries. *Journal of Business Research*, *67*(10), 2224–2230. https://doi.org/10.1016/j.jbusres.2014.01.003

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14657

Behind higher education decisions: Estonian students' take on choosing higher education institute and speciality

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Abstract

The competition between universities for qualified students has gradually increased, at the same time, the number of students acquiring higher education is dropping. In this article, the authors analyse what factors are decisive for those entering higher education when it comes to choosing a speciality/curriculum and higher education institution. For this purpose, a brief study was conducted in October 2021 and a total of 38 students from different Estonian universities and colleges were interviewed. Based on the interviews, the authors conclude that the choice of higher education institution is subjective and marketing higher education is therefore complex. The most effective external way of shaping the selection is considered to be face-to-face marketing, including the student shadow program, doors open days, and joint fairs of universities.

Keywords: *Higher education institution and choice; higher education marketing; university image; social media.*

1. Introduction

The competition between institutions to attract prospective students has increased due to international and national competition, changing roles of universities, and the underfunding of education and research. At the same time, demographic changes have caused a drop in the number people acquiring higher education. With the "supply and demand" of higher education imbalanced, prospective students and higher education institutions need to adapt with potentially altered ways of decision-making, interaction, and marketing techniques.

Estonia is a small country with a population of 1.3 million. For a small country, Estonia has many higher education institutions: 6 universities under public law and 8 state professional higher education institutions, as well as one private university and 5 private professional higher education institutions. Around 45 thousand students acquired higher education in Estonia in 2020.

Previous studies have focused on factors influencing students higher education choices (Pampaloni, 2010; Stephenson et al, 2016), however, the why-and-how behind students' decision-making, institutions' strategies for attracting prospective students, and students' insight to higher education marketing techniques have not been studied.

The aim of this study is to explore via a qualitative study of 38 first-year students, how they made choices between higher education institutions and specialities/curricula and get their take on higher education marketing techniques. To guide the investigation, we posed the following research questions: How and when did students decide on enrolling to and choosing higher education institution, and speciality? Which information is essential for prospective students' decision-making? Which values, information channels, and marketing techniques students relate to?

2. Literature Review

Education is often seen as "a first class ticket for life" (Russell, 2005), therefore choosing a university is one of the most important and complex decisions students have to make.

Universities exist in a changing world and they have to adapt to new circumstances. Due to the commercialization of education, many institutions have been pressured to become heavily involved in higher education marketing. At the same time the competition between universities for qualified students has gradually increased.

To develop an effective competitive strategy, all organisations have to know their target group and develop a marketing campaign based on the group's interests and needs. Thus, it is relevant to know, which factors influence prospective students' decisions on their choice of higher education institution and how can education institutes appeal to students.

Prospective students' choices of higher education institutions have been studied for decades (Foskett & Hemsley-Brown, 2001). Iloh's (2018) analysis on choice of education institutions highlights that the higher education choice process has been framed by multiple perspectives, most notably sociological and economic. At the same time, there are studies approaching choice from different perspectives. For example, Stephenson, Heckert & Yerger (2016) used the consumer decision framework specifically addressing the notation of the consideration set in their work. Earlier studies (e.g. Pampaloni, 2010; Stephenson et al, 2016) have shown the factors influencing students' decisions vary. Papers focusing on how students choose higher education institutions show that a big role is played by personal attributes, including parental background, and socio-economic status. Studies point out students' choices are often utilitarian and may derive from their background, culture, and experience. Therefore, choice involves three broad elements, such as the context, the key influencers, and the choosers, which are interconnected in a complex dynamic (Foskett & Hemsley-Brown, 2001).

Alongside "internal" factors, such as parental background and socio-economic status, also "external" factors, including the perception and image of higher education institutions (Wilkins & Huisman, 2015) play a role when it comes to prospective students' choices. Image is created by an organization to persuade outsiders that the organization represents specific and desirable characteristics. It can be conveyed interpersonally, through direct or indirect contact with an organization or its members, or more indirectly based on the mission statement and stated goals of the organization (Gray, 1991). Since higher education institutions vary in size and specialization, the strategies they use to attract potential members, and the image that is created as a result of their efforts takes on added importance. For higher education institutions that are smaller and not as well-known as others (with which they compete for new students), there is an added burden because image has greater significance when consumers have had minimal direct experience with an organization (Sung & Yang, 2008). Alongside the means of image-creating through self-marketing or publicity, indicators of academic excellence – such as global university rankings – are continuously important factors affecting the decision as prospective students tend to strive for "the best" institution (IHEP, 2007).

3. Methods

3.1. Sample

This study was based on semi-structured interviews with 38 students, including 15 bachelors' and 8 masters' students from University of Tartu, and 15 students from other higher education facilities in Estonia (e.g. Tallinn University, Tallinn University of Technology, Estonian Aviation Academy, Tallinn and Tartu Health Care College etc).

Five focus group interviews, one group interview, and two individual interviews were conducted. Open call in University of Tartu mail lists and social campaign in Facebook and Instagram was launched to invite first-year students to partake in the study. Purposive sampling was used on a pool of University of Tartu students who submitted their data to ensure gender and speciality diversity in the focus groups. The same logic was used for students from other higher education facilities when possible, however diversity was harder to achieve due to a "bias" in a pool of potential participants – social campaign attracted mostly traditionally active people (women, students of social sciences and fields of health care). Thus, diversity on facility rather than individual level was prioritized.

3.2. Data Collection and Analysis

The data was collected in October 2021 using focus group and semi-structured interviews. Focus group interviews were chosen as they allow to stimulate discussion between participants with various experiences and background, keeping a focus on a topic of interest. Individual interviews were used when interviewee could not participate in a focus group but their insight was relevant for maintaining diverse sample. Before conducting the interviews, the interview plan was discussed among the experienced researchers, and piloted on one student who met the sampling criteria. The plan outlined topics such as how and when the decision on speciality and institution was made, which (information) channels and for what reasons were used, and a discussion on different institutions' reqruitment campaigns.

The interviewees were introduced to the purpose and structure of the interview, and ethical issues were explained (confidentiality, data retention, and further use). The interviewees were then asked for permission to record the interview. The interviews were conducted by four researchers and lasted on average 90 minutes. All the interviews were transcribed verbatim and thematic analysis was conducted. This allowed distinguishing and highlighting the most prevalent themes. In the following paragraph, anonymised and grammatically corrected excerpts from the interviews are presented.

4. Results

4.1. Higher education decisions: choice of institution and speciality

First-year bachelor's students described institutions' image as one of the main reasons for choosing the institution they attend. Image was formed by social influence – family member or acquaintances were alumni, institution was continuously ranked high in international ranking system, there was widespread coverage of research and scholars in media. However, image was not on the same level of importance for all participants. It was distinctively highlighted by the students at University of Tartu (hereinafter UT) and Tallinn University of Technology (hereinafter TalTech), which are also the best-known universitites in Estonia.

Image was reported important when it came to a choice of institution, however, was secondary for the choice of speciality.

The only logic solution was University of Tartu, because it was like an unwritten rule in our school that /…/ if you wanted an academic education in life sciences, University of Tartu was your only choice. (FG1, F2).

Also, the location of the institution was relevant. Factors like closeness to home and family, prospective traineeship or career opportunities, and social circle affected students' choice of education institution: *I chose Tallinn [University] mainly because I like living in a big town (FG4, F5).*

However, location was important mainly for students who had variety of interests and thus were flexible in terms of choosing their speciality or their preferred speciality was taught in multiple Estonian institutions. Students who were certain in their preference made their decision based on where they could study their speciality (e.g. one can study medicine only in UT, aeronautics in Estonian Aviation Academy etc.).

Students who described various interests also mentioned uncertainty and difficulties in choosing which institution and speciality they preferred. In these cases, factors such as time of the approval of candidates became important.

I like pretty much everything, and I am also pretty good at everything /…/. I'm the one who applied everywhere. I applied to economics and chemistry in TalTech, recreation in Tallinn University, nursing and midwife programmes in Tartu Health Care College, medicine and physics in UT, and commercial air transport pilot programme in Estonian Aviation Academy. The sad thing is that I was admitted everywhere except medicine, where I would have wanted to go the most. (FG1, F3)

Personal interest was reported the most important factor for deciding on a speciality, but not on an institution. These interests had developed in formal and informal education. Most students also considered available career opportunities when choosing their speciality, bringing up "practicality". Curricula which included traineeships and other practical learning means were attractive to students, both when choosing their speciality as well as the institution to attend to. However, "practicality" did not overpower interest – if students were certain what they wanted to study, traineeships and other practical modules in curricula were less important for them.

It appeared when students had not had a specific interest in certain subjects or speciality from an earlier age, they tended to choose a speciality right before or during the applying period. In these cases, so-to-say systematic self-selection came into play as a factor affecting speciality/curriculum and institution choice – students described they weighed their probabilities of getting admitted to different specialities and applied to the ones they felt they

had the best chances in: *Initially I wanted to become a doctor, but I didn't qualify for a position. And I thought I'll study gene technology because there I was automatically admitted (FG2, F3).* Students who had specific interests usually made their choices for speciality in high school (10-12th grade), rarely already in primary school.

4.2. Information-seeking and higher education marketing

The manner and type of information that freshmen sought was similar across all interviews. The first-year students at the University of Tartu were distinguished from the other students as their knowledge of UT as an educational institution and the related image was formed in communication with their acquaintances. For students of other institutions, the primary focus for information search was on study opportunities in some specific field of interest, or to get acquainted with the general higher education landscape (e.g descriptions of curricula, admission conditions). Students turned to more specific information channels (e.g. university's websites) primarily for admission information when they had already figured out their preferred institutions and had to choose a speciality/curriculum.

One way for capturing target groups' attention is to appeal to their interests, values, and ways of interacting with the world. Thus, the study also aimed to identify what was relevant for the students.

Freshmen mentioned their family and friends as their biggest role models because they found their positive characteristics (diligence, career, success in life, etc.) inspirational. Additionally, they admitted they tend to notice mainly people and messages which are related to their profession (e.g. lecturers who appear in media or freelance specialists): *Especially in the context of elections, one or another lecturer is giving their commentary [in national media]. This makes me feel proud. (FG1, M1).* Also, students follow people who share their values or interests (e.g. spokespeople for green lifestyle, people who travel the world) mostly in social media.

Freshmen found certain values could be increasingly appealing factors for making decisions on higher education in the near future: environment protection, green transition, and the role of artificial intelligence. It is, however, important to note that while there are some so-to-say general values, each student had also their individual interests based on their profession and experience in life. Therefore, speciality/curricula-based marketing (especially for less popular specialities) was still considered very important in sparking prospective motivated students' interests.

When it comes to marketing in general, students struggled to remember any advertisements that stood out as they felt they had developed "ad blindness". Students ignored advertisements, and in some occasions reported altering their consumer behaviour (boycotting services, institutions, products) due to excessive marketing. A few examples of

advertisements students shared in groups stood out either in a good or a bad way (e.g. an advertisement for educational institute that portrayed gender stereotypes was discussed).

Higher education marketing was seen unnecessary for already well-known universities (e.g. UT, TalTech, Tallinn University), which have a long history and have established a place in Estonian cultural memory. Once again, UT stood out – marketing this university was even considered to have negative effect on prospective students' decisions, because *anything that's good, markets itself. If you need to sell it to someone, it's not good (FG1, F1)*. However, institutions that were smaller and less-known (e.g. Estonian Aviation Academy) won from marketing. As people knew little about these institutions and their specifics beforehand, heavy marketing was rationalised as an effort to make the institutions seen. Students also reported advertisements for less-known institutions in social media or in public sphere (e.g posters on the streets) made them apply to these institutions (e.g. Aviation Academy). Generally, students found it less necessary to advertise institutions and rather advised to focus on speciality/curriculum-centred marketing. For example, if a student was interested in piloting, advetisements for the speciality rather than institution were the ones that attracted them.

When it comes to marketing, peer-to-peer marketing was seen as the most influential way to persuade students. They also liked advertisements reflecting the experiences of alumni or people still studying in a programme. Also, informal online-marketing (e.g., students posting their student-life situations on social media, faculties inviting people to participate in studies) was considered highly engaging.

Students reported they use social media (Facebook, Instagram, Youtube) and read news from online media channels daily, however, TV and radio are used rarely or never. The first is also where they tend to notice marketing – if at all. Participants preferred the use of well-produced, short videos and marketing in YouTube and other social media. The message students conveyed when discussing marketing higher education was "bigger is not better" – they expected the advertisement of these institutions to be professional, inclusive (racially, sexually etc.), unique, short and catchy, and highlighting achievements and symbols of these institutions.

5. Conclusion

Marketing higher education is a particular challenge. Similar to previous studies e.g. Wilkins & Huismani, 2005, Foskett & Hemsley-Brown, 2001), the results of this study indicate that a big role in higher education decisions is played by internal factors such as personal attributes, including parental background, and external factors, such as image.

Other factors (e.g. location, "practicality") were reported important by students who were unsure or flexible in terms of higher education choices. In terms of marketing, direct and face-to-face marketing, such as student shadowing, open doors days, and information fairs were favoured by students alongside social media campaigns.

The results the study can be relevant for the marketing and communication specialists in higher education institutions for altering their marketing strategies for attracting prospective students. The findings suggest that higher education institutions should systematically monitor and collect feedback of their recruitment campaigns to get the most direct input from the target group, and involve the students in the processes of developing and conducting marketing campaigns. Monitoring the feedback at regular intervals is suggested as the content and relevance of the campaigns especially attract the people who are unsure of their choice and thus rely on external factors.

References

Gray, L. (1991). *Marketing education*. Open University Press.

Hemsley-Brown, J., Foskett, N.H. (2001). Model Consumers? A model of choice and decision-making in educational markets, *BERA,* University of Surrey.

Iloh, C. (2018). Toward a New Model of College "choice" For a Twenty-first-century Context. *Harvard Educational Review*, 88(2), 227–244. doi: https://doi.org/10.17763/1943-5045-88.2.227

Institute for Higher Education Policy (IHEP). (2007). College and University Ranking Systems. Global Perspectives and American Challenges. https://files.eric.ed.gov/fulltext/ED497028.pdf

Pampaloni, A. M. (2010). The influence of organizational image on college selection: what students seek in institutions of higher education, *Journal of Marketing for Higher Education*, 20(1), 19-48. doi: https://doi.org/10.1080/08841241003788037

Russell, M. (2005). Marketing education: a review of service quality perceptions among international students, *International Journal of Contemporary Hospitality Management*, 17(1), 65-77.

Stephenson, A.L., Heckert, A., Yerger, D.B. (2016). College choice and the university brand: exploring the consumer decision framework, *Higher Education*, 71(4), 489-503.

Sung, M., Yang, S. (2008). Toward the model of university image: The influence of brand personality, external prestige, and reputation, *Journal of Public Relations Research*, 20(4),
357–376. doi: https://doi.org/10.1080/10627260802153207

Wilkins, S., Huisman, J. (2015). Factors affecting university image formation among prospective higher education students: the case of international branch campuses, *Studies in Higher Education*, 40(5), 1256-1272. doi: http://dx.doi.org/10.1080/03075079.2014.881347

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14648

Improving governance of vocational teacher education in Ukraine within Erasmus+ project

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Abstract

The paper aims at discussing the governance of vocational teacher training based on partnership and cooperation with different stakeholders and its implementation within the Erasmus+ Capacity Building in Higher Education project carried out in Ukraine.

The problem of the weak linkage between vocational schools, universities that offer pre-service vocational teacher training and the employment sector is typical of the Ukrainian vocational teacher training. It causes discrepancies between expectations of vocational schools from young ongoing teachers and the competencies prospective teachers are equipped with at universities. Within the project four Ukrainian partner-universities developed different concepts for improving the relevance and quality of provided pre-service teacher education by implementing mechanisms of "collaborative" governance and partnerships, which involves different stakeholders in teaching, content defining and quality monitoring processes. The initial implementation of these models offers solutions to above-mentioned problems in vocational teacher training.

Keywords: *Vocational teacher education; partnership-based governance; cooperation; Ukraine.*

1. Introduction

The governance of vocational teacher education and training can hardly be considered as a topic of active scientific discussions. Partially it can be explained by the fact that the initial (or pre-service) teacher training is carried out by universities, which fall under the jurisdiction of state executive bodies for higher education in a country. In this sphere, either universities have the freedom and autonomy to define the content and methods of the training or the respective Ministry of Science defines the standards and the content of the training. Such an approach leaves unaddressed the needs and expectations of vocational schools from ongoing teachers.

Some countries like Germany have a lengthy process of teacher training, which consists from an obligatory master's degree in vocational pedagogics and 18-24 months of preparatory service (Rahmenvereinbarung über die Ausbildung und Prüfung für ein Lehramt der Sekundarstufe II (berufliche Fächer) oder für die beruflichen Schulen (Lehramtstyp 5), 1995). This second phase of the training is aimed exclusively at equipping young teacher-trainees with practical pedagogical skills relevant to vocational school realities. However, in most countries, the process of vocational teacher training is reduced either to university studies or to advanced pedagogical training for specialists from industries (OECD, 2021). Consequently, equipping ongoing teachers with relevant pedagogical skills, vocational competence and industry knowledge within bachelor's and master's degrees or further training is a task, which requires much cooperation and coordination with other stakeholders, such as vocational schools and employers.

Surprisingly enough, vocational schools are, however, hardly involved in the curriculum development or teaching process in the pre-service vocational teacher training. Mostly, vocational schools are passive end-users of educational services provided by universities. This reinforces a subordinate image of vocational education and creates discrepancies between the competencies acquired by young vocational teachers in the system of higher education and the competencies needed by vocational schools. As a result, it affects the quality of the vocational training and creates tension between the different educational spheres.

The situation looks different with the pre-service teacher training for secondary education. University-school partnerships are recognised as an effective approach to fostering pre-service teacher engagement, improving teacher identity and enhancing the formation of the relevant pedagogical skills (Allen, Howells, & Radford, 2013; Gabureanu, 2015; Maskit & Orland-Barak, 2015). Recognising the complexity of training for the teaching profession, partnerships and school-based teacher education tackle the main problem of the pre-service teacher training: the theory-practice gap. It has three main features that make it particularly effective and beneficial: congruous learning and developmental possibilities for all partners,

professional development and the professionalization of teachers and curriculum development relevant to school realities and settings (van Velzen, Bezzina, & Lorist, 2009).

Based on findings of the cooperation between schools and universities in pre-service teacher training for secondary education, an Erasmus+ project was launched in 2020 in Ukraine, which deals with governance in vocational teacher education (VTE) in Ukraine. The project aims at developing and piloting governance structures and mechanisms between Ukrainian partner higher education institutions (HEIs) and regional vocational schools. The focus is on overcoming the theory-practice gap between university education and teaching requirements in vocational education and training, and on setting up governance in a new, i.e. partnership-based manner between relevant institutions in VTE.

2. Conceptual framework

2.1. Theory of modes of governing teacher training

As an analytical tool for explaining the governance of vocational teacher training the notion of modes of governance developed by Gideonse (1993) is applied. The theory of modes of governing teacher training suggests that depending on the dominant role of the stakeholder (state, universities and schools or professional unions) certain mechanisms of interaction, decision-making and management are formed, which make up a mode of governing. Three modes can be distinguished (political, institutional and professional), however, hardly any of them exists in a pure form. Gideonse remarks that usually these modes are determined by the context and time and may change or complement each other.

The first mode of governance is political. In this mode of governance, public officials and state legislatures fully exercise their authority and hardly delegate it. On the one hand, it recognises the importance of the schools and teachers on the political agenda. On the other hand, the disadvantage of this mode is preventing "professionals [from] defining and maintaining preparation and performance standards" (Gideonse, 1993, p. 402). In addition, it creates a public perception in which changes are determined by the regulatory process and happen only top-down as prescribed by the government. The teaching profession receives an image of a servant of the state, who implements the state policy within their professional activity (Young & Boyd, 2010).

According to the institutional mode of governance, the governance is exercised predominantly by providers of the pre-service teacher education (HEIs, schools, colleges and school districts responsible for internship). Gideonse states that "the strength of governing through the institutional mode is that it is the closest to where the teacher education action is" (1993, p. 403). However, the challenge of this mode is the diversity of the types, capacities

and status of the institutions and, consequently, the governance mechanisms may have very local solutions.

In the professional mode of governance, professional units and agencies are delegated by the government the function of governance and policy setting. They define standards and have authority over preparation. Composed of professionals from the teaching profession and being able to execute policy power, these bodies enhance the occupational status of this profession. The shortcoming of this mode is possible problems in the internal institutional processes and structures of such bodies. As well, there is a danger that the public perception may allege the protectionism of vested interests (Gideonse, 1993; Young, 2004; Young & Boyd, 2010).

Though vocational teacher training is considered to be more complex than teacher training for secondary education, since vocational teachers are expected to be pedagogues and professionals (Deissinger, Braun, & Melnyk, 2019), its governance can be analysed through the theoretical lens of modes of governing. The main reason is the composition of actors is similar and the goal of trainings shares the same fundamentals. The difference lies in the fact that in vocational teacher training employers come into play because of the twofold professionalism of vocational teachers. In addition, the structural configuration and standards are rarely distinguished from the teacher training for general schools. In most countries, vocational teacher training similarly to teacher training for secondary schools is carried out at universities or other institutions of higher education.

2.2. Ukrainian vocational teacher training at a glance

Vocational teacher training is a complicated topic for the Ukrainian education policy. For many years a clear regulatory framework for the profession of a vocational teacher was absent (Melnyk, 2019; Radkevych, Romanova, Artiushyna, & Borodiyenko, 2019). Thus, occupational standards for vocational teachers and educational standards for vocational teacher training programmes were developed just a few years ago (in 2019 – educational standards for a bachelor's degree, in 2020 – educational standard for a master's degree) by working groups set up by the Ministry of Education and Science of Ukraine. Universities, academies and other types of HEIs provide training to teachers of special theoretical subjects. The minimum requirement for entering the profession is at least a bachelor's degree in a relevant industrial speciality with additional pedagogical training or a bachelor's degree in a vocational teacher training speciality. Trainers who deliver practical training at vocational schools are usually recruited directly by vocational schools from industries and there are no requirements for them for entering the teaching profession what concerns pedagogical skills. The accreditation of study programmes in vocational teacher training at HEIs is performed by the National Agency for Higher Education Quality Assurance. However, this is not a specialised agency for pedagogical professions but a non-profit organisation, which on behalf

of the state monitors the quality and transparency of education services and research in higher education.

The governance is built in a hierarchal way in which the determining role belongs to the government. HEIs are granted the autonomy and freedom of teaching and research by the Law on Higher Education but there is a financial dependence on the government: study programmes can be fully cut off from financing and even be closed by the Ministry if there are too few applicants. It is especially dangerous for vocational teacher training programmes, which constantly suffer from extremely low enrolments and have to fight every year to prove their right to existence. Vocational schools in this system have marginal or no influence on the quality or content of the training at HEIs and remain on the periphery of policy-making in the sphere of vocational teacher training.

3. Rationale of Erasmus+ project

With the intention to contribute to fostering cooperation and partnerships in VTE and reconfigure the mode of governing vocational teacher training, the Erasmus+ project 'New mechanisms of partnership-based governance and standardization of vocational teacher education in Ukraine' (PAGOSTE) was launched on January 15, 2020, in Ukraine. The project aims at fostering the quality and relevance of VTE in Ukraine by establishing standards with respect to partnership-based governance (PBG) mechanisms between universities and vocational schools. Partnership-based governance is seen as an instrument to tackle problems of the 'hierarchical' governance, the theory-practice gap and the overall relevance of training in HEIs by including vocational schools in activities of pre-service training, such as curricula development and teaching methodology. It even could lead to establishing a governance system based on partnerships reaching beyond these two stakeholders. In more specific terms, the project pursues such objectives as to establish effective mechanisms of the partnership between HEIs, which are involved in VTE, and vocational schools (and other stakeholders if relevant); to employ mechanisms of PBG for in-service vocational teacher training; to enable educational institutions involved in vocational teacher training to use standards for PBG. The project consortium consists of nine partners, including three European universities, four Ukrainian universities, the Ministry of Education and Science of Ukraine and the national research organisation in the sphere of vocational education and training in Ukraine. The project is a structural 'Capacity Building' project that is expected to lead to visible changes in the Ukrainian VTE system.

4. New visions of governing vocational teacher training

The Ukrainian universities in the project offer vocational teacher training in specific fields: Kyiv National Economics Universities offers a bachelor's degree programme for vocational

teacher training for commercial schools (economics), the South Ukrainian National Pedagogical University trains vocational teachers in apparel design; the National Transport University can provide a rare specialization of vocational teacher training for vocational schools of the transport industry. The exception is the Ukrainian Engineering-Pedagogics Academy, which is the only specialized HEI in Ukraine, which is responsible for training vocational teaching personnel for 24 industry branches. The preliminary need analysis conducted by the partner-HEIs identified problems of low enrolments in vocational teacher trainings courses, the weak cooperation with vocational schools in teaching and curriculum development and the theory-practice gap, which affects the quality of the training and the professional identity of their students. Within the project, each university developed a concept of how to involve stakeholders in the vocational teacher training at their institution, built a sustainable partnership and in such a way how to tackle the existing problems (PAGOSTE, 2021). Though the specializations of the universities, the number of students and their capacities are very diverse, all the approaches worked by the partners are united by such main actions which address the problems of the isolation and lacking collaborative governance in VTE in Ukraine: involvement of practitioners in the teaching process at the universities; setting up examination or accreditation boards with external experts from the field for quality monitoring and assurance; increasing the share of practical training or practice in the curriculum; organising common activities with vocational schools for exchange and networking.

On the institutional level, the universities create structures, which are to carry out these actions. These structures are based on the universities but obligatory must include the representatives from the vocational education sector as well as the employment sector. Since the partnership is expected to be reciprocal, HEI academic staff must be represented on advisory boards of vocational schools. Thus, the institutional interception creates a network of professionals, so the responsibility and ownership for the results and quality of the training are shared between different stakeholders. The expertise of practitioners from vocational institutions is expected to make didactics and pedagogics courses more relevant to real settings in vocational education. Due to the participation of HEI academic staff in advisory boards of vocational schools, insights into their needs and expectations are received. Moreover, vocational schools may profit from scientific approaches that HEI academic staff can employ when analyzing situations or problems in vocational settings. The implementation of the concepts of partnership-based governance started in June 2021 and it is hardly possible to make any conclusions because not even one year passed since piloting. However, all the partners reported that due to the first cooperation with vocational schools and conducting events for experience exchange and professional orientation at vocational schools the student enrollment into vocational teacher training programmes (predominantly the bachelor's degree) increased impressively as of the academic year 2021-2022.

5. Conclusions

Building an alliance between HEIs, vocational schools and experts from the employment sector is a step toward changing the mode of governance in Ukraine from the political one into a mixture of the institutional and professional ones. The subsidiary role of vocational schools in vocational teacher training makes the training offered by HEIs and governed by the Ministry of Education and Science detached from the reality of vocational education and training and the needs of vocational schools. By building the connecting bridge between the different spheres the urgent problems of the theory-practice gap, vague teaching identity and quality of vocational teacher training can be effectively solved. Given the twofold professionalization of vocational teachers, the change is quite promising and potentially can affect the vocational sector as well. As with any change on the institutional and systemic levels, it takes time to observe the real measurable and concrete results. However, the experience of other countries (Gerholz, Ciolek, & Schlottmann, 2020; Maskit & Orland-Barak, 2015; Pentelényi & Toth, 2011) proves to be positive and encouraging. Based on the results of piloting partnership-based governance at the partner-universities the national umbrella concept is to be developed and implemented in Ukraine. "Collaborative" or partnership-based governance of vocational teacher education and its implementation opens a new page for research not only for educationalists but also for organizational and political scientists.

Acknowledgement.

The number of the discussed Erasmus+ project is 609536-EPP-1-2019-1-DE-EPPKA2-CBHE-SP. It has been funded with support from the European Commission.

References

Allen, J. M., Howells, K., & Radford, R. (2013). A 'Partnership in Teaching Excellence': ways in which one school-university partnership has fostered teacher development. *Asia-Pacific Journal of Teacher Education*, *41*(1), 99–110. https://doi.org/10.1080/1359866X.2012.753988

Deissinger, T., Braun, V., & Melnyk, O. (2019). VET teacher education in Germany. Structural issues and fields of conflict in Business and Economics Education. In T. Deissinger & V. Braun (Eds.), *Improving teacher education for applied learning in the field of VET* (pp. 29–72). Münster: Waxmann.

Gabureanu, S. (2015). Teacher training for embedding life skills into vocational teaching. *Procedia - Social and Behavioral Sciences*, *180*, 814–819. https://doi.org/10.1016/j.sbspro.2015.02.215

Gerholz, K.-H., Ciolek, S., & Schlottmann, P. (2020). Linking theory and practice through University Schools. An empirical study of effective learning design patterns. *Forschendes*

Lernen im Spannungsfeld von Wissenschaftsorientierung und Berufsbezug, *15*(2), 147–166. https://doi.org/10.3217/zfhe-15-02/08

Gideonse, H. D. (1993). The governance of teacher education and systemic reform. *Educational Policy*, *7*(4), 395–426. https://doi.org/10.1177/0895904893007004001

Gunadi, Alias, M., Sofyan, H., & Triyono, M. B. (2020). Designing industrial internship model to improve the skills of prospective vocational teachers. *Journal of Technical Education and Training*, *12*(1), 140–148.

Rahmenvereinbarung über die Ausbildung und Prüfung für ein Lehramt der Sekundarstufe II (berufliche Fächer) oder für die beruflichen Schulen (Lehramtstyp 5) (1995).

Maskit, D., & Orland-Barak, L. (2015). University–school partnerships: student teachers' evaluations across nine partnerships in Israel. *Journal of Education for Teaching*, *41*(3), 285–306. https://doi.org/10.1080/02607476.2015.1046265

Melnyk, O. (2019). Diversity of vocational teacher education models in Ukraine. In T. Deißinger, U. Hauschildt, P. Gonon, & S. Fischer (Eds.), *Contemporary apprenticeship reforms and reconfiguration* (pp. 51–54). Vienna: Lit Verlag.

OECD (2021). *Teachers and leaders in vocational education and training: OECD reviews of vocational education and training*. Paris: OECD. Retrieved from OECD website: https://doi.org/10.1787/59d4fbb1-en https://doi.org/10.1787/59d4fbb1-en

PAGOSTE (2021). Elaboration and implementation of PBG. Retrieved from https://pagoste.eu/work-packages/wp2/

Pentelényi, P., & Toth, A. (2011). Europe-wide cooperation for efficient vocational teacher education. *Óbuda Universitye-Bulletin*, *2*(1), 217–224.

Radkevych, V., Romanova, G., Artiushyna, M., & Borodiyenko, O. (2019). Vocational education and training and the vocational teacher education system in Ukraine. A path towards economic development and social cohesion. In T. Deissinger & V. Braun (Eds.), *Improving teacher education for applied learning in the field of VET* (pp. 127–156). Münster: Waxmann.

van Velzen, C., Bezzina, C., & Lorist, P. (2009). Partnerships between schools and teacher education institutes. In A. Swennen & M. van der Klink (Eds.), *Becoming a teacher educator: Theory and practice for teacher educators* (pp. 59–73). Dordrecht, London: Springer. https://doi.org/10.1007/978-1-4020-8874-2_5

Young, J. (2004). Systems of educating teachers: Case studies in the governance of initial teacher education. *Canadian Journal of Educational Administration and Policy*. (32).

Young, J., & Boyd, K. (2010). More than servants of the state? The governance of initial teacher preparation in Canada in an era of school reform. *Alberta Journal of Educational Research*, *56*(1), 1–18.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14626

Values Education and Teaching Zest for Life: Japanese Experience and New Ukrainian School Reform

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Abstract

This paper highlights the importance of sustainable values education for Ukrainian society to become united and economically strong. The authors signify the Japanese value-creating pedagogy as transformational and leverage in making Japan a strong nation and competitive economy. Therefore, the experience is of interest to Ukraine. The New Ukrainian School Reform transforms schooling into an inspirational environment and a place of joy. It differs from the traditional classroom of the assertive discipline and, accordingly, leads to changes in teacher education. The research concludes that the Japanese approaches to teaching values and zest for life are within reform algorithms that are an adequate response to the democratization and humanization of education in the globalized world. The paper finds more profound comparative research in pedagogy necessary to improve teacher preparation.

Keywords: *Japanese experience; New Ukrainian School Reform; teacher education; globalization; values-based education; zest for life.*

1. Introduction

Since the first days of independence, Ukraine has struggled to overcome the deeply-rooted traditions of the Soviet past and a lack of experience in building a democracy. No wonder, for Ukrainian education, the 30 years of independence have become the years of "intensive search" for how to modernize and comply with European democratic standards (Higher Education in Ukraine [HEU], 2017, p. 18; Nychkalo, 2017, p. 89). As a result, the young country has taken significant steps to create novel educational paradigms aligning with the political aspirations in the context of a globalized world (HEU, 2017, p. 28; Kuchai, 2014, p. 282; Matvienko & Kuzmina, 2020, p. 161; Nychkalo, 2017, p. 91). The adoption of the new laws and regulatory documents on education from 1991 through 2021 (Laws of Ukraine on Higher Education. Parliament Portal, n.d.) resulted in the establishment of the national education system, development of the national educational standards, the introduction of the new qualifications levels in correspondence with the European certification criteria. The emergence of the private educational sector contributed to competitiveness and responsibility for university reputation and student enrollment. (HEU, 2017, p. 15). The piecemeal reforms eventually changed the landscape of Ukrainian education. They led to the "de-ideologization, demilitarization, transfer from elite to mass education, humanization of education," integration of distance education, financial autonomy of universities, internationalization of education, and academic mobility (British Council, 2020; HEU, 2017, p. 17; Ministry of Education and Sciences of Ukraine [MESU], 2020). The establishment of the National Agency for Higher Education Quality Assurance became a milestone for quality, accountability, and academic honesty (Luniachek et al., 2020; NAQA, 2017-2020).

Alarmingly, secondary schooling remained focused on providing academic knowledge rather than practical application and values. The outcome of that was reduced motivation and an increase in unhappy students. The lack of a holistic approach to values education became an obstacle to consolidating the nation. Responding to those above, the Ministry of Education and Science initiated the New Ukrainian School Reform – "an ideology of change" to bring up a well-rounded and happy personality with competencies to succeed in the 21st century. (New Ukrainian School Reform [NUSR], 2016, p. 18).

2. Methodology

The research emphasizes values-based education and underscores its significance for teacher education. The method in use is the descriptive comparison based on the literature review and its analysis, along with a brief review of the evolution of education in independent Ukraine. The literature includes scientific papers, governmental documents, and Internet resources. Since the authors believe that the Japanese values education

contributed to the well-being of society and the economy (Aranito, 2019, p. 150; Kumagai, 2000, p. 20; OECD, 2018, p. 20) hence, they are confident that Ukraine can benefit from addressing values education seriously. Changes in teacher preparation are considered inevitable due to the political aspirations of today's Ukrainian society (Matvienko & Kuzmina, 2020, p. 162; NUSR, 2016, p. 7; Nychkalo, 2017, p. 90). Traditionally, teacher preparation is the domain wherein the future transformation of school is forged.

3. Values-Based Education in the Globalized World

3.1. Globalization as a Catalyst for Better Values Awareness

The era of globalization urges us to acquire new knowledge and competencies at an accelerated pace. Furthermore, it questions the body of knowledge sustainability if it does not integrate into the socio-political and cultural context and does not apply to different fields of human activity. According to Whalley (2005), "globalization can affect social values and vice versa," impacting mutual understanding. While values cooperate, it is primarily believed that societies change (Blair, 2009). Keeping in mind that each country has a nationally-based values system (Parademetriou & Masouras, 2014, p. 5), values-based education helps avoid conflicts inside and beyond the boundaries. Globalization provides more access to research and integrated knowledge in parallel, deepening understanding of cultural uniqueness and authenticity. However, judging by the number of social and war conflicts many countries suffer from, education should address the values of diversity, equity, and tolerance better (Whalley, 2005). According to Tony Blair (2009), each nation possesses the "spiritual capital," comprising the values of "democracy, freedom, and justice." Responsible citizenship and empathy for the neighbors' needs are conducive to the emergence of shared values, trust, and respect.

3.2. Prioritizing Approaches to Values Education: comparative profile

The 25-year partnership between Ukraine and Japan has developed effective, fruitful exchange and collaboration in education and science (Bielieskov, 2016, p. 12). Once Japan faced economic, social, and political challenges, it overcame them. It is essential to pay credit to Japanese education for that achievement due to "relativism and knowledge construction," adherence to national values and spiritual tradition of stoicism, and quiet dignity strong enough to withstand foreign influence. (Arimoto, 2019, p. 149; Crehan, 2016; OECD, 2018, p. 19).

According to Aramito (2019, p. 150), cultural and historical influence on values education in Japan is decisive. Similarly, Kumagai (2000, p. 42) suggests life itself should be the source of value that takes root in history and has resulted in value-creation in education. Furthermore, "value-creating pedagogy" never loses topicality because it is based on love

of life. Stemming from this theory, the Zest for Life concept relies on " the academic prowess, moral, physical, and mental health" (Kimura & Tatsuno, 2017, pp. 1-2; Kumagai, 2000, p. 44). The time has added new features: *Solid Academic Capabilities* consisting of basic literacy, self-direction, decision-making, problem-solving, and a *Well-Rounded Character* distinguished by self-control, cooperation, and empathy. *A Healthy Body* comprises both physical and mental health (Figure 1). The demands of the 21st century have broadened the concept resulting in including the *Practical Ability to Act for the World.* It is differentiating between individualism, relationship building, motivation for social participation, responsibility for building a sustainable future; *Collaborative Thinking and Problem-Solving* address problem finding and solving, logical, critical thinking, meta-cognition, adaptability; *Basic Literacy as Thinking Tools* - literacy, numeracy, information literacy (Kimura & Tatsuno, 2017 pp. 5-6; MEXT 2010). It is interesting to note that all these new developments and adjustments of the Zest for Life Concept took their start from "the education for happiness" (Kumagai, 2000, p. 43) and from the personal values: *Chi-iku* meaning cognitive development; *Toku-iku* – moral virtue; *Tai-iku* - physical development. Kugamai (2000, p. 44) emphasizes that Japanese values have been tested across centuries, ensuring harmonious "value-creating pedagogy," making the Japanese a strong nation. (Arimoto, 2017, p. 149, Crehan, 2016; OCED, 2018). The model's success may be related to cultural heritage; however, the input of the Japanese secondary and higher education is apparent.

Figure 1. Structure of "Zest for the Living concept" (source: MEXT, 2010).

Considering the value-oriented education and competencies outlined by the Ukrainian New School Reform, school becomes an environment that teaches to enjoy life (Nychkalo, 2017, p. 98), focusing equally on reason and emotion, which fully corresponds with the Japanese Zest for a Living Concept. Social, emotional, and physical development is equal to the

academic body of knowledge for contribution to the economy and society. Relating to real life, providing the competencies necessary for the 21st century, e.g., cross-cutting skills, critical thinking, creativity, risk assessment ability, cooperation with others, and a healthy lifestyle, are common (NUSR, 2016, p. 7). Compared with Japan, cognitive, moral, and physical developments are also substantial. Patriotism, honesty, dignity, hospitality, dedication, compassion, and service are the values the Ukrainians have treasured for centuries (Holos, 2019, p. 44; Kuchai et al., 2019, p. 90). Consolidating Ukrainian national identity, fostering the status of the Ukrainian language, and becoming a member of the European Union are the goals aligned with the immediate needs. The reform pledges to educate all-rounded, patriotic, responsible, innovative citizens, equipped with competencies of "mathematical literacy, cultural awareness, life-long learning, environment, and health knowledge, foreign languages proficiency, science, technology, and digital literacy, mother and national languages knowledge" (Holos, 2019, p. 49; NUSR, 2016, pp. 10-13).

4. Teacher Training in the Context of New Ukrainian School Reform

Interestingly, the survey conducted at the end of 2021 by the public educational organization "Osvitoria" revealed that many Ukrainian teachers followed the old teaching paradigm focused on subject content, although the reform was launched in 2016. About 66% of teachers admitted that they took professional development courses to fit the NUSR but still felt challenged. 59% - only read the directives of the Ministry of Education and needed guidance. 27% - obtained training on the learning platform EdERa. About 14% of working teachers did not take any training (Ukrainian School Reform, 2022). The New Ukrainian School Reform questioned the compatibility of the teacher education programs with its goals. Therefore, the "Teacher Preparation for the New School Reform" academic course in the graduate school syllabus and professional development programs appeared to be necessary. Judging by the feedback of graduate students, they believe the NUSR is transformational because it insists on holism and schools "created for joy." The lack of joy may lead to the lack of the desire to live (Elkin, 2022). 95% of respondents are unanimous that the course improves their readiness to work under the NUSR. 100% of graduates approve of the emphasis on values-oriented education and making school a place of joy. The empirical studies demonstrate that teachers cannot instill values and morals they lack (Serikova & Nizhegorodov, 2017, p. 74; Vasilevskaya-Rutskaya, 2009, p. 64; Ukrainian School Reform, 2022). Thereby, enriching teacher preparation with values-based classes becomes a must.

Teacher education is widely believed to benefit from comparative pedagogy research, disseminating and applying the findings outside the country for transformational impact on home education. The Japanese experience motivates Ukrainian educators to explore and ensure the "cross-cutting educational process that informs values valid throughout the

world" (Kuchai et al., 2019, p. 87; NUSR, 2016, p. 7, p. 16; Vasilevskaya-Rutskaya, 2009, p. 59; Zmievska, Dovgaliuk, Glazunova, Kuzmina & Lisnichenko, 2020, p. 8).

To respond to the NUSR goals in an achievable way, the coherent changes in teacher education are noticeable: the student-centered approach, elective classes, interdisciplinary approach to teacher education, teaching academic integrity; internationalization of campuses, student mobility programs with cross-cultural and values exchanges opportunities (British Council, SAM Program, 2020; Laws of Ukraine on Higher Education, n.d; Law of Ukraine on Academic Integrity, 2020: Luniachek et al., 2020; Matvienko & Kuzmina, 2020, p. 166; Nychkalo, 2017, p. 89). However, more focus should be made on studying the world's best experiences. Arguably, the Japanese experience prompted the understanding that school is created to enjoy.

5. Conclusions

The authors believe that the Japanese values-based education and teaching Zest for Life Concept are in tune with the Ukrainian New School Reform orientation to raise generations of people who value life and respect freedom and democracy. The Japanese experience proved successful in uniting its nation while reinforcing its statehood and economy. Hence, the further research with the implementation as a follow-up into teacher education programs as a segment of comparative pedagogy is reasonable. Importantly, values-oriented education lays a durable foundation for justice, equity, patriotism, and integrity in prospective teachers. This leads to assurance they will be able to pass these values on to their students. Both countries seriously address shaping national identity but, in parallel, teach universal competencies applicable in the globalized world. It is necessary to note that Japan emphasizes socio-emotional aspects of education, problem-solving, and critical thinking. Similarly, the New Ukrainian School Reform focuses on well-rounded development (Nychkalo, 2017, p. 98). If Ukrainian teacher education engages in research and collaboration more profoundly, the country will succeed in achieving the goals of Ukrainian society to consolidate and prosper.

References

Arimoto, M. (2019). Using classroom assessment to improve pedagogy: the Japanese experience. *Education and New Developments* 2019, 149-153. DOI: 10.36315/2019v2end031. Retrieved from https://www.researchgate.net/publication/334481251

Bielieskov, M. (2016). *Foreign Policy Audit*: Ukraine-Japan. Kyiv: Institute of WorldPolicy. Retrieved http://neweurope.org.ua/wp-content/uploads/2017/10/Audyt-zovnishnoyi-polityky_Ukr_YAponiya_eng_inet.pdf.

Blair, T. (2009). What Can Values Do for Globalization? Yale Insights. Retrieved from https://insights.som.yale.edu/insights/what-can-values-do-for-globalization.

British Council. (2020). Ukraine Student Academic Mobility (SAM) Programme. Retrieved https://www.britishcouncil.org.ua/en/programmes/education/sam-ukraine.

Crehan, L. (2016). Values Education in Japan. Blog. Retrieved from https://lucycrehan.com/values-education-in-japan/. Education in Ukraine. (2022). Are teachers of secondary schools ready for the New

Elkin, O. (2022). School is for Joy – One of the Authors of the New Ukrainian School Reform Concept about the Reconsideration of Education. Education 24v.ua. Retrieved from https://education.24tv.ua/shkola-potribna-dlya-radosti-odin-avtoriv-kontseptsiyi-garyachi-novini_n1849411

Higher Education in Ukraine. Agenda for Reform. (2017). KAS Policy Paper. Retrieved from https://www.kas.de/c/document_library/get_file?uuid=11396582-8774-8a81-1492-9dee7e451d2d&groupId=252038

Holos, H..A. (2019). Schooling and value education: the Japanese experience. *Young Scientist, 1*(65), 43-50. DOI: 10.32839/2304-5809/2019-1-65-11.

Kimura, D., & Tatsuno, M. (2017). *Advancing 21st Century Competencies in Japan*. Asia Society. Center for Global Education. Retrieved from 21st-century-competencies-japan.pdf (asiasociety.org)

Kuchai, T. P., Bida, O.A., Sbruieva, A. A., & Kuchai, O. V. (2019). The theoretical basis of primary school teacher training in Japanese and Ukrainian universities. *Zhytomyr Ivan Franko State University Journal. Pedagogical Sciences, 4*(99), 86-94. DOI:10.35433/pedagogy.4(99).2019.86-94. Retrieved from http://pedagogy.visnyk.zu.edu.ua/ article/view/pedagogy.4%2899%29.2019.86-94.

Kuchai, T. (2014). Comparative characteristics of teaching children and youth in Ukraine and Japan. *Journal Vasyl Stefanyk Precarpathian National University, 1*(2-3), 283-289. DOI:10.15330/jpnu.1.2-3.283-289. Retrieved from https://www.researchgate.net/publication/276901807_Comparative_Characteristics_of_Teaching_Children_and_Youth_in_Ukraine_and_Japan.

Kumagai, K. (2000). Value-creating pedagogy in Japanese education in the modern era. Retrieved from https://www.tmakiguchi.org/assets/images/kumagai.pdf.

Laws of Ukraine on Higher Education. Parliament Portal. (n.d.). Retrieved from https://zakon.rada.gov.ua/laws/show/1556-18#Tex.t

Law of Ukraine on Academic Integrity (2020). NAQA. Retrieved from https://en.naqa.gov.ua/wp-content/uploads/2021/02/Bill-on-Academic-Integrity_EN.pdf

Luniachek, V., Brovdii, A., Kulakovskyi, O., Varenko, T. (2020). Academic integrity in higher education of Ukraine: Current state and call for action. *Education Research International, vol. 20.* Hindawi. DOI: https://doi.org/10.1155/2020/8856251 Retrieved from https://www.hindawi.com/journals/edri/2020/8856251/.

Ministry of Education and Science of Ukraine. (2020). Distantsiini ta onlain services v osviti [Distance and online services in education]. Retrieved from https://mon.gov.ua/ua/distancijni-ta-onlajn-servisi-v-osviti.

Matvienko, O., & Kuzmina, S. (2020). English language education at Ukrainian university: Interdisciplinary aspect. *Arab World English Journal: Special Issie on English in Ukrainian Context,* 161-170. DOI: https://dx.doi.org/10.24093/awej/elt3.14. Retrieved from https://awej.org/english-language-education-at-ukrainian-university-interdisciplinary-aspect/.

MEXT. (2010). Structure of Zest for Living Sources. Download Scientific Diagram Uploaded by Hiroki Yoshida. Retrieved from https://www.researchgate.net/figure/Structure-of-zest-for-living-source-MEXT-2010-translated-by-author_fig5_304814566.

NAQA. (n.d.). Strategic Orientations in Maintaining the Quality of Higher Education in Ukraine during 2017-2020 Retrieved http://education-ua.org/ua/draft-regulations/890-strategichni-napryamki-diyalnosti-natsionalnogo-agentstva-iz-zabezpechennya-yakosti-vishchoji-osviti-na-period-2017-2020-rokiv-proekt.

New Ukrainian School Reform. (2016). Ministry of Education and Science of Ukraine. Retrieved from https://mon.gov.ua/storage/app/media/zagalna%20serednya/Book-ENG.pdf

Nychkalo, N. (2017). "New Ukrainian School": the present and the view to the future. *Labor et Educatio*. 5, 89-106. DOI: 10.4467/25439561LE. 17.005.7980.

OECD. (2018). Educational Policy in Japan. Building Bridges towards 2030. Retrieved from https://read.oecd-ilibrary.org/education/education-policy-in-japan_9789264302402-en#page11.

Parademetriou, C. & Masouras, A. (2014). National culture underpins individual behavior and work-related values: The importance of nationality. Retrieved from https://www.researchgate.net/publication/278932250_National_Culture_Underpins_Individ ual_Behaviour_and_Work-Related-Values_The_importance_of_nationality.

Serikova, L. A., & Nizhegorodov, D. G. (2017). Preparing future teachers for the moral and spiritual upbringing of children in the multicultural educational environment *Pedagogical Sciences, 10,* 73-78. Retrieved from https://cyberleninka.ru/article/n/podgotovka-buduschih-pedagogov-k-duhovno-nravstvennomu-vospitaniyu-detey-v-polikulturnom-obrazovatelnom-prostranstve/viewer.

Ukrainian School Reform: interesting results and surveys. (2022). Education 24v.ua. Retrieved from https://education.24tv.ua/gotovi-vchiteli-do-nush-seredniy-shkoli-tsikavi-ukrayina- novini_n1855741

Vasilevskaya-Rutskaya, S. Y. (2009). Forming of the attitudes to professional activity as the moral value of intending teachers. *Ongoing Professional Education. Cyberleninka*. Retrieved from https://cyberleninka.ru/article/n/formirovanie-u-buduschih-pedagogov-otnosheniya-k-pedagogicheskoy-deyatelnosti-kak-nravstvennoy-tsennosti/viewer.

Whalley, J. (2005). Globalization and Values. CESifo Working Paper no.1441. SSRN. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=706781.

Zmievskaya, O. O., Dovgaliuk, T. A, Glazunova, T. V, Kuzmina, S. A, & Lisnichenko, A. P. (2020). *Preparation of the New Generation School Teacher: Theoretical and Practical Aspects*. (2020). Collective Monograph. Ministry of Education and Science of Ukraine. Vinnytsia Mykhailo Kotsiubynskyi State Pedagogical University.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14591

Modifications and Accommodations for Higher Education Students with Special Educational Needs

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Abstract

Students with learning disabilities and attention disorders in higher education are often described as individuals with invisible disorders. This perception may lead to misinterpreting and stereotyping of their educational needs and also to ineffective accommodations. This study aims to review recent research on accommodations and modifications for individuals with learning disabilities and attention disorders in higher education. The authors identified ten studies published between 2017 and 2021 that focused on accommodations for higher education students with learning disabilities (especially dyslexia) and attention disorders (ADHD). The recent research results show that learning difficulties are often manifested during traditional teaching and evaluation. Innovative student-centred approaches might be beneficial not only for students with special educational needs. To be effective the accommodations should be designed concerning personal and environmental factors. Study was supported by grant agency VEGA 1/0119/21.

Keywords: *special educational needs; dyslexia; ADHD; accommodations; higher education; review.*

1. Introduction

According to recent studies (Rouweler, 2021; Ryder & Norwich, 2019), the prevalence of students with special educational needs in colleges and universities is increasing. Universities across the world need to cope with the diversity of students and the variety of their educational needs. This study aims to discuss different types of modifications and accommodations for students with special educational needs in general and then to analyse ten examples of research evaluating or discussing the accommodations or modifications for individuals with learning disabilities and ADHD.

Accommodations in education can be defined as changes to the way of assessment that should help students with special educational needs demonstrate their knowledge or skills, while modifications refer rather to the change of what is being assessed or what learning and teaching methods and materials are being used, e. g., the use of assistive technology. Both accommodations and modifications are based either on the recommendations of psychologists, special educators or other specialists to fit and benefit each particular individual or they could be arranged by university centres for individuals with special educational needs, e. g., for a group of students with similar educational needs.

According to Dunn et al. (2018), the accommodations can be divided into four groups based on the aspect of assessment, which is changed to benefit an individual with special educational needs: A) presentation: The instruction or test items are presented in a modified way, e. g., students with special educational needs may listen to pre-recorded instructions rather than read written instruction. B) response: The form of students´ responses to assignments or test items are modified, e. g., the student can use digital technology instead of handwriting. C) setting: The environment where the student completes the assessment is changed, e. g., the student completes the examination individually to limit distractions or in a small group. D) timing and scheduling: The organization of the assessment is modified, e. g., students are provided with extra time or breaks during the examination (Dunn et al., 2018).

Universities and colleges need to decide what accommodations and modifications could and should be implemented with particular students and how to assess their effectiveness and benefits for students. Ideally, the choice of these tools should be evidence-based and at the same time, it should be the result of a discussion between the teacher and the student based on the recommendations of specialists.

2. Students with special educational needs in higher education in Slovakia

The problem of the support for students with special educational needs is not new in Slovakia. Universities have support centres for those students and if they are registered in a centre based on current legislation, they are eligible to apply for suitable accommodations. However, these

services are more commonly offered to students with sensory or physical disabilities rather than those with learning or attention disorders. According to the national statistics (Sokolová & Lemešová, 2022, in press), in primary and secondary education there are about 3% of pupils/students registered as individuals with special educational needs due to learning disabilities. The statistics for higher education are not available. Based on unpublished anecdotical data from authors´ institutions we may say that those students do not apply for accommodation in higher education very often. If so, they usually prefer timing and scheduling accommodations, even though these are not always considered valid and effective by some authors (Jansen et al., 2018; Miller et al., 2013).

3. Accommodations and modifications in higher education

For this study, we decided to focus on accommodations and/or modifications for two particular groups of students with special educational needs: students with attention deficit disorders (ADHD) and learning disabilities (especially dyslexia). These are considered invisible disabilities or disorders (Mullins & Preyde, 2013). Students may try to hide their difficulties, particularly when transiting to a higher level of education. On the other hand, when they apply for some accommodations or modifications their special educational needs are often challenged and questioned, e.g., by the university staff, teachers or peers (Mullins & Preyde, 2013; Norris et al., 2020; Stampolzis et al., 2015). The authors searched Science Direct and Web of Science databases to identify studies evaluating different types of accommodations and/or modifications for these particular target groups. We used the following inclusive criteria for the studies: studies published in peer-reviewed journals between 2017 and 2021 (five years), studies written in English, systemic reviews or research studies focused on samples of university or college students with learning disabilities or attention disorders, studies evaluating study interventions (accommodations and/or modifications) for these students. Ten studies that met the required criteria were identified (see Table 1) and discussed in the context of an evidence-based approach to intervention planning.

3.1. Attention deficit disorders (ADHD)

Symptomatology of attention-deficit/hyperactivity disorder is defined as the presence of symptoms of inattention and/or hyperactivity and impulsivity (American Psychiatric Association, 2013). While the symptoms of hyperactivity and impulsivity are highly prevalent in children with diagnosed ADHD, in adolescents and young adults we observe problems with attention, organization, executive functioning, time management, study skills, anxiety and mood (Weis et al., 2019). All these symptoms could be a barrier to successful functioning and performing in higher education. Weis et al. (2019) explored the way how clinicians report about college students with ADHD. Based on the results, they focus mostly

on symptoms rather than barriers and accommodations, in their sample, 32% of clinicians described barriers and only 42% described some history of accommodations. The data about provided accommodations were based mainly on students´ self-reports.

Table 1. Overview of accommodation and modification studies

Study	Country	Method	Conclusions
Alabdulakareem & Jamjoom, 2020	Saudi Arabia	review	The gamified intervention has positive effects on improving ADHD individuals.
Knouse et al., 2020	USA	experiment	Students with and without ADHD used retrieval practice to a similar degree.
Weis et al., 2019	USA	document analysis, interview	The evidence about accommodations for ADHD students came from students´ self-reports rather than from specialists.
Jansen et al., 2018	Belgium	experiment	The extended examination duration is not objectively effective for ADHD students.
Jansen et al., 2017	Belgium	survey	The effectiveness of accommodations depends on which problems students experience.
Knoop-van Campen et al., 2020	Netherlands	experiment	The only aspect where audio-support facilitated learning for students with dyslexia was factual knowledge learning.
Ryder & Norwich, 2019	UK	questionnaire	The awareness of dyslexia among university teachers is inadequate.
Serry et al., 2017	Australia	survey and interview	Self-advocacy and study resources and skills facilitate successful studies with dyslexia.
Pitt & Soni, 2017	UK	interview	Determination, time management strategies and university staff support are important facilitators.
Griful-Freixenet et al., 2017	Belgium	interview	The Universal Design for Learning (UDL) framework seems to address effectively the needs of students with disabilities.

Source: Sokolová, Lemešová, & Groma (2022).

One of the most common accommodations reported by students is the extended duration of tests and other types of examinations. However, these are not always accepted by experts as effective. Jansen et al. (2018) designed an experimental examination situation with a group of students with ADHD and controls. They were supposed to fill in a paper-and-pencil test in three different time conditions: 1 hr (+0%), 1 hr 20 min (+33%), and 1 hr 30 min (+50%). The participants in both groups used extended time but their performance did not increase. Based on those results, the authors conclude that extended duration of exams does not seem to be objectively effective for ADHD students.

Knouse et al. (2020) used a similar experimental design to compare the effectiveness of retrieval practice. Students with ADHD and controls used a computer interface to practice study material either in a self-regulated mode of learning or with a set criterion of three retrievals. Again, students with and without ADHD used retrieval practice similarly and the recall and recognition of studied material were high in both groups. Based on their results, the authors recommend using retrieval practice as a criterion for both ADHD and non-ADHD higher education students. Assistive technology and innovative interventions seem to be beneficial for students with ADHD at different levels of education including university. Alabdulakareem & Jamjoom (2020) reviewed intervention studies and concluded that serious games and gamified intervention had overall positive effects on individuals with ADHD. The use of gamified learning environments may help students with ADHD to focus on study material and to practice it more effectively.

Even though educators use different types of accommodations, Jansen et al. (2017) concluded that the perceived effectiveness of accommodations depends on actual problems that students face. The authors collected data from individuals with and without ADHD and student counsellors and they found that most of the problems with concentration and focusing among ADHD students are related to the traditional methods of teaching and evaluation. They recommend considering both personal and environmental aspects in accommodation planning.

3.2. Dyslexia and learning disabilities

The symptoms of learning disabilities, among which dyslexia is the most frequently discussed and explored, are persisting from primary school age to higher education in many students. It is manifested especially in the speed and quality of reading; however, it might affect also other areas of study skills and overall functioning in higher education (Rouweler, 2021; Ryder & Norwich, 2019). Similarly to students with ADHD, the students with dyslexia might experience lower self-esteem related to their studies, anxiety, or fear of stigmatization. As far as dyslexia affects especially reading, the accommodations are often designed for this particular area. Knoop-van Campen et al. (2020) used a computer-assisted multimedia learning environment to test the impact of audio support on learning outcomes. Surprisingly, they found that adding audio to multimedia learning material negatively impacts learning and this impact is similar in students with and without dyslexia. The only aspect where audio-support facilitated learning for students with dyslexia was factual knowledge learning (Knoop-van Campen et al., 2020).

Pitt & Soni (2017) and Serry et al. (2017) interviewed students with dyslexia in the United Kingdom and Australia to identify their perception of effective accommodations and academic support. Participants reported several factors facilitating successful studies with dyslexia including family support, self-advocacy skills and learning resources (Pitt & Soni,

2017). The authors recommend developing interventions related to literacy support, self-advocacy, thinking and study skills. Similar results were reported by Serry et al. (2017), study and time management skills were identified as important facilitators by their participants. These also highlighted the role of university teachers and their awareness of dyslexia among university students and their ability to use a more individualised and targeted approach to support students with special educational needs. This result is supported by the survey conducted by Ryder & Norwich (2019) who approached university teachers with an online questionnaire on dyslexia. Their findings showed that teachers´ awareness of relevant dyslexia research was inadequate and inaccurate, which might have serious implications for the quality of academic support for those students.

As accessibility seems to be the crucial condition for effective learning, Griful-Freixenet et al. (2017) created the Universal Design for Learning (UDL) framework to support access for all learners. They interviewed higher education students with disabilities to evaluate the concept. They identified different types of accommodation used for those students and found that the system should reflect the individual learning needs of students not only through setting and curricular changes. It should be more direct, reflecting individual needs and asking students "the right questions" (Griful-Freixenet et al., 2017, p. 1627).

4. Discussion and conclusion

Accommodations and modifications for higher education students with learning disabilities and attention disorders are still little explored compared to those designed for younger learners. Higher education students would appreciate especially timing and setting accommodations to avoid distractors during examinations, they also find it useful to have access to assistive technology, to have online study materials available in advance or have an opportunity to communicate their questions and problems with teachers, e.g., via online forums (Pitt & Soni, 2017; Serry et al., 2017; Stampoltzis et al., 2015).

However, the results of the studies included in this review show that some of these accommodations and modifications designed originally for individuals with special educational needs are not beneficial only for this particular group of higher education students. The differences in learning processes and learning outcomes between the students with learning and attention disorders and control groups are not always significant (Jansen et al., 2018) and it is not rare if both groups benefit from the educational change. For students with ADHD, the problems with focusing often arise during classical teaching and evaluation methods (Jansen et al., 2017). It seems that innovative approaches in learning and teaching, including the use of digital media, e.g., serious games or virtual reality (Alabdulakareem & Jamjoom, 2020; Cibrian et al., 2022), computer-assisted retrieval practice (Knouse et al., 2020) or complex environments based on student-centred approach (Griful-Freixenet et al.,

2017; Tops et al., 2021) could be beneficial for students with learning difficulties but also for general higher education students. This is following the concept of inclusive education where learning and teaching are designed to fit the educational needs of all students and at the same time foster understanding of diverse educational needs among teaching staff (Ryder & Norwich, 2019). According to Serry et al. (2017), optimal inclusive practices require greater awareness among staff about the challenges these students face. A combination of teaching staff awareness and understanding with student-centred teaching might help to create adequate academic support for students with learning disabilities and attention disorders.

Despite the reported increase in the number of students with special educational needs in higher education, the research on the topic of accommodations and modifications for this target group is relatively scarce. Our selection of recent studies shows a variety of methods and approaches toward academic support of individuals with disabilities and it also illustrates current trends in the evidence-based evaluation of those approaches.

Acknowledgement

Study was supported by grant agency VEGA 1/0119/21.

References

Alabdulakareem, E., & Jamjoom, M. (2020). Computer-assisted learning for improving ADHD individuals' executive functions through gamified interventions: A review. *Entertainment Computing, 33*, 100341. https://doi.org/10.1016/j.entcom.2020.100341

American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.). American Psychiatric Publishing.

Cibrian, F. L., Lakes, K. D., Schuck, S. E. B., & Hayes, G. R. (2022). The potential for emerging technologies to support self-regulation in children with ADHD: A literature review. *International Journal of Child-Computer Interaction, 31*, 100421. https://doi.org/10.1016/j.ijcci.2021.100421

Dunn, D. et al. (2018). *Assessment Guide for Psychology Teachers*. Washington: American Psychological Association.

Griful-Freixenet, J., Struyven, K., Verstichele, M., & Andries, C. (2017). Higher education students with disabilities speaking out: perceived barriers and opportunities of the Universal Design for Learning framework. *Disability & Society, 32*(10), 1627–1649. https://doi.org/10.1080/09687599.2017.1365695

Jansen, D., Petry, K., Ceulemans, E., van der Oord, S., Noens, I., & Baeyens, D. (2017). Functioning and participation problems of students with ADHD in higher education: Which reasonable accommodations are effective? *European Journal of Special Needs Education, 32*(1), 35–53. https://doi.org/10.1080/08856257.2016.1254965

Jansen, D., Petry, K., Evans, S. W., Noens, I., & Baeyens, D. (2018). The Implementation of Extended Examination Duration for Students with ADHD in Higher Education. *Journal of Attention Disorders, 23*(14), 1746-1758. https://doi.org/10.1177/1087054718787879

Knoop-van Campen, C. A. N., Segers, E., Verhoeven, L. (2020). Effects of audio support on multimedia learning processes and outcomes in students with dyslexia. *Computers & Education, 150*, 103858. https://doi.org/10.1016/j.compedu.2020.103858

Knouse, L. E., Rawson, K. A., & Dunlosky, J. (2020). How much do college students with ADHD benefit from retrieval practice when learning key-term definitions? *Learning and Instruction, 68*, 101330. https://doi.org/10.1016/j.learninstruc.2020.101330

Miller, L. A., Lewandowski, L. J., & Antshel, K. M. (2013). Effects of extended time for college students with and without ADHD. *Journal of Attention Disorders, 19*(8), 678-686. https://doi.org/10.1177/1087054713483308

Mullins, L., & Preyde, M. (2013). The lived experience of students with an invisible disability at a Canadian university. *Disability & Society, 28*(2), 147–160. https://doi.org/10.1080/09687599.2012.752127

Norris, M., Hammond, J., Williams, A., & Walker, S. (2020). Students with specific learning disabilities experiences of pre-registration physiotherapy education: a qualitative study. *BMC Medical Education, 20*(2). https://doi.org/10.1186/s12909-019-1913-3

Pitt, S., & Soni, A. (2017). Students' experiences of academic success with dyslexia: A call for alternative intervention. *Support for Learning, 32*(4), 387–405. https://doi.org/10.1111/1467-9604.12182

Rouweler, L. (2021). *The Impact of Dyslexia in Higher Education*. University of Groningen. https://doi.org/10.33612/diss.190485392

Ryder, D., & Norwich, B. (2019). UK higher education lecturers' perspectives of dyslexia, dyslexic students and related disability provision. *Journal of Research in Special Educational Needs, 19*(3), 161-172. https://doi.org/10.1111/1471-3802.12438

Serry, T., Oates, J., Ennals, P., Venville, A., Williams, A., Fossey, E., & Steel, G. (2017). Managing reading and related literacy difficulties: University students' perspectives. *Australian Journal of Learning Difficulties, 23*(1), 5–30. https://doi.org/10.1080/19404158.2017.1341422

Sokolová, L., & Lemešová, M. (2022 – in press). Poruchy učenia a pozornosti u vysokoškolákov: analýza prevalencie. [Learning and attention disorders among university students: analysis of prevalence]. In: *PhD Existence 2022: Conference Proceedings*.

Stampoltzis, A., Tsitsou, E., Plesti, H., & Kalouri, R. (2015). The learning experiences of students with dyslexia in a Greek higher education institution. *International Journal of Special Education, 30*(2), 157–170.

Tops, W., Jansen, D., Ceulemans, E., Petry, K., Hilton, N., & Baeyens, D. (2021). Students with Dyslexia in Higher Education: A multi-informant survey on functioning and participation problems and the effectiveness of accommodations. https://doi.org/10.13140/RG.2.2.10818.30401

Weis, R., Till, Ch. H., & Erickson, E. P. (2019). Assessing and Overcoming the Functional Impact of ADHD in College Students: Evidence-Based Disability Determination and Accommodation Decision-Making. *Journal of Postsecondary Education and Disability, 32*(3), 279-295.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14196

Enhancing Learning in the Finance Classroom

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Abstract

This paper aims to describe a teaching-learning experience based on Project-Based Learning (PBL). This experience is part of an educational innovation project devoted to transforming finance classes in various facets of financial advice. Specifically, the article focuses on the transformation process of a subject that studies financial markets and the assets traded in them. Based on this experience, the classroom becomes a financial consulting firm that advises investors on how to invest their capital. The results show us a remarkable active dedication of the students to the course, improved knowledge, and marks. In addition, the development of skills and values such as teamwork, autonomy, solidarity, equality, and professional skills are elements that encourage us to continue along this line.

Keywords: *PBL; financial advisory; professional skills; teamwork; financial markets.*

1. Introduction

This paper aims to describe a teaching-learning experience based on Project-Based Learning (PBL). This experience is part of an educational innovation project of the Public University of Navarre (UPNA) to transform finance classes in various facets of financial consulting. Specifically, we show the transformation process of a traditional subject of the Business Administration and Management degree (ADE for its acronym in Spanish) that studies financial markets and the assets traded in them. Based on this experience, the classroom becomes a financial consulting firm that advises investors on how to invest their capital.

The paper is structured as follows: the second section briefly presents the theoretical framework of the methodology used, PBL. Section 3 explains the context in which it is carried out. Section 4 describes the experience, and section 5 shows its results. Finally, section 6 presents the main conclusions drawn from the experience.

2. Brief literature review about PBL

The PBL methodology is a form of learning centered on John Dewey's idea of "learning by doing." With this methodology, the learning takes place in a specific context; the student is actively involved in the learning process and achieves the proposed goal through social interaction. Du and Han (2016) further develop this definition. This methodology is close to problem-based learning (Helle et al., 2006) and also shares characteristics with puzzling (Aronson et al., 1978). PBL engages students in elaborating a final product through collaboration with each other. Collaboration is its main differentiating element. In addition, the teacher does not explain the topics that the students must know to produce the product, i.e., the learning itself is part of this PBL. Butler (1998), Thomas (2000), Duan and Han (2016), Kokotsaki et al. (2016), and Condliffe et al. (2017), among others, conducted an exhaustive review of the literature on this methodology showing a comparative advantage over other methodologies.

However, PBL is more demanding in time and resources than traditional methodologies (Al-Balushi and Al-Aamri, 2014). Therefore, for this methodology to succeed in the classroom, the teacher's involvement is essential. Kokotsaki et al. (2016) include additional issues to maximize success. We highlight the scheduling project, getting started, managing student groups, teacher support, practical group work, and the assessment emphasis on reflection, self and peer evaluation, among others.

Most of the applications of this methodology have been in fields such as language learning and health, although it has recently been extended to other fields such as finance. As an example, Parrado-Martínez and Sánchez-Andújar (2020) show the usefulness of PBL to improve compentences for employability and for learning about finance .

3. Context

The experience presented here is carried out in the "Financial Markets and Instruments" course. It is a compulsory course that students must take in the fourth semester (spring semester) within the Business Administration and Management degree. The course is taught four hours per week for 15 weeks, with a course load of 6 ECTs. Students taking this course have basic knowledge of financial asset valuation, acquired in the first semester of the degree, and macroeconomics in the third semester.

The topics of the course are the following:

- Macroeconomic environment, interbank and money markets
- Fixed income markets
- Equity markets
- Foreign exchange markets
- Derivatives markets

Prior to the experience described in this paper, the course used lectures, combined every two weeks with seminars working with actual market data. The proposed transformation covers the first three points and occupies half of the semester.

4. Experimental course

One of the main aspects of applying this methodology is detecting a "saleable" product. In the case of this course, the product that our students will be able to sell to potential customers is an investment advisory service. When requested, this financial advisory service will have a report on the state of the financial markets and offer a diversified asset portfolio with bondsand equities, individualized for an investor with a specific risk profile. A student who finishes the degree could have this job position, thus seeing the direct application of what they learn to their professional life. It is a simulation of a possible professional environment.

4.1. Formation of the teamwork

The first step in this experience is the formation of teamwork. In our case, three students form a group. This number seems ideal for creating positive interdependence among students. If one of the members leaves, the work that impacts the two remaining team members is 1/3 of the total work, which means a considerable amount of additional work. This fact can generate more responsible and supportive behaviors among team members, reflected in lower dropout rates. In our experience, there were no dropouts. The students grouped themselves on the condition that the teamworks were mixed. This condition requires the formation of gender-diverse groups.

4.2. Puzzle

We began the project by working on a puzzle. Three syllabus topics are worked on: macroeconomic environment, bond markets, and equity markets. Each team member is assigned a piece of the puzzle corresponding to each of these topics. The student receives theoretical and practical material and must become an expert on its part of the puzzle.

To become an expert, the student works in two stages. The first stage consists of individual work on its material. The student must review it and try to understand and assimilate the main concepts described in that material. The second stage consists of the experts´ in-depth study on a topic by getting together in groups of 3-4 students. They delve into the assigned material, answering some questions that guide them in their learning. In this second stage, experts interact and work on the material among equals. Subsequently, they must understand aspects that they might not have understood individually.

Once the puzzle pieces are ready, the next step is to assemble the puzzle. The initial components of the team are already experts. Now it is when they join together. In this new phase, each member must explain the topic they are experts on and facilitate learning the main aspects of that topic to their teammates. In other words, all team members should know and understand the fundamentals of the three topics.

To achieve this global knowledge, each student must provide an overview of his/her puzzle piece to his/her teammates (a theoretical and practical explanation). In a group session, they must transmit the essential ideas necessary to understand the topic. At the moment, each member evaluates the material and explanations provided by the other team members. Our experience in this aspect is that, at the time being, students evaluate correctly even if the explanations and materials have not been satisfactory. In other words, at this stage, the tendency is still not to negatively evaluate the work of the other team members. Although peer assessment is not taken into account for the final mark, it is useful for detecting opportunistic behaviour within teams.

4.3. Product elaboration

Once all team members acquire the basic knowledge of the topics, the teamwork must prepare an initial version, “version 0”, of the product within a week. This version is a product that meets all the requirements but that needs to be improved for the final sale. The students must suggest to the customer the best way of investing 100,000 euros in Spanish financial markets. The proposal should be a diversified portfolio that fits the investor´s risk profile. Each group of students decides the customer profile that they have to advise, so students can consider different contexts.

When the proposal is ready, it should be submitted to the teacher, who acts as the company's director, and comments to improve the proposal to become a saleable product for the

customer. In one week, the students will correct "version 0" of their product to elaborate the next version, "version 1", which could already be offered to the customer. This version is finally presented to the customer. Students must submit a detailed investment portfolio report containing expected returns, risks, and convincing arguments. In this presentation, the teacher takes the role of the customer to whom the product is sold. The customer offers the possibility of an additional investment of 20,000 euros, along the same lines but is dedicated to acquiring other types of assets, e.g., assets with ESG characteristics. This last installment is what we call "version 2"

4.4. Evaluation

The PBL evaluation comprises three parts. The first part represents 20% of the mark, obtained by completing all the deliveries on time. Moreover, it is compulsory to hand in 80% of the installments; otherwise, the student fails.

The second part represents 60% of the mark and includes several aspects. The mark for "version 1" represents 15%, and for "version 2", 30%, both grades are the same for all team members. This fact generates positive interdependence within group. The versions are evaluated through a rubric given to the students at the beginning of the project. The remaining 15% is evaluated through an individual exercise on each team's project, implying interdependence since it takes 0 if the exercise is wrong, 5 if it is satisfactory, and 10 only if everyone in the group gets it right.

The third part represents the remaining 20% and measures the achievement of the basic knowledge measured by an exam.

5. Results from the experience

Knowing the experience results helps us to decide on its continuation and future extension to other finance subjects.

5.1. Results from PBL

Satisfaction with the results obtained from the PBL is very high. On the one hand, the implementation of the project has significantly increased the number of queries made to the teacher since the first week of the course. It was usual to have around five queries from students in this subject and always on dates close to weeks 10-12. On no occasion did this occur during the first five weeks. With the experience of the PBL, these consultations have occurred from the first week, which is related to student's superior work at the beginning of the semester. This observation is already a first result favorable to the methodology. Table 1 shows the data of several indicators for two consecutive years: before implementing the experience in which the traditional methodology was followed (previous academic year), and

the current one (actual academic year). Actual period is the period in which we use the PBL methodology. For the comparison we employe the information obtained from Sakai, which is the Learning Management System (LMS) employed in this course.

Table 1. Results of PBL

Period	emails	Downloads in Sakai	Sakai access	Basic knowledge
Previous	90	1148	2424	6.21
Actual	132	1977	4464	7.06
Diference	47%	72%	84%	0.85*

Source: Own elaboration. * significant at the 10% level.

There are clear signs of improvement in the students' course follow-up and interest. Firstly, emails received by the teacher in comparable periods have increased by 47%. Secondly, the visits to the Sakai platform have grown by 84%. Thirdly, the documents read by the students on the LMS increased by 72%. This increase in activity has been observed since the first week.

As for the product generated by the students, in 85% of the cases, the product could be sold to a potential customer, and the arguments used to offer it was credible in most cases. It leads us to assume that their learning was more internalized and reflective than traditional methodology. With the development of the advisory service, the students have developed autonomous learning, teamwork, and professional skills, so we consider the results to be outstanding.

Finally, the two final tests show the results obtained in the knowledge. In the test about the product, 70% of the groups obtained the maximum mark, and only four students did not pass the test. In the general knowledge test, only five students could not achieve a score of 5 points, which means a 100% pass rate once the product results are taken into account. These grades also represent a substantial improvement concerning those obtained in the evaluation of general knowledge using the previous methodology, since in the last course they were 6.21 on average and in this course the grade has risen 0.85 points, being this difference statistically significant.

5.2. Feedback from the students

In order to assess student satisfaction with this methodology, a survey was carried out, with items scaled from 1 to 5. Table 2 shows the descriptive data.

Table 2. Student´s Opinions

Items	NºObs	Mean	St.D
Methodological adequacy	40	2.45	0.93
Possible future career	40	2.44	1.17
Hours per week	40	8.00	3.17
General satisfaction	40	3.05	1.13

Source: Own elaboration.

Students do not find this methodology better than the traditional one, and they indicate a workload of about 6-8 hours per week. Perhaps, the assesment is conditioned by the the greater workload that PBL implies for them. However, although this workload may seem excessive to them, is consistent with the number of hours that must be dedicated to it according to the ECTS of the course. The general satisfaction shown by the students was about the average. Finally, few students see financial advicing as a possible future career.

6. Conclusions

The use of the PBL methodology for learning financial assets and the markets in which they are traded is an opportunity for students to acquire knowledge about these aspects more deeply. Moreover, this methodology adds additional advantages to the mere fact of learning since it allows for developing skills linked to self-learning, teamwork, solidarity, and professional skills.

In addition to developing the skills mentioned above, this proposal aims to help reducing the gender gap evident in different aspects of the financial profession. Previous studies show that men have a greater preference for finance than women. However, the percentage of female students in the degree program is 50%. If our students see themselves as financial advisors, they can change the male perception of this career and consider this profession within the spectrum of possibilities to which they can dedicate themselves.

Our experience in this course has allowed us to learn a few things:

- Students need more guidance than we thought. We must develop a tutorial or practical guide to help them.
- Students are not able to put together very scattered information. We need to develop some primary material to guide them, which they can supplement with additional material.

- Students tend to value their peers well in the project's first stage. However, they do not do so much in the end. We must stress the importance of detecting wrong behaviors in the puzzle assembly phase, where these behaviors can still be corrected.
- Teamwork among students is not easy. However, they must get used since collaboration will be essential in their professional future.

The global vision of the results encourages us to continue developing this methodology in the subsequent courses and even implement it in other subjects related to the finance, such as the one related to the economic viability of investments. Future course extensions will allow us to analyse results in more detail. The pending task for the teaching team is to convince our students that this way of learning improves the necessary skills for their professional future, which are difficult to achieve with traditional methodologies.

References

Al-Balushi, S. M., & Al-Aamri, S.S. (2014). The effect of environmental science projects on students´ environmental knowledge and science attitudes. *International Research in Geographical & Environmental Education,* 23(3), 213-227. doi: 10.1080/10382046.2014.927167

Aronson, E., Blaney, N., Stepahan, C., Sikes, J. & Snapp, M. (1978). *The Jigsaw Classroom*. Sage Publications, Beverly Hills. California.

Butler, S. M. (1998). The process of problem-based learning: A literature review. *Journal of Health Occupations Education,* 13(1), 9, 132-168. Available at: https://stars.libray.ucf.edu/jhoe/vol13/iss1/9.

Condliffe, B., Quint, J., Visher, M.G., Bangser, M.R., Drohojowska, S., Saco, L., & Nelson, E. (2017). *Project-based learning. A literature review*. Working Paper. New York, NY. MDRC. Available at: www.mdrc.org.

Du, X., & Han, J. (2016). A literature review on the definition and process of Project-based learning and other relative studies. *Creative Education*, 7, 1079-1083. doi:10.4236/ce.2016.77112

Helle, L., Tynjälä, P., & Olkinuora, E. (2006). Project-based learning in post-secondary education –theory, practice and rubber sling shots. *Higher Education*, 51, 287-314. doi:10.1007/s10734-004-6386-5

Kokotsaki, D., Menzies, V., & Wiggins, A. (2016). Project-based learning: A review of the literature. *Improving Schools*, 19(3), 267-277. doi:10.1177/1365480216659733

Parrado-Martínez, P., Sánchez-Andújar, S. (2020) Development of competences in postgraduate studies of finance: A project-based learning (PBL) case study. *International Review of Economics Education*, 35, 100192. doi: 10.1016/j.iree.2020.100192

Thomas, J. W. (2000). *A review of research on project-based learning.* San Rafael, CA: The Autodesk Foundation.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14259

Universities' Attractiveness and Grading Policies: A Spatial Competition Model

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Abstract

This article compares two different views about universities' attractiveness and grading policies. On the one side, inflating grades should be a suitable strategy in order to attract students to a certain university. On the other side, soft grading policies damage departments' reputation, so discouraging students' applications. From this perspective, students are really interested in the quality of courses and the socio-economic characteristics of the territories in which universities are settled. We propose a spatial competition model, showing that grading inflation is a reaction to adverse conditions, aimed at balancing the distortions generated by fees level and differences in the socio-economic characteristics of the locations.

Keywords: *Higher Education; Students' choices; Grading Policies; Spatial Competition.*

1. Introduction

The main aim of this article is to show how a simple spatial competition theoretical model could describe the relationship between universities' attractiveness and grading policies more efficiently than how the existing economic literature actually does. Indeed, the idea that students benefit from higher grades is in place from decades. As an example, Juola (1979) showed how American universities used to "quiet down" the student bodies' protests caused by the Vietnam War increasing grades artificially.

Without regard to underlying reasons, such a strategy would cause anyway student attainment of higher grades independent of increased levels of academic attainment (Eiszler, 2002). Consequently, the idea that students would be straightforwardly attracted by the so-called *soft grading policies* implies that they are so myopic to desire a policy which would make them less prepared, with less valuable degrees and less sortable in the job market (Lombardi and Ghellini, 2019). There are studies which try to debunk this kind of a commonplace, such as Marsh and Roche (2000), who find a positive relationship between teaching evaluations and student workload. Analyzing the existing literature, Boretz (2004) highlights that students really want their fees to be worth, but in the sense that this money has to be devoted in challenging them and increasing their competencies. On the other side, she defines the idea that students want to buy easy *A*s just as *student consumerism*, namely the idea that universities are businesses which have to sell their good at the largest audience as possible.

Nonetheless, in the next section we will show how there is still a large stream of literature (especially in Economics) in which this misconception acritically holds. At the same time, we will present a list of empirical studies whose data seem to contradict this viewpoint. Then, we develop a simple theoretical model aiming to demonstrate that it would be sufficient to allow universities to compete interacting each other – so maintaining a conservative approach in modelling them similarly to firms selling a product – to obtain as a result that students are in many cases discouraged from choosing a university engaged in soft grading policies. Finally, we will conclude with a discussion of model result, its possible policy implication and some hints about further developments.

2. Soft Grading Policies: Comparing Different Perspectives

One of the first attempts of giving a formal modelling of Grade Inflation is McKenzie (1975), where the main assumption is that rational students would experiment a trade-off between grades and leisure time, aiming at maximizing their grades constrained to the time available. Nonetheless, even if his model highlights a possible distorsive effect generated by soft grading policies, he is persuaded that in reality students are very much interested in the quality of their education itself. One of the paper testing this assumption is Bratti and Staffolani (2013): even if grades' elasticities can negatively influence study time allocation,

in general students are active players in the learning process, highly responsive to changes in their workload.

Nevertheless, many following attempts to model the relationship between students' preferences and grading exhibited a more simplistic approach. As an example, Jewell *et al.* (2013) build the departments' production function generating a teaching output, which positively depends on the number of students, which positively depends by the level of grading. A possible explanation for this assumption – beyond the trivial idea that students would like to obtain high grades without effort – can be found in Chan *et al.* (2007) and Ostrovsky and Schwarz (2010). In this case, inflating grades could be a strategy played by departments themselves in order to blend mediocre students into the good ones when their abilities are signaled to the job market through the degree's final mark. Unfortunately, it is sufficient to add a reputational cost to the model to show that, when employers learn that students' ability does not match with grades, they start to penalize students from those departments. Then, students will learn that inflating-grades departments are not able to place them on the labor market, starting to avoid them (Ehlers and Schwager, 2016).

While there are evidences that teachers can "buy" good evaluations inflating grades – namely, students positively rewards high grades when they are already involved into a certain education process – (Nelson and Lynch, 1984; McPherson *et al.*, 2009; Weinberg *et al.*, 2010) very little evidences are available about the attractive power of soft grading policies when students have to decide where to apply. Some literature suggests that departments exhist which employ soft grading as a suitable tool in order to attract a larger number of students, but with conflicting effects. Higher grades are provided by those departments experiencing a low enrolments' rate, but with the unintended consequence not only of generating overeducated students with lower wages and higher chances of remaining unemployed (Bagues et al., 2006, 2008), but also losing their own reputation (De Paola, 2008).

Accordingly, several empirical studies are able to show how the main driver of students' choice of university is to be searched in the local socio-economic characteristics of origin and destination, especially in terms of labor market conditions (Croce and Ghignoni, 2011; D'Agostino *et al.*, 2019). Students want to anticipate the job market, moving soon towards those places able to give them better chances of being collocatated on a suitable employment, in many cases facing several 'settling costs' from economic, psychological, and social points of view (D'Agostino *et al.*, 2021). They seem also very interested in the competencies they are going to acquire, showing high selectivity in their choice of the educational curricula (Columbu *et al.*, 2021) Thus, students are not attracted by departments providing on average a higher level of grades. If any effect emerges, it is only in comparison with particularly low levels of average grading (Lombardi and Ghellini, 2019). At the same time, departments try to employ such a strategy only when they are facing low enrolments rate, interacting in

competitition with other departments stronger in terms of educational offer and/or socio-economic local characteristics (Lombardi and Distaso, 2021).

3. Theoretical Model

We develop a model in which two universities compete *a la Hotelling* with fixed positions (Hotelling, 1929). To keep the model simple, the two universities provide just one same subject. In this setting we assume that students are uniformly distributed along a segment on whose extremes are located the two universities. The segment is represented by the linear space [0,1]. The two universities are differentiated along several dimensions. The first difference is the location. Ceteris paribus students prefer the closer university, in fact, they pay a transportation cost called shoe-leather cost that is proportional to the distance between them and the university. For the student located in x, the shoe-leather cost of attending university $I_i \in 0,1$ is equal to $\tau|I_i\text{-x}|$. We assume that the two locations have differences in socio-economic characteristics such as unemployment rate and GDP that can be represented with the parameter Δ. Universities have no control over these socio-economic characteristics but nevertheless students have a preference for the university located in the place that guarantees better opportunities. Without loss of generality we assume that the university located in 0 has the worst socio-economic characteristics. A second level of differentiation between universities are the fees that are the only source of financing for universities. From the standpoint of students low fees are preferable. In fact, we assume that fees are not signals of the quality of a university, and thus only the monetary side matters. For universities both the price and quantity effects are at work. Increasing the fees generate a greater revenue per student, but decreases the number of students attending the university. We note that in this setting it is not the absolute value of the fees that matters, but the relative value of the two universities' fees. The last source of heterogeneity between universities is the grading policy which is represented through the parameter G. We assume in this theoretical section that students are attracted by the possibility of obtaining high grades with low effort, thus preferring universities characterized by high values of G. Again the standpoint of universities is more complex. In fact, two mechanisms similar to the quantity and price effect are at work for the grading policy. As we argue before, a greater value of G increases the attractivity of the university, and thus it increases the number of students and the quantity of fees collected. In addition to this positive effect of grading policy there is a negative one, that concernes to the dimension of reputation of the university. The increase of grades has not a direct financial effect on the university, but it has a negative effect on job market. In fact, grading policies perturb and distort the signal of the quality of students harming the efficiency of the job market. Universities are blamed for this negative esternality generating a reputation cost. We assume that the reputation cost depends both on the magnitude of the grading policy and on the quantity of students that are subject to it. Indeed, the effect on the job market is

proportional to the number of graduates with artificially high grades. We further assume that the quality of the two universities in terms of teachers, services, and quality of the research is the same, and thus the utility, in terms of knowledge, that students get from attending the two universities is the same, label it with *r*.

Each student has to attend one of the two universities and thus the choice is determined by the comparison of the total utility obtained attending the university in 0, U_0, and the university in 1, U_1. The only difference between students is their location it is the only characteristic through which is possible to discriminate between students attending one university or the other. The utility of attending university *i* (that can be either 0 or 1) of a student located in *x* (with $0 \leq x \leq 1$) is:

$$U_i = r - \tau|I_i - \mathrm{x}| + \mathrm{aG_i} \pm \mathrm{b}\Delta - \mathrm{f_i}$$

Where *a* is the propention to appreciate high grades of students and *b* is the importance for students to attend the university in the wealthier location. The sign in front of $b\Delta$ is positive for the university located in 1 and negative otherwise. The indifferent student is the one that obtains the same utility from attending the two universities:

$$\hat{x} = \frac{1}{2} - \frac{\mathrm{a}}{2\tau}(\mathrm{G_1} - \mathrm{G_0}) - \frac{\mathrm{b}\Delta}{\mathrm{t}} - \frac{1}{2\tau}(\mathrm{f_0} - \mathrm{f_1})$$

Students located on the left of $\hat{x}$ prefer the university in 0 and students on the right prefer the university in 1. The objective of universities is to maximize total fees net of the reputational cost due to the grading policy. We assume that fees are fixed, at least in the short term, and thus the only instrument to increase revenues is the grading policy. The maximization problems for the two universities are respectively:

$$\max_{G_0}(f_0 - G_0)\,\hat{x} \quad \text{and} \quad \max_{G_1}(f_1 - G_1)\,(1 - \hat{x})$$

Solving the to maximization problems separated we initially obtain the optimal grading policy for each university given the grading policy chosen by the other one.

$$\begin{cases} G_0(G_1) = \dfrac{G_1}{2} + \dfrac{(a+1)f_0 - f_1 + 2b\Delta - \tau}{2a} \\ G_1(G_0) = \dfrac{G_0}{2} + \dfrac{(a+1)f_1 - f_0 - 2b\Delta - \tau}{2a} \end{cases}$$

The solutions of the system are:

$$G_0 = \frac{f_0(2a+1) - f_1(1-a) + 2b\Delta - 3\tau}{3a} \text{ and } G_1 = \frac{f_1(2a+1) - f_0(1-a) - 2b\Delta - 3\tau}{3a}$$

The grading policies of the two universities critically depend on the fees charged. Three different solutions emerge for different values of $f_1 - f_0$. In the first region, $f_0 > f_1$ and $G_0 >$

G_1, meaning that the two universities pursue different strategies to attract students. The university located in 0 use the vicious strategy made of high fees and high grades, while the university located in 1 use the virtuous strategy made of low fees and low grades. In the second region, where $f_1 - f_0 > \frac{4b\Delta}{a+2}$ and $G_0 < G_1$, the strategies are inverted. The university located in 0 pursue the virtuous strategy unlike the university located in 1 that use the vicious strategy. In the third region, where $0 < f_1 - f_0 < \frac{4b\Delta}{a+2}$ and $G_0 > G_1$, two different strategies emerge. The university located in 1 chooses an elitarian strategy with high fees, low grades, and few students. The university located in 0 chooses instead a predatory strategy made of low taxes and high grades, that attracts the large majority of students. The third region is more likely to occur the more students are interested in the socio-economic characteristics of the location and the less are interested in high grades.

4. Discussion and conclusion

Our model shows how can be simple to model the consequences of adopting soft grading policy on the students' decisions about departments where to apply, just allowing universities to interact competitively each other. Firstly, let us notice that the model is as conservative as possible, including high grades as a positive parameter in the students' utility function.

The model shows that grading inflation is a reaction to adverse conditions. In fact, soft grading policies can be intended as interventions by the departments aimed at balancing the distortions generated by different fees and differences in the socio-economic characteristics of the locations. Two different scenarios emerge, in the first one soft grading policies are substitutes of the policies on fees, while in the second one they are complements. We intend that when each of the two universities is more attractive in one of the two dimensions but less attractive in the other, then soft grading policies and fees are used as substitutes. Analogously when one university is more attractive in both the dimensions, then soft grading policies and fees are used as complements. In the first region identified in the previous section, the university located in 0 has both higher fees and worst socio-economic characteristics making it less attractive than the other. Soft grading policy is the strategy chosen by the departments of the university located in 0 to be more attractive and counter the negative effects of fees and socio-economic characteristics of the location 0. In the second region identendified in the previous section the soft grading policy is implemented by the departements of the university located in 1. In fact, in this region the positive effect in terms of attractivity generated by the socio-economic characteristics is more than compensated by the negative effect generated by the large fees of the university located in 1. Also in this region fees and soft grading policies act like substitutes. In the third region identified in the previous section, the university located in 0 has lower fees but the positive effect in terms of attractivity is more than compensated by the negative effect of the socio-economic

characteristics of location 0. In this region fees and soft grading policies are instead complements, in fact the university located in 0 needs both soft grading policy and low fees to be attractive for students. As a special case we note that when the fees of the two universities are equal, the departements of the university in the bad location, in terms of socio-economic characteristics, implement soft grading policies. The larger is the difference in the quality of the location, the greater should be the difference in grading policies.

The take-away massage of this model is that soft grading policies are a strategy to counter imbalances in the attractiveness of universities. While the socio-economic characteristics of the location are, at least in the short and medium term, out of the control of universities, fees are directly chosen by universities. In this type of model one instrument, fees, is enough to balance the attractivity of the universities. We stress that in the model presented the two universities have the same quality in terms of teachers, services, and quality of the research. A possible extension of the model could consider the quality of university as linked to both fees and grading policies. On one side higher fees generate higher quality of services for students (Beine *et al.*, 2020), and on the other side that grade inflation is instead harmful for the quality of the university (Edwards, 2000). In this setting the effectiveness of soft grading policies would be severely reduced. In this setting grading policies have a direct positive effect on the preferences of students, but at the same time reduces the quality of the university an thus they have an indirect negative effect on preferences of students. When the second effect is larger grading inflation impairs the attractivity of universities.

References

Boretz, E. (2004). Grade inflation and the myth of student consumerism. *College Teaching*,52(2),42–26.

Bagues, M., Sylos Labini, M. & Zinoryeva, N. (2006), Endogenous grading standards and labour market mismatch, in *'2ndWorkshop on the Reform Process of the University Systems*, 4th–6th May'.

Bagues, M., Sylos Labini, M. & Zinovyeva, N. (2008), 'Differential grading standards and university funding: Evidence from italy', *CESifo Economic Studies* 54(2), 149–176.

Beine, M., Delogu, M., & Ragot, L. (2020). The role of fees in foreign education: evidence from Italy. *Journal of Economic Geography*, 20(2), 571-600.

Bratti, M., & Staffolani, S. (2013). Student time allocation and educational production functions. *Annals of Economics and Statistics*, 103-140.

Chan, W., Hao, L., & Suen, W. (2007). A signaling theory of grade inflation. *International Economic Review*, 48(3), 1065-1090.

Columbu, S., Porcu, M., Primerano, I., Sulis, I., & Vitale, M. P. (2021). Geography of Italian student mobility: A network analysis approach. *Socio-Economic Planning Sciences*, 73, 100918.

Croce, G. & Ghignoni, E. (2011), 'Overeducation and spatial flexibility in italian local labour markets', *MPRA Paper n. 29670*, University Library of Munich .

D'Agostino, A., Ghellini, G., & Lombardi, G. (2021). Movers and stayers in STEM enrollment in Italy: who performs better?. *Genus*, 77(1), 1-19.

D'Agostino, A., Ghellini, G., & Longobardi, S. (2019). Out-migration of university enrolment: the mobility behaviour of Italian students. *International Journal of Manpower*, 40(1), pp. 56-72.

De Paola, M. (2011). Easy grading practices and supply–demand factors: evidence from Italy. *Empirical Economics*, 41(2), 227-246.

Edwards, C. H. (2000). Grade Inflation: The Effects on Educational Quality and Personal Well Being. *Education*, 120(3).

Ehlers, T., & Schwager, R. (2016). Honest grading, grade inflation, and reputation. *CESifo Economic Studies*, 62(3), 506-521.

Eiszler, C. F. (2002). College students' evaluations of teaching and grade inflation. *Research in Higher Education*, 43(4), 483-501.

Hotelling, H. (1929), Stability in Competition. *Economic Journal*, 39, pp. 41-57.

Jewell, R. T., McPherson, M. A., & Tieslau, M. A. (2013). Whose fault is it? Assigning blame for grade inflation in higher education. *Applied economics*, 45(9), 1185-1200.

Juola, A. E. (1979). Grade Inflation in Higher Education: What Can Or Should We Do?. *Paper presented at the Annual Meeting of National Council on Measurement in Education* (San Francisco, California).

Lombardi, G., & Distaso, A.P. (2021). Can Grading Policies influence the competition among Universities of different sizes?. In *Book of Short Papers SIS 2021* (pp.1400-1405). Torino : Pearson.

Lombardi, G., & Ghellini, G. (2019). The effect of grading policies on Italian Universities' attractiveness: A Conditional Multinomial Logit approach. *Electronic Journal of Applied Statistical Analysis*, 12(4), 801-825.

Marsh, H. W., & Roche, L. A. (2000). Effects of grading leniency and low workload on students' evaluations of teaching: Popular myth, bias, validity, or innocent bystanders?. *Journal of educational psychology*, 92(1), 202.

McKenzie, R. B. (1975). The economic effects of grade inflation on instructor evaluations: A theoretical approach. *The Journal of Economic Education*, 6(2), 99-105.

McPherson, M. A., Jewell, R. T., & Kim, M. (2009). What determines student evaluation scores? A random effects analysis of undergraduate economics classes. *Eastern economic journal*, 35(1), 37-51.

Nelson, J. P., & Lynch, K. A. (1984). Grade inflation, real income, simultaneity, and teaching evaluations. *The Journal of Economic Education*, 15(1), 21-37.

Ostrovsky, M., & Schwarz, M. (2010). Information disclosure and unraveling in matching markets. *American Economic Journal: Microeconomics*, 2(2), 34-63.

Weinberg, B. A., Hashimoto, M., & Fleisher, B. M. (2009). Evaluating teaching in higher education. *The Journal of Economic Education*, 40(3), 227-261.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14556

Rebuilding our Toolkits for the future - How social science research educators changed their teaching in 2020 and 2021 to be fit for a digital future

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Abstract

Adaptation to digital teaching during the COVID-19 crisis was very much discipline-specific. Subject-specific pedagogical concepts were sometimes more or sometimes less easy to transfer to this new environment. In particular, teaching areas like social science research methods (SSRM) that on the one hand require personal interaction, practical application and individual support of students, and on the other hand have little previous standards and didactic know-how, with digital or virtual teaching elements, faced specific challenges. In an Austrian interview case study, experiences of SSRM educators have been analyzed. Digitization related changes are less apparent on the content level, but pronounced at the didactic level. Main challenges are: encouraging students' attention and participation, providing opportunities for good collaboration on all levels. Chances for the future are seen in the newly expanded pedagogical toolbox. Implementing tools supporting communication in the virtual space could free resources for direct support for students.

Keywords: *Social science research methods; Research Education; Distance Teaching; Acceptance of Distance Teaching; Case Study; Austria.*

1. Introduction

The effects of the digital transformation of society on higher education have long been the subject of controversial debates. However, the COVID-19 pandemic thwarted this discourse and initiated a far-reaching, potentially long-lasting transformation of the teaching and learning process as digital elements were moved to the center of academic education (Prandner & Hasengruber 2021).

The resulting challenges and strategies to adapt to this situation, as well as the acceptance of virtual learning environments and digital teaching initiatives, have been addressed in many research projects (e.g. Moorhouse & Kohnke, 2021; Núñez-Canal et al., 2022). While all academic disciplines have been confronted with this digitization push, specific opportunities and challenges are also tied to disciplines as subject-specific pedagogical concepts were more or less transferable to this new environment. This paper takes a closer look at effects of the digitization push in the field of teaching social science research methods and methodology, which has generally gained in importance as the datafication of society continues and interest in societal data is increasing (Döring & Hocks, 2021).

This particular domain of higher education is characterized by face-to-face interaction, practical application and immediate and individual support for students by instructors, on how data collection and analysis have to be conducted. In this respect, there was little experience and didactic knowhow on how digital teaching elements – especially distance teaching – can be included in this field, despite the high level of technology use for computer-based data collection and data analysis. Accordingly, for a long period studies have shown that social science research methods courses are often individually tailored and there is little standardization, resulting in the perception that they are challenging for students and lecturers alike (Carter et al., 2017).

Against the background of these particularities, we examine the perceived advantages and disadvantages that research methods educators identified, after introducing digital elements to their teaching repertoire. The empirical foundation for this discussion is based on the *Digitize!*-project, a case study from Austria, by using qualitative interviews with social scientists who teach social science methods and/or methodology at Austrian universities.

The following section two outlines the current state of research and theoretical arguments, while section three gives an insight into the methodological approach. Subsequently, the results are presented in terms of perceived advantages and disadvantages of virtual teaching environment's, aspects of teaching particularly affected by it, and how educators deal with it (4). A discussion concludes the paper (5).

2. The specifics of the digitization of social science education research

Prior to the COVID-19 pandemic, the number of digital elements in higher education was steadily increasing, but skepticism was generally high and especially the push for digital technology based virtual teaching environments (e.g. distance teaching via tools like *SKYPE* or *ZOOM*) was seen as problematic (Ali, 2020). Institutional resistance to adapting to virtual teaching formats has been particularly strong in disciplines and courses primarily concerned with teaching application-oriented content based on interactions between students and instructors, like social science research methods (Prandner & Hasengruber, 2021). This comes to no surprise, as missing homogeneous didactic approaches in methods teaching left instructors with fewer opportunities to draw on a canon for virtual learning and pedagogical digitization strategies (Nind & Lewthwaite, 2018). Often the quality of digital lessons depends on the instructor's individual commitment as well as his or her media and communication skills (Bolliger & Martin, 2018).

However, a recent case study from Austria shows that there is at least some acceptance of virtual teaching environments (Prandner & Hasengruber, 2021), as two-fifths of the respondents showed interest in implementing digital aspects in their post-pandemic teaching. It also highlighted that educators who perceived preparation and follow-up of virtual teaching as more time-consuming and interactions with students as more difficult were less willing to implement digital elements in their teaching, while respondents who described themselves as open to new didactic methods were more likely to include digital elements in their courses.

3. Methods Used

The data that will be used in this case study was collected as part of the *Digitize!* initiative, which is funded by the Austrian Ministry on Education, Science and Research (*BmBWF*). It aims to continuously accompany the digitization of social science research methods education in Austria.

The population for the study was defined as public university faculty teaching social science research and methods courses in the four core disciplines of the social sciences in Austria: Sociology, Political Science, Communication Science, and Educational Science. A deliberate and criterion-guided selection of individuals was made, including wide variations on the one hand and minimum and maximum contrasts on the other (Hensel & Kreuz, 2018). The dimensions of subject discipline, position, university location, and gender were used. Between March and August 2021, nine semi-structured narrative driven interviews were conducted. Interview duration varied from half an hour to nearly two hours.

Four women and five men between 40 and over 60 years of age from six Austrian universities were interviewed. The positions of the interviewees ranged from scientific staff without (n=1)

and with doctoral degrees (n=4) to associate professors (n=2) and full university professors (n=2). Three of the interviewees work as external lecturers at the university and are not or no longer employed there full-time. The desired breadth of disciplines was also achieved: Sociology (n=3), Political Science (n=2), Communication Science (n=2) and Educational Science (n=2).

The interviews were intended to stimulate (biographical) narrative explanations; especially when it came to the interviewees understanding of social science research methods, as well as their current research and teaching agenda. On the topic of digitization, questions were asked about how the increasing digitization of society affects research and teaching. Data analysis was conducted via thematic coding (Gibbs, 2007), with the use of *MaxQDA 2020*.

4. Perceived advantages and disadvantages of digital instruction of social science research

Overall the interview partners experience pandemic-driven teaching in the virtual space as a boost for digitization. Even if not every one of them completely welcomes digital elements in their teaching, there is still an awareness that the experiences of the last two years will permanently change the pedagogy in higher education – digital elements have become indispensable to university level teaching. The interviews thus reflect what recent quantitative research for Austria has also shown: While there is a certain amount of lecturers, who want to reduce digital elements in the future teaching once again, there is a sizable amount "*advocates*" and "*pragmatics*", who intend to keep digital elements in their teaching, either because they believe in digital elements from a pedagogical perspective or because they do not want to let accumulated experiences, acquired competences and adapted concepts and teaching materials unused (Hasengruber et al., 2021). These arguments can be seen in most of the interviews, as the two following statements – answers to the question if they want to continue with digital in the future – illustrate:

"So as far as teaching is concerned, I think that we have actually made a qualitative leap here in terms of digitizing [teaching], which is important. But again, I warn against completely falling for this technology hype and believe that we can now perfectly design a university purely in online mode" (Interview 01).

"I believe that this digitization, i.e. the forced digitization, has now triggered an enormous boost. So, I also think that in the future we will be confronted with digital environments much more in teaching and research than in the past. So, I think that even if we return to classroom teaching, we at the department will do it in the next academic year, in such a way that we will do about half of the courses virtually and the others in person" (Interview 08).

The challenges described by the interviewees in connection with the abrupt digitization do not refer to the content being taught. The continuous digitization of society, which was already apparent long before COVID-19, also has an impact on social science methods, but obviously the teaching content was not so strongly influenced by the pandemic. The how of teaching is coming to the forefront and has to be reflected upon anew due to the digitization push.

Ultimately, the same content must be transported differently, both in a virtual space created by tools like e.g. *ZOOM* or *WebEx* or using digital platforms that enable communication and content use like e.g. *MOODLE* or *BLACKBOARD*. Accordingly, the interviewees perceive the actual challenges and opportunities on a didactic level. Their main concern regarding digital teaching was the fact that virtual teaching became the norm and paying attention to the lecturer as well as the lecture itself may be difficult:

"[…] I actually admire the students who are actually committed, in the vast majority of cases […] When a survey comes out of nowhere and the whole audience answers immediately, then you know that they are actually all on board and that is very gratifying. However, if it takes some time till half of them press a button, then you know that they have moved on to other spheres, […] I also admire the fact that they are actually relatively present in an online lecture for 1.5 hours [...]" (Interview 01).

To deal with such changes, educators must reflect on teaching methods, mastering their use and finding sensible usage scenarios. The interviewees repeatedly use the image of a toolbox to show the necessary adaptations. In order to design good digital teaching in the future, the didactic toolbox must be rebuilt. After trying out new didactic tools during the pandemic it is now necessary to establish a systematic use. It can be interfered that the interviewees see good social science methods teaching in the virtual space as quite different to in-class teaching. On a general level the most common aspect named was, that they had to rebuild their toolbox regarding their approaches to teaching to keep student's attention and sort out unnecessary tools or tools that may not be necessary:

"I mean, I've also had a learning spurt myself, due to corona, simply to use systems like *MOODLE* or other systems even better or to use them more systematically" (Interview 05).

"It cannot be that you somehow sit down in front of *ZOOM* and record something and then the students listen to it relatively unmotivated at some point. It has to be interactive; you have to think about how to manage it well interactively with breakout sessions, with survey questions for example, which I also like to use quite a bit now. The fact that such controversial content is surveyed in the lecture and then discussed in the lecture" (Interview 01).

"Of course, you have to get involved, you have to use the different tools, these innumerable tools. Use it for the right tasks, but then it gets even better I think" (Interview 03).

"So, the learning content remains the same. So, the basic analysis that you want to convey remains. The exciting thing is actually that it is now starting a step further back. It's now purely about the teaching and learning methods, where you have to make certain adaptations [...] you are now trying to convey this learning content differently. [...] You now have a bit of a different methodological toolbox at your disposal and you have to try to use it to develop content in the background" (Interview 02).

As mentioned above, methods teaching requires successful interaction between educators and students, often including individualized repetitions of learning steps, for example during feedback procedures, resulting in new ways that help the students to engage with the material. The interaction should ensure that instructions on data collection and evaluation methods are properly understood and applied and allows direct questioning of students in case of ambiguities. While most of the responses focused on distance teaching several answers go deeper. Those may include strategies using digital elements that are independent of learning in virtual spaces like e.g. flipped classrooms that use asynchronous tutorial videos, interactive assessments that can be completed at the students' own pace as well as assignments that can be completed with their own computer equipment – and not the lab equipment of the university, establishing a more familiar work pattern. Such strategies using asynchronous, unsupervised learning may be combined with synchronous virtual and/or on-site learning activities, while reducing the content load for interactive sessions.

The value of such strategies can be seen when combined with virtual learning scenarios in e.g. *ZOOM* or *WebEx*-Rooms, as those tend to inhibit active participation. It is assumed by most of the interviewees that it is easier for students to ask questions in a typical classroom. Accordingly, those doubt the applicability of virtual teaching formats for future research seminars and practical training, as those require interaction among lecturers and students as well as cooperation between students. Obstacles to collaboration and discussion are assumed to be tied to the lack of personal relationships and too much anonymity:

"But the interesting thing is that students somehow can't form groups so well virtually, because they can't make new social contacts so well virtually. That's quite interesting. So, group work works much worse than before, which I would not have expected. […] Even then, when they are in the group, it is much more so, they say so themselves, that they divide up the individual parts and that somehow, if you don't know each other, you don't have such a good basis for discussion. […] they describe it in a way that it's all so anonymous, because some people don't turn on the camera or the camera doesn't work for some people. And if the whole thing is so anonymous, they are much less motivated" (Interview 08).

However, if a social science methods lessons with virtual participation is designed based on interaction and if content is also made accessible regardless of time, digital elements can have a positive effect. The potentially higher inclusion of students was highlighted as an advantage

of using digital elements in teaching. Participation in virtual learning scenarios is independent of the distance of the student's place of residence and mobility options. Asynchronous elements, such as video recordings of courses, enable time-independent learning, which is a particular advantage for students who must work or meet caregiving obligations. Recordings can also support international students and people who are not native speakers:

"It has advantages when there are records of it, it makes the whole thing much more inclusive. On the linguistic level, on the level of students who perhaps have caring responsibilities or mobility restrictions, even if they are only temporary" (Interview 03).

5. Discussion

Summing up, the role of the importance of faculty-student interaction in teaching social science research methods can be highlighted. Based on quantitative research, the perception of interaction with students as more difficult in distance mode was identified as an indicator of the acceptance of a virtual teaching environment (Prandner & Hasengruber, 2021). Based on qualitative data, this paper was able to specify which aspects of interaction are affected by digitization. The interviewed lecturers emphasized more strongly the disadvantages for students when it comes to both asynchronous and synchronous virtual teaching: attention, active participation and opportunities to ask questions, as well as good collaboration in working groups could be more difficult in the context of virtual teaching.

The interviewees associate the digitization of higher education primarily with virtual teaching and the need of new didactics in this field. This comes to no surprise after the last two years, shaped mostly by the pandemic. However, the provided narrations go deeper and show that some elements of this crisis mode teaching should be kept in the future and become part of the new didactic toolboxes are not only tied to virtual teaching over distance. There are scenarios where the interviewees highlight that there may be chances to improve personal contact and immediate individual support, when expanding the pedagogical toolbox with the implementation of synchronous as well as asynchronous digital elements: The use of (pre-)recordings, materials and interactive elements on digital platforms to forester interaction and more inclusive out of class learning, leaving time and resources during interactive sessions to concentrate on working with the students and their state of knowledge. However, the interviews also showed a realistic assessment of the problems tied to virtual teaching environments, mostly tied to the limited ways to "read the room".

Furthermore, the interviews support previous quantitative data (Prandner & Hasengruber, 2021), insofar that an open attitude towards new didactic approaches promotes the willingness to implement digital elements in future teaching. The fact that certain elements of digital teaching such as pre-recorded videos or interactive materials for pre-class preparation are very time-consuming to create was mentioned in some of the interviews, but

was less emphasized compared to the importance of this aspect in the context of the quantitative analysis (ibid.). Perhaps this is also due to that the preparation and follow-up of teaching research methods are usually time-consuming.

References

Ali, W. (2020). Online and remote learning in higher education institutes: a necessity in light of COVID-19 pandemic. *Higher Education Studies, 10(3), 16-25.*

Bolliger, D. U. & Martin, F. (2018). Instructor and student perceptions of online student engagement strategies. *Distance Education, 39(4), 568-583.*

Carter, J., Brown, M., & Sumpson, K. (2017). From the Classroom to the workplace: how social science students are doing data analysis for real. *Statistics Education Research Journal*, 16 (1), 80-101. Retrieved from: http://e-space.mmu.ac.uk/id/eprint/618709

Döring, H. & Hocks, P. (2021). Methodenausbildung im digitalen Zeitalter: Neue Daten, Projektseminare und Selbstlernmodule. *Polit Vierteljahresschr 62, 1–17.*

Gibbs, G. R. (2007). Analyzing Qualitative Data. SAGE Publications, London. https://10.4135/9781849208574

Hasengruber, K., Forstner, M., & Prandner, D. (2021). Adapting your teaching during the pandemic? How social science research education adapted to the COVID-19 pandemic. In: *7th International Conference on Higher Education Advances (HEAd'21).* Universitat Politècnica de València, pp 281-288. DOI: https://doi.org/10.4995/HEAd21.2021.13059

Hensel, T. & Kreuz, S. (2018). (Um-)Wege im Feld: qualitative Fallauswahl zwischen Gegenstandskonstituierung und Feldbeschaffenheit. In M. S., Maier, C. I., Keßler, U., Deppe, A., Leuthold-Wergin, S., Sandring (Eds.): *Qualitative Bildungsforschung: Methodische und methodologische Herausforderungen in der Forschungspraxis.* Wiesbaden: Springer Fachmedien, pp. 75–92. DOI: https://10.1007/978-3-658-18597-8_5

Moorhouse, B.L. & Kohnke, L. (2021). Thriving or Surviving Emergency Remote Teaching Necessitated by COVID-19: University Teachers' Perspectives. *Asia-Pacific Edu Res 30, 279–287*. https://doi.org/10.1007/s40299-021-00567-9

Nind, M. & Lewthwaite, S. (2018). Methods that teach: developing pedagogic research methods, developing pedagogy. *International Journal of Research & Method in Education*, 41(4), 398-410. https://doi.org/10.1080/1743727X.2018.1427057

Núñez-Canal, M., de Obesso, M., & Pérez-Rivero, C.A. (2022). New challenges in higher education: A study of the digital competence of educators in Covid times. *Technological Forecasting and Social Change, 174.* https://doi.org/10.1016/j.techfore.2021.121270

Prandner, D. & Hasengruber, K. (2021). Embracing the digitalization of research education? How social science research education was influenced by the COVID-19 pandemic. In: *7th International Conference on Higher Education Advances (HEAd'21).* Universitat Politècnica de València, pp. 413-420. DOI: https://doi.org/10.4995/HEAd21.2021.12984

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14396

Covid-19 pandemic, school closures and perception of the importance of education in the country

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Abstract

The objective of this paper is to analyze the effects of the Covid-19 pandemic on the consideration of the importance of education in the society. Using a difference-in-differences strategy and representative survey data from 28 European countries: the Eurobarometers 91.5 (June-July 2019) and 93.1 (July-August 2020), we estimate the impact of the pandemic (approximated by regional mortality) over perception of education, as well as the effect of schools/universities closure, both from a personal and country-wide perspective. The results show that the pandemic has generated a deep rift in society. On the one hand, unemployed, immigrants and those who consider themselves as working class are more prone to think that education is no longer one of their fundamental concerns. On the other hand, among those who are more educated or consider themselves as "higher class", there is a substantial increase in concern for education at both the personal and societal levels.

Keywords: *education, Covid-19, difference-in-difference, mortality*.

1. Introduction

Worldwide, school closures due to the pandemic affected at least 63 million primary and secondary school teachers (TTF, 2020). The impact of school closures on student learning loss depends on multiple factors, such as access to distance learning, students' attitudes toward self-directed instruction, quality of distance learning or support at home. Without structured school routine, and frequent contact and support from teachers and peers, students on the dropout path may become even more disengaged (OECD, 2020b). In addition, teachers may find it more difficult to identify red flags and act on them. According to PISA 2018, less than 70% of students attended schools where teachers had effective professional resources to learn how to use digital devices (OECD, 2019). Prolonged absence from school or lack of engaging distance learning mechanisms may lead students to become disconnected from their education, with detrimental long-term effects (OECD, 2020a).

Home environments and parental support add another layer to educational inequality. Distance learning strategies shift the burden of learning onto families, making student learning outcomes dependent on the home environment and the time parents are able to invest in their children's learning (Sayer al., 2004). First, better educated parents are potentially better positioned to help their children with homework (Holmlund et al., 2008). Second, with the focus on digital learning, parents' digital skills are critical to the effectiveness of their children's learning strategies (Zhang and Livingstone, 2019). Third, more educated parents tend to be more likely to provide better emotional care to their children (OECD, 2019). As Moran et al. (2004) note, this creates "*opportunities for policymakers to support parents and influence child outcomes*."

Shonkoff and Meisels (2000) show that strengthening and improving parental involvement through closer collaboration and networking improves parenting skills and benefits children. Studies focusing on parent-school engagement show that close engagement is a factor that improves student motivation and helps children acquire good quality education and training (Spera, 2005).

The objective of this paper is to analyze the effects of the Covid-19 pandemic on the consideration of the importance of education in the society. While previous studies refer to academic performance, continuity of studies, availability of technical means or teacher training, this paper will focus on the variable "*importance given to education*". For this purpose, we will compare the percentage of people who consider education to be one of the main concerns, both at the country level and according to their personal situation, at a pre-pandemic moment (2019) and after the first wave of the pandemic (summer 2020). We implement a difference in differences strategy, using representative survey data from 28 European countries: the Eurobarometers 91.5 (June-July 2019) and 93.1 (July-August 2020),

which allows us to introduce the regional relative mortality in 2019 or in 2020 with respect to the average 2015-2018.

2. Data

Data used come from two Eurobarometers (EB): the EB91.5 conducted between June and July 2019 and the EB93.1 conducted between July and August 2020. The Eurobarometer surveys are conducted on behalf of the European Commission under the responsibility of the Directorate-General Communication. The regular sample size (in the sense of completed interviews) is approximately 1000 respondents per country, except the United Kingdom (1,300) or Germany (1,000), and on the other extreme, Luxembourg, Cyprus and Malta with 500 interviews each. In the following analysis post-stratification weights will be used.

Dependent variables

Both dependent variables refer to the level of concern about the education system. Firstly, the respondent is asked what he/she considers to be the two main concerns in his/her country. Fourteen possible alternatives are indicated (crime, economic situation, cost of living, taxation, unemployment, terrorism, housing, government debt, immigration, health and social security, education system, pensions, environment and climate and other issues). A binary variable (*EDUC_country*) takes the value 1 if the education system is mentioned as one of the two largest country concerns. Secondly, the respondent is asked what he/she considers to be his/her two main personal concerns. The same fourteen alternatives are indicated. A binary variable (*EDUC_personal*) takes the value 1 if one of the answers is the education system is one of the two most important personal concerns.

According to Table 1, in 2019, the countries with lowest level of concern at the national level were (Netherlands, Latvia, and Hungary) or at the personal level (Hungary, Netherlands, and Denmark). At the opposite extreme, Greece, Malta and Belgium at the national level and Lithuania, Spain and Greece at the personal level. In 2020, we observe that the inhabitants of the Netherlands and Denmark show the least concern on a personal level, while residents of Malta, Spain and Lithuania show the highest levels of concern.

Explanatory variables

Sociodemographic characteristics. The following variables have been included in the model are: age, sex, nationality, marital status, number of years of education, relationship with economic activity and size of the area of residence. The survey indicates whether there are persons under 15 years of age in the household, although the kinship relationship is not known. The income level of the household is not recorded, but can be approximated by difficulties for making ends meet, having internet at home and self-reported social class.

Table 1. Consideration of education as one of the main concerns of the country or one of the main personal concerns. Excess mortality with respect to the 2015-2018 average.

	Most important issue facing your country EDUC_country		Most important issue you are facing at the moment EDUC_personal		Excess mortality with respect to average 2015-2019	
	Jun-Jul 2019	Jul-Aug 2020	Jun-Jul 2019	Jul-Aug 2020	2019	2020
Austria	9.65	8.53	6.77	4.70	-4.00	-1.89
Belgium	17.91	9.31	12.23	10.10	0.20	14.10
Bulgaria	11.07	8.33	10.12	8.43	-3.88	-4.34
Croatia	8.92	6.81	5.24	8.14	-7.94	-4.28
Cyprus	8.28	7.18	7.00	8.64	-12.40	4.98
Czech Republic	14.46	9.70	9.11	8.32	-1.77	-0.64
Denmark	9.16	4.16	4.78	4.46	-2.46	-1.30
Estonia	13.52	6.77	6.32	3.94	-1.79	0.12
Finland	11.96	7.65	7.98	8.56	-4.80	2.04
France	13.25	7.00	10.76	5.64	-5.65	6.52
Germany	10.37	7.46	7.80	5.86	-4.60	0.37
Greece	17.22	15.52	11.43	9.64	-8.51	0.38
Hungary	5.24	2.66	6.03	7.58	-2.60	-5.99
Ireland	11.75	10.29	7.23	7.37	-3.84	21.19
Italy	7.00	5.57	10.70	9.28	-3.91	14.97
Latvia	4.58	5.94	7.60	8.96	0.78	-5.74
Lithuania	13.48	13.65	7.87	10.94	4.38	-0.62
Luxembourg	11.63	12.24	5.07	6.67	-9.17	1.90
Malta	17.39	12.00	13.44	12.55	-9.41	4.14
Netherlands	4.37	2.99	5.96	3.78	-6.38	9.23
Poland	10.90	5.36	8.65	6.10	-3.95	0.62
Portugal	11.27	7.17	15.69	10.36	-4.51	4.50
Romania	6.29	5.70	5.90	5.13	-5.13	0.37
Slovakia	13.20	6.79	4.70	4.66	-2.49	-2.43
Slovenia	7.04	5.92	5.95	7.42	-3.15	2.36
Spain	13.37	14.48	10.83	11.24	-5.61	23.04
Sweden	7.52	4.47	7.41	6.99	-6.27	6.16
United Kingdom	9.55	8.17	4.25	5.11	-4.70	17.74
Total	11.14	8.42	8.07	7.66	-4.43	4.05

Source: Own work using Eurobarometer 91.5 (June-July 2019) and Eurobarometer 93.1 (July-August 2020). Regional statistics by nuts. Demographic statistics (Database - Eurostat (europa.eu)) for "Relative mortality in 2013" and "Relative mortality in 2020".

School closure days: For the purpose of estimating the potential impact of the number of schools closure days over concerns about education, we have taken into account that the EB93.1 was carried out in July and August 2020, and have used 31st July as the reference date for calculating the closure period.

Epidemiology variables: For each region (NUTS[1]), the "relative mortality in 2019" is computed as registered weekly deaths (all causes) in 2019 by NUTS with respect to average deaths between 2015 and 2018 by NUTS (Database - Eurostat (europa.eu)). With this indicator we can identify regions where there is excess mortality if $RM_{2019,Nut} \geq 0$.

The "relative mortality in 2020" is computed as average weekly registered deaths (all causes) between week 11 ($W_{11-2020}$) and the week when respondent was interviewed ($W_{EB93.1}$) with respect to average weekly deaths between 2016 and 2019 by NUTS. With this indicator we can identify regions where there is excess mortality if $RM_{2020,Nut} \geq 0$ In this case, the variable "excess mortality" provides information on the "potentially" pandemic-related mortality burden (i.e., including deaths that are directly or indirectly attributed to Covid-19).

We have also included the average of 14-day notification rate of Covid-19 new cases. This variable is defined as newly reported COVID-19 cases per 100,000 population by week and NUTS-2 between week 11 ($W_{11-2020}$) and week when respondent was interviewed ($W_{EB93.1}$).

3. Model

To identify the impact of the pandemic on the educational system, we propose the following difference-in-difference (dif-in-dif) model that compares the concern about educational system, in regions with excess mortality versus all other regions, and in 2019 versus 2020. Given the extensive coverage of the pandemic in all media, it is reasonable to assume that citizens have had access to national and regional information on the evolution of mortality (Anwar et al., 2020; Tsao et al., 2021).

$$EDUC_{irct} = \alpha_0 + \alpha_1 RM_{rct} + \alpha_2 Year(2020)_t + \alpha_3 RM_{rct} Year(2020)_t + \alpha_4 Schools_{ct} + \\ + \alpha_5 Notif_{rct} + \gamma' X_{irct} + \delta_r + \nu_c + \varepsilon_{irct} \quad (1)$$

$$EDUC_{irct} = \{EDUC\_country_{irct}, EDUC\_personal_{irct}\}$$

where $EDUC_{irct}$ denotes concern about educational system of individual i living in region (NUTS) r of country c and year t, whether one of the most important issues facing one's country ($EDUC\_country_{irct}$) or one of the most important issues facing oneself ($EDUC\_personal_{irct}$).

RM_{rct} represents the relative mortality of region (or NUT) r in year t (2019, 2020) with respect to the average 2015-2018. Two possibilities have been considered in the estimations, as a binary variable (1 there is overmortality, 0 otherwise) or as a continuous variable.

1 The nomenclature of territorial units for statistics (Nomenclature des Unités territoriales statistiques – NUTS) is a geographical system, according to which the territory of the European Union is divided into hierarchical levels. In this paper, NUTS-2 (basic regions for the application of regional policies) have been considered.

$Notif_{rct}$ is the average of 14-day notification rate of newly reported COVID-19 cases per 100,000 population in region r of country c and year 2020 (takes the value 0 for 2019), $Schools_{ct}$ is number of closure school days due to the pandemic in country c (takes the value 0 for 2019). $Year(2020)_t$ is an indicator variable equal to 1 if the individual is interviewed in 2020, 0 otherwise. X_{irct} contains individual-level variables: age, gender, nationality, marital status, relation with economic activity, age when stopped full-time education, household composition, having internet at home, difficulties in paying bills, self-reported level in society and size of municipality of residence. Regional and country fixed effects are captured by δ_r and ν_c, respectively. Robust standard errors are obtained with clusters at regional level. The dif-in-dif coefficient is α_3, which represents the effect of the pandemic on the probability of considering that education is one of the most important issues in regions with Covid-19 excess mortality.

4. Results

Table 2 shows the results of the dif-in-dif model for the total sample and differentiating by sociodemographic characteristics. For the population as a whole, living in a region with Covid-19 overmortality increases personal *EDUC_personal* by 1.18pp in households with children (15.20% with respect to the mean value) and is not significant in households without children. Regardless of household type, no significant effect is observed for *EDUC_country*. On the other hand, an average notification rate of 100 cases per 100,000 inhabitants increases *EDUC_personal* by 8pp, while each month of school closures leads to an increase in *EDUC_personal* by 1.5pp (more than double the increase in EDUC_country; 0.6pp).

5. Conclusions

Although the long-term consequences of the pandemic on students are still unknown, this paper has attempted to address the extent to which it has changed our perception of education, both from a personal and country-wide perspective. The results show a rather worrying reality. The pandemic seems to be generating two independent and disconnected worlds. The importance attached to education has declined among those who consider themselves working class and unemployed. In contrast, concern for education has increased among those who are still studying, have higher education, are working (especially if they are white-collar). The other "world", made up by the more educated, express an increase in their personal concern for education. Parents with better economic status and more stable jobs have been able to invest more in their children's education during the pandemic and have become more involved in their children's learning.

Table 2. Estimations of the difference-in-difference model

		EDUC_country			EDUC_personal	
	All sample	Living with children	Not living with children	All sample	Living with children	Not living with children
All sample						
Notification rate	0.0002***	0.0002	0.0002***	0.0003***	0.0008***	0.0001**
	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0002)	(0.0001)
Days school closure	0.0002***	0.0002**	0.0002***	0.0000	0.0005***	0.0000
	(0.0001)	(0.0000)	(0.0001)	(0.0000)	(0.0001)	(0.0000)
Year(2020)	-0.0662***	-0.0719***	-0.0649***	-0.0242***	-0.0385**	-0.0188***
	(0.0075)	(0.0178)	(0.0082)	(0.0063)	(0.0183)	(0.0060)
Relative mortality	-0.0106***	-0.0055	-0.0120***	-0.0073**	-0.0022	-0.0070**
	(0.0038)	(0.0085)	(0.0043)	(0.0032)	(0.0087)	(0.0031)
Relative mortality* Year(2020)	0.0072	-0.0019	0.0100	0.0117**	0.0118***	0.0033
	(0.0057)	(0.0128)	(0.0062)	(0.0047)	(0.0045)	(0.0132)
N	54402	13363	41039	54402	13363	41039
R2	0.0192	0.0172	0.0170	0.0449	0.0377	0.0221
F	354.183	86.447	262.037	852.317	193.257	342.748
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Foreign		EDUC_country			EDUC_personal	
Notification rate	0.0003	0.0009	0.0001	0.0002	0.0010	-0.0002
	(0.0006)	(0.0013)	(0.0006)	(0.0005)	(0.0012)	(0.0005)
Relative mortality* Year(2020)	-0.0091	-0.1429	0.0459	-0.0602	-0.0155***	-0.0872**
	(0.0448)	(0.0999)	(0.0502)	(0.0389)	(0.0028)	(0.0417)
N	5001	1921	3080	5001	1921	3080
Unemployed		EDUC_country			EDUC_personal	
Notification rate	-0.0005**	-0.0002	-0.0006**	-0.0002	-0.0005	-0.0001
	(0.0003)	(0.0006)	(0.0003)	(0.0002)	(0.0006)	(0.0002)
Relative mortality* Year(2020)	0.0048	-0.0073	0.0045	-0.0223	-0.0256***	-0.0215
	(0.0190)	(0.0374)	(0.0220)	(0.0159)	(0.0061)	(0.0165)
N	3682	1160	2522	3682	1160	2522
Still studying		EDUC_country			EDUC_personal	
Notification rate	0.0000	0.0006	-0.0002	-0.0007	0.0004***	-0.0011**
	(0.0004)	(0.0007)	(0.0004)	(0.0004)	(0.0001)	(0.0005)
Relative mortality* Year(2020)	-0.0672**	-0.1055*	-0.0640**	0.0028	0.0571***	-0.0132
	(0.0280)	(0.0581)	(0.0321)	(0.0333)	(0.0092)	(0.0383)
N	4064	1031	3033	4064	1031	3033
Working class		EDUC_country			EDUC_personal	
Notification rate	-0.0003**	-0.0006	-0.0002	0.0002*	0.0001**	0.0001
	(0.0001)	(0.0003)	(0.0001)	(0.0001)	(0.0000)	(0.0001)
Relative mortality* Year(2020)	-0.0165*	-0.0210***	-0.0034	0.0033	-0.0297***	0.0084
	(0.0088)	(0.0054)	(0.0233)	(0.0067)	(0.0027)	(0.0059)
N	14044	2979	11065	14044	2979	11065
Middle class		EDUC_country			EDUC_personal	
Notification rate	0.0003***	0.0004*	0.0003**	0.0003***	0.0007***	0.0001
	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0002)	(0.0001)
Relative mortality* Year(2020)	0.0104	0.0095	0.0108	0.0197***	0.0269***	0.0119**
	(0.0070)	(0.0151)	(0.0078)	(0.0058)	(0.0054)	(0.0058)
N	34704	8851	25853	34704	8851	25853
Higher class		EDUC_country			EDUC_personal	
Notification rate	0.0011***	0.0010	0.0011***	0.0005*	0.0012***	0.0004
	(0.0003)	(0.0007)	(0.0003)	(0.0003)	(0.0001)	(0.0003)
Relative mortality* Year(2020)	0.0002	0.0173	-0.0094	0.0456**	0.0776***	0.0254
	(0.0237)	(0.0473)	(0.0277)	(0.0220)	(0.0033)	(0.0223)
Difficulties making ends meet: always/almost always		EDUC_country			EDUC_personal	
Notification rate	0.0002	0.0001	0.0002	0.0002	0.0007	0.0000
	(0.0002)	(0.0005)	(0.0003)	(0.0002)	(0.0005)	(0.0002)
Relative mortality* Year(2020)	-0.0149	-0.0298	-0.0088	-0.0459	-0.0435***	-0.0016
	(0.0141)	(0.0313)	(0.0157)	(0.0112)	(0.0089)	(0.0112)
N	4883	1323	3560	4884	1323	3561

Regressions include age, sex, nationality, marital status, education, relation with economic activity, internet at home, difficulties for making ends meet, self-reported social class, size of municipality of residence, region fixed effects and country fixed effects. Coefficients for these variables not shown due to space constraints.

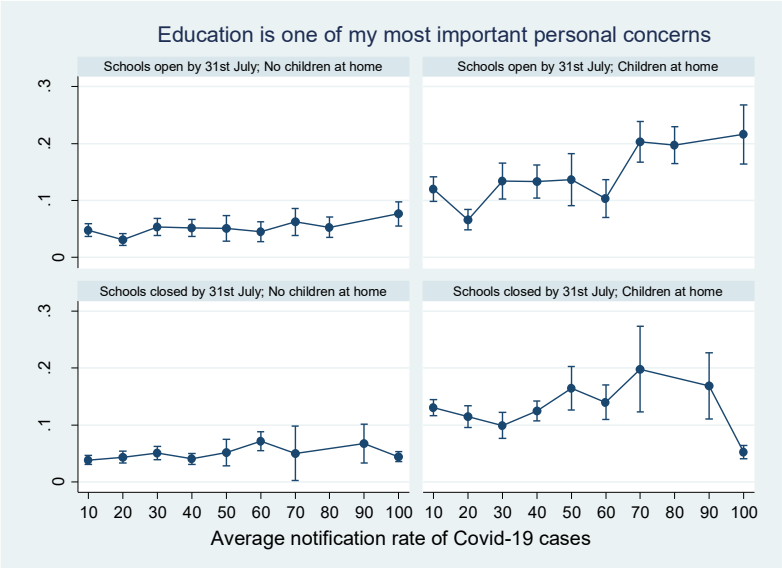

Figure 3. Effect of average notification rate of Covid-19 new cases per 100,000 inhabitants with respect and school closure over EDUC_personal, conditioned on having children or not. In these figures a binary version of the variable "days of school closure" has been defined, that takes the value 1 if schools/universities had opened by 31st July and the value 0 if they were still closed.

Are these changes a consequence of the pandemic and the economic crisis, or has the pandemic simply exacerbated a previous trend? What will the long-term effects be? Will this shift in priorities affect children's educational outcomes? All these questions provide a very relevant starting point for further research.

References

Anwar A, Malik M, Raees V, Anwar A. (2020). Role of mass media and public health communications in the Covid-19 pandemic. *Cureus* 12(9): e10453.

European Commission and European Parliament, Brussels (2019). Eurobarometer 91.5 (2019). GESIS Data Archive, Cologne. ZA7576 Data file Version 1.0.0.

European Commission, Brussels (2021). Eurobarometer 93.1 (2020). GESIS Data Archive, Cologne. ZA7649 Data file Version 1.2.0.

Holmlund, H., Lindahl, M., Plug, E. (2008). The causal effect of parent's schooling on children's schooling: A comparison of estimation methods. IZA Discussion Paper, No. 3630, Institute for the Study of Labor, Bonn.

Moran, P., Ghate, D., Van der Merwe, A. (2004), What works in parenting support? A review of the international evidence, Policy Research Bureau, Research report No 574, p.129.

OECD (2019). PISA (Programme for International Student Assessment) Database. OECD Publishing, Paris.

OECD (2020a). Education and COVID-19: focusing on the long-term impact of school closures. OECD Policy Responses to Coronavirus (COVID-19). OECD Publishing, Paris.

OECD (2020b). Teachers and school leaders as lifelong learners. OECD Publishing, Paris.

Sayer, L., Gauthier, A., Furstenberg, F. (2004). Educational differences in parents' time with children: Cross-national variations. *Journal of Marriage and Family* 66, 1152-1169.

Shonkoff, J., Meisels, S. (2000). *Handbook of early childhood intervention*. Cambridge University Press, Cambridge.

Spera, C. (2005). A review of the relationship among parenting practices, parenting styles, and adolescent school achievement. *Educational Psychology Review* 17, 125–146.

Tsao, S., Chen, H., Tisseveransinghe, T., Yang, Y., Li, L., Butt, Z. (2021). What social media told us in the time of COVID-19: a scoping review. *The Lancet: Digital Health* 3(3), E175-E194.

TTF (2020). COVID-19: a global crisis for teaching and learning. International Task Force on Teachers for Education 2030. Paris.

Zhang, D., Livingstone, S. (2019). Inequalities in how parents support their children's development with digital technologies. Parenting for a digital future: Survey Report 4, London School of Economics.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14644

The International System and the Transformation of Democracy in the 21st Century: Reflecting on a Virtual Exchange Module between Italy and the United States during COVID

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Abstract

In the Spring of 2021, the authors of this paper collaborated on a co-taught Virtual Exchange (or Collaborative Online International Learning, COIL) module titled "The International System and the Transformation of Democracy in the 21st Century". Students in Italy and in the United States were brought together virtually to explore the changing international order of the post-Cold War era, and to investigate ways in which 21st century democratic institutions of the United States and Italy are affected. This paper describes the qualitative experiences of the professors and their students in this virtual exchange and argues that the practice can offer a unique learning environment which – despite not being a substitute for international mobility – enhances, to a certain degree, students' intercultural awareness and flexibility, organizational and collaborative skills, and ability to learn and operate in diverse environments using an array of technological tools.

Keywords: *Virtual Exchange; COIL; International Politics; World Order; Democracy; Intercultural Competence.*

1. Introduction

Although existing international programs allow undergraduate students to challenge themselves by attending university courses in other countries for a semester or more, quite a few, for a plurality of reasons — economic, personal, and cultural — remain in their home university for their entire academic careers. In addition, the Covid-19 global pandemic dramatically interrupted opportunities to study abroad. However, the pandemic also increased interest in the potential of remote learning and teaching with technology, offering new and exciting opportunities in higher education. One of the more innovative and impactful teaching approaches is "Virtual Exchange."[1]

Virtual Exchange is a teaching and learning technique aimed at promoting global awareness and intercultural competence by employing technology to facilitate collaboration among students who live in different parts of the world (Swartz, Barbosa, & Crawford, 2020). Often described as an "innovative and inclusive" pedagogy, practitioners celebrate the approach as a means to internationalize the curriculum and as an alternative to studying abroad (Oakley, 2018; Rubin & Guth, 2105; Miao, 2018). However, it is unclear to what degree virtual exchanges allow student to engage with each other meaningfully, and how comparable they therefore are to traditional face-to-face exchange programs in terms of the intercultural and peer-learning experience offered.

2. Learning Objectives, Evaluation, Structure, and Themes of Our Virtual Exchange Module

In Fall 2020, Kimber Quinney, Assistant Professor of History from the California State University, San Marcos; and Alessandro Quarenghi, Lecturer in International Relations at the Università Cattolica del Sacro Cuore, Milano and Brescia, Italy, received a faculty fellowship from the American Higher Education Alliance (AHEA)[2] and the Consortium for North American Higher Education Collaboration (CONAHEC)[3] to collaborate on a co-designed course and to co-teach a Virtual Exchange module in Spring 2021.

[1] We use *virtual exchange* to describe our experience, but the pedagogical practice is also referred to as "internationalization at home," "telecollaborative learning" and very often, Collaborative Online International Learning (COIL). The COIL Center at State University of New York (SUNY) https://coil.suny.edu/ has been working to promote and professionalize the practice of COIL and Virtual Exchange for more than fifteen years, offering resources for best practices, such as this course development guide http://www.ufic.ufl.edu/uap/forms/coil_guide.pdf.

[2] We are grateful to the staff at the American Higher Education Alliance https://www.ahealliance.org/virtualexchangefellowship/ for their support and guidance throughout the planning phase of our Virtual Exchange module. We would also like to thank the external reviewers of our original paper for their excellent recommendations for revision.

[3] Consortium for North American Higher Education Collaboration https://conahec.org/

Over the course of the following six months, we developed a ten-week Virtual Exchange module titled "Il sistema internazionale e la trasformazione della democrazia nel XXI secolo/The International System and the Transformation of Democracy in the 21st Century." Our virtual exchange brought together approximately 90 students from their respective undergraduate courses in the United States (History of U.S. Foreign Policy) and Italy (International Relations).

2.1. Student Learning Objectives

We co-designed student learning objectives that emphasized knowledge as well as disposition with regard to multicultural competence and global civic literacy. We relied on frameworks such as the American Association of Colleges and Universities (AAC&U) Global Learning and Intercultural Knowledge and Competence Value Rubrics.[4] After having participated in the Virtual Exchange, we anticipated that students would have: (A) challenged their own worldview—from both a personal and national perspective—and gained access to different perspectives on contemporary international and national political changes; (B) connected contemporary international change to internal socio-political transformations; (C) demonstrated an ability to research individually and collectively, to organize their work in a flexible manner and in a technologically innovative environment; and (D) engaged and collaborated in small and wider groups in producing a cumulative digital project illustrating their research and common understanding of a complex issue.

2.2. Evaluation

Students were evaluated based on their participation in the two preliminary 'ice-breaking' activities; their group research, discussion, and final product; and a final personal review. More specifically, grade assessments were based on the items from Table 1.

2.3. Structure

Our U.S.-Italian internationalized curricular module was complex, in terms of planning, tools, scheduling, and themes: we explored the changing international order of the post-Cold War era, allowing all of us to investigate the ways in which 21st century democratic institutions of the United States and Italy (and other NATO nations) are affected.

For ten weeks in the middle of our respective terms, we co-taught the module, asynchronously sharing lectures given in our respective courses, while guiding the students through the module's steps and respective tasks. Initially, the module introduced students to one another, thanks to two 'ice-breaking' activities: the first was a guided short video

[4] American Association of Colleges and Universities, *Global Learning Value Rubric* https://www.aacu.org/initiatives/value-initiative/value-rubrics

presentation to be shared online by each student, outlining their personality and interests, while the second was an online guided group discussion on our module's main theme, as discussed in an online resource. Meanwhile, we asked our students in the United States and in Italy to join a group (4-5 members, with a more or less equal mix of Italians and Americans). Students were organized into twenty (20) different groups, each of which correlated with twenty (20) Global Issues, focusing on various subtopics while analyzing the changing international order of the 21st century and its impact on the future of democracy. We provided extensive foundational readings that included scholarly books, articles, and relevant contemporary essays in magazines and newspapers. When possible, we also provided multimedia resources for students to explore, including videos and graphic illustrations that visually represented the themes of our course.[5]

After the second 'ice-breaker', students started to collaborate with one another on our global themes in the course module as well as on a final digital project. Throughout the whole module, students engaged in discussions and activities using Google Drive and met face-to-face via Google Hangouts, WhatsApp, and Zoom. The final Collaborative Digital Project was created using Google Sites, then presented by students and discussed collectively in our respective classes.

Table 1. Grade assessment breakdown

Activity to be assessed	Description	Weight (% final grade)
Engagement	Students' demonstration of collaboration with group members	25
Originality of Collaborative Project	Students' ability to link information, analyses, and perspectives gained from different sources, and to give the class personal insights through a collective (or group) interpretation	25
Communication Effectiveness of Collaborative Project	Students' ability to organize, plan, and deliver the information in the clearest and most effective way	25
Personal Review	Students were asked to submit a short personal review of the module (500 words max.)	25

[5] We would like to acknowledge the generosity of graphic illustrator Doug Chayka for permitting us to employ his artwork, which aptly captures the global themes of our module and appears in publications around the world. https://dougchayka.com/

2.4. Themes

The themes of the course encouraged students to consider the ways in which the changing international order of the 21st century impacts the future of democracy. To address this complex question, we defined four Global Topics, each of which was associated with a hypothesis to assess the impact of that particular topic on democratic institutions: 1) The weakening of unipolarity (or the empowerment of asymmetric multipolarity); 2) The International System and the Media; 3) 'Old' (20th Century) and 'New' (21st Century) Security Issues and Domestic Politics; and 4) International and Domestic Institutions and Actors. We then further divided the topics into twenty different Global Issues, each of which was collaboratively researched, discussed and presented by the respective groups of students through the final Collaborative Digital Project in order to validate or refute the respective hypothesis. [6]

The module demanded that students possess a solid grasp on the recent history of U.S. foreign relations and theoretical principles of international relations. But beyond this important foundation, we called on students to use that knowledge to interpret and analyze the changing conditions of the international system and to test the extent to which those changes impact democratic structures and institutions. We reminded our students that experts in both of our fields of study — including ourselves! — were similarly wrestling with the dramatic changes in the world and grappling with testing the hypotheses articulated in our global themes.

We took the exercise one step further: we encouraged students to identify ways in which these rapidly changing international systemic changes were directly affecting their own lives and to share concrete examples and evidence with one another. In this way, we pushed our students to think differently not merely about the world "out there," but about their own worlds and to exchange ideas with one another about their respective local communities, regions, and nations.

3. Students' Reflections

Notwithstanding a few technological glitches, which was to be expected, and challenges with navigating the different time zones, the course was highly successful.

Overall, students' reflections on their experience with the course were overwhelmingly positive. One Italian student summarized her experience: "Personally speaking, all the work involved in this module was worth it. If I had to go back, I'd do it again a hundred times. It

[6] We are happy to share our Virtual Exchange Syllabus and various course assignments. Readers can contact us at Alessandro.Quarenghi@unicatt.it and kquinney@csusm.edu.

was so fascinating, the fact that we could have a debate with people from the other side of the world, with different cultures, thoughts, point of view etc. I don't have suggestions to improve it, only because it was an amazing experience that every person should have at least once in their life. It helps you to grow as a person but also to improve your oral skills. […]I know that an exchange study involves the culture, the food, the lifestyle but we have done what we were allowed to do, due to the Covid emergency and I was satisfied and happy with that. In my opinion, the collaborative virtual exchange had value as an intercultural experience, even if we were not allowed to travel and study abroad. The most valuable aspects about meeting with American students were the exchanges of opinions, views and the debate created between us."

One U.S. student explained, "Meeting with students from a European nation was amazing as it forced me to get out of my own personal bubble and look at an issue like climate change, which I have studied extensively, through a completely new perspective. It was beneficial as I have now started applying a more global worldview to other issues that plague our societies and democracies today." Another U.S. student noted, "The most valuable aspects of this virtual exchange were learning about viewpoints from students who are similar to us but also vastly different. I learned a lot about Italy […] and their views on their own nation and history from them beyond what was needed to know from the module. I learned about how they feel about Covid, their history, politics, and country."

And still another American student shared, "Getting to speak with international students helped make school feel more interactive and exciting... The work that was assigned in the module directly correlated to the theme of the class and allowed each student to explore different areas of the current state of global democracy … Although the exchange module is not akin to studying abroad, it still enables international students to interact with one another and discuss contemporary events." Italian students concurred: "The most valuable aspect of meeting with students living in the United States was realizing how different our culture and perception of the world are. Some things that for us are natural are very odd for them, and vice versa, so there never is a common conception. I was able to feel like I was standing right next to the American students to collaborate on a very interesting topic that reaches out to everyone in the world."

4. Conclusion

We were wholly satisfied with the outcomes of the course. In assessing the module, a few issues appeared paramount to us: firstly, a virtual exchange module, or at least the one summarized here, is time-consuming and organizationally challenging, both for students and instructors. The success (or not) relies entirely on students, who are indeed its main engine; as other studies have concluded, an advantage of this pedagogy is inherently to "lower the

profile of the teacher as protagonist" (Sadler & Dooly , 2016, p.12). For this reason, however, virtual exchange requires that at least most students be willing, even enthusiastic, about participating actively and that they be committed to organizing their time according to the module's workflow. In our case, roughly 98% percent of students in our classes decided to participate. In addition, some students inevitably carried a heavier workload to compensate for other students' lack of commitment. Finally, students were asked to be culturally open-minded and respectful of others, as well as committed to submitting their work on time. In our case, although we had to face some of the critical issues above, such problems surfaced in a very limited number of groups.

Virtual Exchange is built upon a collaborative relationship between the instructors, which requires flexibility and understanding. Because of our different backgrounds, courses, and expertise, we were asked to work across two linked but different academic fields, while significantly modifying our own course syllabi to accommodate the module. Moreover, Virtual Exchange most typically occurs among faculty "in literature, education sciences, and cultural studies" (Cotoman, et al., 2022, p.189) rather than in Political Science, International Relations or History. Our distinct fields thus proved challenging in some respects but the necessary and resulting exchange between the instructors made the module rewarding and enriching, both for us and for our students.

Given our diverse academic fields and expertise, we claim distinct perspectives in our teaching about the international system and global changes in that system. But beyond our respective professional variations, our differences in *global perspective* shaped by our respective national identities were fundamental to our rich collaboration and exchange of ideas. Studies about the principle of "cultural distance" in virtual exchange confirm our experience that cultural distinctions between faculty are an essential principle of the intercultural experience (Boonen, Hoefnagels, & Pluymaekers, 2019).

As a few students noted, our experience suggests that virtual exchange differs significantly from studying abroad. We are persuaded by other scholars' observations that virtual exchange does not serve as "a substitute for international student mobility." Indeed, we would agree that the full experience of studying abroad "instills intercultural competences to an extent that a COIL project could never achieve" (Cotoman, et al., 2022, p. 190). However, we also concur with the assertion that "Virtual exchange is not 'study abroad light' — it's another type of intervention" (Abdel-Kader, 2021, para. 4). Virtual exchange does indeed offer an opportunity to challenge culturally preconceived notions about others; it allows students to overcome parochialism and offers an invitation to raise intercultural awareness by asking students to share personal experiences and ideas. In addition, it fosters students' active learning by offering a unique learning environment that enhances student resilience, organizational skills, flexibility, and knowledge of a plurality of technological tools, as well

as ability to operate in diverse environments — all of which are sure to remain significant characteristics of teaching and learning in the 21st century.

References

Abdel-Kader, M. (2021) "The Viability of Virtual Exchange," *Inside HigherEd*. https://www.insidehighered.com/views/2021/07/29/virtual-exchange-will-be-key-part-internationalizing-education-even-after-covid

Boonen, J., A. Hoefnagels, & M. Pluymaekers (2019). "The Development of Intercultural Competencies During a Stay Abroad: Does Cultural Distance Matter?" In R. M. O. Pritchard, et al. (Eds.) *The Three Cs of Higher Education: Competition, Collaboration and Complementarity* (pp. 185–202). Central European University Press. http://www.jstor.org/stable/10.7829/j.ctvs1g987.15

Cotoman, V., et al. (2022). Un(COIL)ing the Pandemic: Active and Affective Learning in Times of COVID-19. *PS: Political Science & Politics*, 55(1), 188-192. https://doi.org/10.1017/S1049096521001050

Miao, S. (2018). Toward an Inclusive Approach to Internationalization: Collaborative Online International Learning as an Alternative to Studying Abroad. In L. E. Rumbley & H. de Wit (Eds.), *Innovative and Inclusive Internationalization: Proceedings of the WES-CIHE Summer Institute June 20–22, 2018 Boston College* (pp. 34–36). Boston College Center for Higher Education. http://www.jstor.org/stable/resrep39587.16

Oakley, C. K. (2018). Strategies and Resources for Internationalizing the Curriculum. In M. L. Kozimor-King & J. Chin (Eds.), *Learning from Each Other: Refining the Practice of Teaching in Higher Education* (1st ed., pp. 71–82). University of California Press. http://www.jstor.org/stable/10.1525/j.ctv3znxq0.10

Rubin, J. & S. Guth (2015). Collaborative Online International Learning: An Emerging Format for Internationalizing Curricula. In A.S. Moore & S. Simon (Eds.), *Globally Networked Teaching in the Humanities: Theories and Practices*. (pp. 15-27). Routledge. https://doi.org/10.4324/9781315754925

Sadler, & Dooly, M. (2016). Twelve years of telecollaboration: what we have learnt. *ELT Journal*, *70*(4), 401–413. https://doi.org/10.1093/elt/ccw041

Swartz, Barbosa, B., & Crawford, I. (2020). Building Intercultural Competence Through Virtual Team Collaboration Across Global Classrooms. Business and Professional Communication Quarterly, 83(1), 57–79. https://doi.org/10.1177/2329490619878834

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14866

Core Competences in Agri-food Sustainability: Student Self-Assessment After Online Action-Learning

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Abstract

The need to cultivate student competences to improve sustainability in agrifood systems is indisputable. This paper shows the example of an online student competition course in Sustainable Food for Master students based on action-learning principles and the five core competences of Observation, Participation, Dialogue, Visioning, and Reflection. The course ran three times from 2019-2022 and 85 students assessed themselves in these five competences by responding to 17 rating statements. Analyses revealed significant improvement in all competences except Participation after the course. Yet since Participation was highest rated before the course, rating of this competence was not less than other competences at the end. Practicing these five core competences and integrating competency self-assessments into educational activities can contribute to a paradigm shift in education that fosters the cultivation of competences for sustainability and that may be applicable to other courses.

Keywords: *Competence development; education for sustainable development; student competition.*

1. Introduction

Improving sustainability in agri-food and forestry systems requires a new educational approach that cultivates student competences enabling them to take responsible action and become changemakers (UNESCO, 2017). In action-learning, experiences form the basis of learning, and knowledge is produced through reflection on the experiences. Thus, action-learning aims at shifting the focus of the learning process from knowledge to competences and from theory to experience.

This competence-based action-learning educational strategy has been adopted by the NextFood project (*H2020 No 771738)* which aims to educate the next generation of professionals in the agri-food system through, in part, a shift from linear to cyclical learning. The strategy requires that learners practice five core competences essential for being a changemaker. These five are defined as follows:

Table 1. The Five Core Competences

Competence	Short Definition
Observation	carefully examining situations in the "world out there" in an unbiased manner
Participation	joining a task, not as a distant observer, but rather with personal commitment and dedication
Visioning	creating images of desired future states
Reflection	exploring and examining ourselves, our perspectives, attributes, experiences, actions, and interactions
Dialogue	accessing the collective intelligence of a group

Source: adapted from (Laenerts et al., 2019).

In the online student competition course in Sustainable Food, "FoodFactory-4-Us", students practice the core competences in six training sessions and in at-home assignments. This practice can take the form of written exercises, e.g., for Reflection students answer a series of thought questions after each session. Oral assignments are however more common as working together during the sessions, rather than listening to a lecture, is an aim of action-learning, e.g., for Dialogue and Participation students work in random groups and assign roles in order to complete a short, timed assignment.

Evaluating the success of any learning methodology may be approached in several ways, from written teacher evaluations to machine-graded examinations and many other options. Student self-assessment of their own learning, particularly in competency-based food system education, has been favored recently as it produces rich datasets that both students and

teachers can use for furthering their goals (Galt et al., 2013). A recent review of 74 studies using project-based learning in a variety of academic disciplines, suggests that student self-assessment, including of competences such as those studied here e.g., teamwork, can contribute to courses in fields as varied as biology and hotel administration (Guo et al., 2020).

In this study, three online competition courses followed a competency-based action-learning format and collected data from student self-assessments in order to evaluate student perception and performance of five core competences.

2. Methods

2.1. Competition Course

An online student competition course in Sustainable Food, "FoodFactory-4-Us," ran three times between 2019 and 2022. The course was completely voluntary and teams of between three and five Master students applied with a 100-word project description following a widely publicized open call. An Advisory Board selected up to 10 teams for each competition. There was no cost for student teams to participate in the competition and students received no university credit for their participation.

Each competition lasted approximately five months and contained six online trainings of between 1 and 1.5 hours followed by a final virtual conference where student teams gave a 10-minute presentation of their projects and answered questions from the audience. The competition winner was decided based on presentation performance as well as a written report and "participation" which included attendance at online sessions and completion of the evaluations which provide the data for this study.

2.2. Data Collection

Students completed a quantitative self-assessment after the first course session, called "Self-Assessment Start", and the same self-assessment at the end of the competition, called "Self-Assessment End". Here, students reviewed 17 statements (three or four discrete aspects for each of the five core competences) and rated their level for each one on a scale of 1 (novice) to 9 (expert). Some statements were very direct, e.g., "Carefully observe a situation" and "Empathize with the goals and feelings of group members" for the competences of Observation and Participation, respectively. Others were more descriptive, e.g., "Understand the processes that enhance a group's ability to identify today's critical challenges and envision a desired future state" for Visioning. The five core competences were introduced in the first course session and practiced throughout the course and a couple of sentence description of each of the nine rating levels was provided both at the Start and End Self-Assessments.

2.3. Data Analysis

Self-assessment rankings were averaged for each of the three or four questions on each competence for each student. Then, overall averages and standard error of the mean (SEM) were calculated for each of the five competences. One way ANOVA followed by Tukey-Kramer post hoc was used to check for significant differences among ratings of the five competences both for Self-Assessment Start and Self-Assessment End. Student t-test with the Bonferroni correction for multiple t-tests compared overall Start and End ratings of all students for each of the five competences.

3. Results and Discussion

3.1. Students

Overall, 84 students completed Self-Assessment Start out of 106 students who started the competition course and 85 completed Self-Assessment End of the 89 who completed the competition course as follows:

Table 2. Demographics of Student Self-Evaluation of Competences

Variable	Comp 1	Comp 2	Comp 3	Total
Self-Assessment Start/End	39/40	30/31	15/14	84/85
Start: Male/Female	19/20	8/22	4/11	31/53
End: Male/Female	19/21	8/23	6/8	33/52
Start: Inside/Outside EU	37/2	15/15	5/10	57/27
End: Inside/Outside EU	37/3	16/15	5/9	58/27

The demographic breakdown in Table 1 indicates an average of 39% more females than males and 53% more students based in the EU than outside completing the Self-Assessments. The numbers also show that most students who began the competition and completed Self-Assessment Start, finished the competition and also completed Self-Assessment End. It has indeed been suggested that high dropout rates in online courses can be decreased by, among other interventions, using pre- and post-testing (Laato et al., 2019). The very high retention rate in this competition course suggests that students found the course, with its start and end rating self-assessments and multiple written and oral assessments (not presented here), to be a worthwhile experience despite the voluntary nature.

3.2. Student Self-Assessments

A one-way ANOVA compared self-assessment ratings for the five competences at the start and at the end of the course. Each student's responses to the three or four questions about each competence were averaged to eliminate bias error from the same respondent. At the start, the significant difference among ratings for the five competences was very high at $p = 4.1*10^{-7}$, and the Tukey-Kramer Post Hoc revealed Participation to be rated significantly higher than all other competences (p 0.05). At the end of the course, ratings were barely significantly different at p = 0.05, and the Tukey-Kramer Post Hoc revealed that Participation was significantly higher than only Observation and that there were no significant differences between any other competences (Fig. 1).

These five competences were expressed in everyday and easy-to-understand language in the Self-Assessment document where e.g., Dialogue is defined as follows: "Dialogue is a tool to access the collective intelligence of a group. Dialogue enables us to ask difficult questions and examine the assumptions behind our thinking." However, the application of these competences to daily academic life is not always obvious and that may explain why students at the start of the course rated themselves highest in Participation, which is commonly stressed in academia. In fact, a recent review evaluated practices to improve student in-class participation over 50 years of attention to this competence, beginning in 1958 (Rocca, 2010). For competences like Visioning and Reflection, on the other hand, this competition course may very well be the first time students were introduced to these concepts.

To compare Start and End self-assessment ratings for each of the five individual competences, the Student t-test with the Bonferroni correction for multiple t-tests (α adj=0.01) was used. Here, students rated themselves as significantly improved ($p<1.4*10^{-7}$) in all skills except Participation, where there they found no improvement (p=0.03). However, students had already rated themselves as more skilled in Participation than in the other competences so, although the Participation rating did not improve, Participation was not rated lower than the other competences at the end of the course.

These individual comparisons suggest that students found the six online trainings of the competition course useful for improving their abilities in the core competences of Dialogue, Observation, Reflection, and Visioning. Online learning has in fact been shown to be as effective as in-person learning, and particularly for younger people online courses are the preferred delivery method (Borun et al., 2010). Evidence for improvements in the more esoteric core competences such as Visioning were seen both in the Self-Assessment and also in student responses to open-ended questions, as exemplified by this comment, "Visionary thinking, as it is more important. It's from this creative thinking that we get different alternatives for the problems being faced by us, to think and act differently from others."

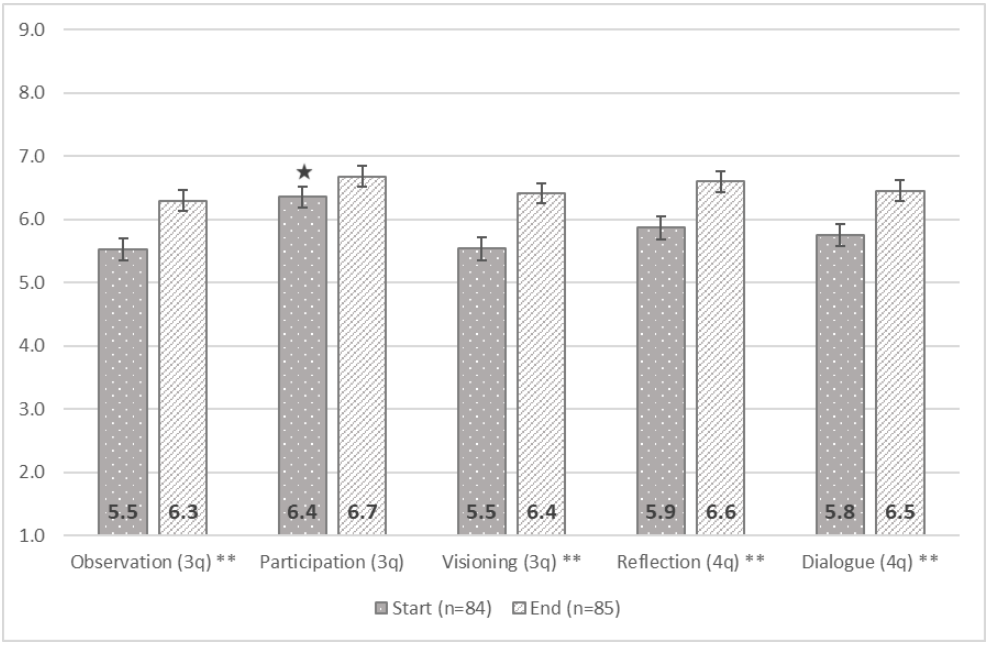

*Figure 1. Average self-assessment +/- SEM of the five core competences at the start and the end of the course shows significant increases in four of the five at the course's end. (3q) or (4q) indicates number of questions about that competence. * indicates significance at 0.05 and ** indicates significance at 0.001*

4. Conclusion

Training of the core competences Dialogue, Observation, Participation, Reflection, and Visioning in an online action-learning setting led to significant improvements in student self-evaluation of their expertise in these competences. Participation may be the most accessible competence as students viewed their expertise highest here even before the six online sessions which trained the five competences. Competency training through project-based learning may be applicable in many academic disciplines. Teaching students to improve their performance in these core competences through action-based courses offers a way to train the sustainability leaders of tomorrow.

Acknowledgements

The authors acknowledge the NextFood project and the funding received from the European Union's Horizon 2020 Research and Innovation programme Grant Agreement No. 771738. Information and views set out across this work are those of the authors and do not necessarily reflect the official opinion or position of the project coordinators nor of the European Union.

References

Borun, M., Schaller, D. T., Chambers, M. B., & Allison-Bunnell, S. (2010). Implications of learning style, age group, and gender for developing online learning activities. Visitor Studies, 13(2), 145 - 159. DOI: 10.1080/10645571003621513

Galt, R., Parr, D. & Jagannath, J. (2013). Facilitating competency development in sustainable agriculture and food systems education: A self-assessment approach. International Journal of Agricultural Sustainability, 11(1), 69-88. DOI: 10.1080/14735903.2012.683569

Guo, P., Saab, N., Post, L.S., & Admiraal, W. (2020). A review of project-based learning in higher education: Student outcomes and measures, International Journal of Educational Research, 102, 101586. DOI: 10.1016/j.ijer.2020.101586.

Laato, S., Lipponen, E., Salmento, H., Vilppu, H., & Murtonen, M. (2019). Minimizing the number of dropouts in university pedagogy online courses. In: Proceedings of the 11th International Conference on Computer Supported Education (CSEDU) (1) (pp. 587-596).

Lenaerts, L., Steiro, A.L., Nicolaysen, A.M., Breland, T.A., & Lieblein, G. (2019). Nextfood D2.1: Action Research Protocol, URL: lw3lg-elg2mbx3vgqgt.pdf (nextfood-project.eu)

Rocca, K.A. (2010) Student participation in the college classroom: An extended multidisciplinary literature review, Communication Education, 59:2, 185-213, DOI: 10.1080/03634520903505936

UNESCO (2017). Education for sustainable development goals: learning objectives. URL: https://unesdoc.unesco.org/ark:/48223/pf0000247444

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14192

Development of Sustainability Competencies in a Higher Education Semester Program on Smart Sustainable Cities

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Abstract

Cities face enormous challenges regarding their sustainable development. Facing these challenges requires a range of competencies that enable professionals to in-depth analyse problems, envisage multiple futures, reflect on norms and on their own actions and beliefs and develop innovative solutions in a multidisciplinary approach. For students in Higher Education to develop these competencies, an elective semester program was designed and implemented, the learning effect of which was determined through self-assessment by the participating students. Results show that students report strong or slight improvement on most of the six key sustainability competencies, most significantly on self-awareness, strategic and normative competencies. In addition, students learn from the application of design skills in the program. This paper demonstrates a relation between the program components and self-reported growth in sustainability competencies. Further research is deemed necessary to explain exactly how competency development is fostered by the didactical approach and content of the program.

Keywords: *Sustainability competencies, design skills, interdisciplinary cooperation, smart sustainable cities.*

1. Introduction

Cities face enormous challenges on the road to a sustainable future, such as inclusion, climate adaptation, mobility, circular use of materials, a healthy environment for all and sustainable business propositions (Vandecasteele *et al*., 2019), while information and communication technology, offering a wealth of data, is increasingly being used to monitor developments and contribute to solutions (Haarstad, 2017). This 'Smart Sustainable City' paradigm requires an interdisciplinary or transdisciplinary approach to study and solve problems (Bibri, 2018).

Students in higher education must learn how to deal with these challenges. Therefore, we designed and piloted, together with our European partner universities, a one semester study program (Eweg & Rietbergen, 2019; HU, 2017). This minor program on Smart Sustainable Cities (SSC) is an elective course of 30 European credits (EC) that students can take next to their major study program. From 2018 on, it was offered to Dutch students as well as students from universities that comply with the requirements for student exchange with our own.

The minor SSC was designed with the following principles, requirements and ambitions in mind: it should be a multidisciplinary program, combining various disciplines from social science, engineering and economics in about equal amounts. It takes an applied research approach, aimed at problem solving and solution design. After taking the course, students will:

- demonstrate knowledge and insight from various disciplines in challenges for SSC;
- understand and discuss practical situations in the context of SSC with a client;
- put into practice a number of methods and techniques for analysing SSC challenges;
- research and design creative sustainable solutions for SSC;
- communicate these solutions effectively, both orally and in writing;
- reflect on their results as a team and their own professional contribution to it.

The program has now been offered successfully to four consecutive groups of students. Among the latest group, of September 2021, we aimed to establish whether students taking the course have indeed developed the competencies that we intended during its design. Our research question was: 'to what extent do students feel they have developed key sustainability competencies and, in particular, multidisciplinary work, analytical and design skills?'

2. Key Sustainability Competencies

Several sets of competencies, associated with sustainable development, have been proposed. In this research, the five competencies were used that were proposed by Wiek *et al*. (2011): systems-thinking, anticipatory, normative, strategic, and interpersonal competencies. A sixth competency, self-awareness, was added, i.e. the competency to reflect on one's own actions, results and feelings (UNESCO, 2017). These competencies are detailed in Table 1.

Table 1. Key Sustainability Competencies (based on Wieck et al., 2011 and UNESCO, 2017).

Competency	Description
Systems thinking competency	The 'ability to recognize and understand relationships, to analyse complex systems, to perceive the ways in which systems are embedded within different domains and different scales, and to deal with uncertainty'. It requires knowledge about (the complexity of) system theories, skills such as interdisciplinary thinking and seeing interconnections, and the attitude of curiosity and perseverance.
Anticipatory competency	The 'ability to understand and evaluate multiple futures – possible, probable and desirable – and to create one's own visions for the future, to apply the precautionary principle, to assess the consequences of actions, and to deal with risks and changes'. It requires knowledge about the past, trends and novelties to build future scenario's, skills such as critical and creative thinking, and attitudes like flexibility and curiosity.
Normative competency	The 'ability to understand and reflect on the norms and values that underlie one's actions and to negotiate sustainability values, principles, goals and targets, in a context of conflicts of interests and trade-offs, uncertain knowledge and contradictions'. It requires knowledge about different norms and values about sustainability depending on the perspective, skills like critical thinking, and attitudes like being receptive for other views.
Strategic competency	The 'ability to jointly develop and implement innovative actions that promote sustainability at the local level and beyond'. It requires knowledge about applicable strategies, skills like action planning, problem-solving and attitudes like positivity.
Self-awareness competency	The 'ability to reflect on one's own role in the local community and (global) society, continually evaluate and further motivate one's actions, and deal with one's feelings and desires'. It requires self-knowledge, skills such as being resilient, developing an own world view, engaging to a sustainable society; and attitudes such a being open to self-reflection.
Interpersonal competence	The 'ability to motivate, enable, and facilitate collaborative and participatory sustainability research and problem solving' It requires knowledge about e.g. other cultures, collaboration skills, diversity skills, and an open attitude towards other people's culture, beliefs etc.

3. The Minor SSC Program

The minor consists of a ten week course and a multidisciplinary 'Sustainability Challenge' project. The course offers students a variety of topics, indicated in Table 2. Each weekly topic is taught through lectures and assignments. Design thinking skills (Karhu and Rietbergen,

2020) are included to make students understand real human needs, identify opportunities and conceive, prototype and test creative solutions for smart sustainable city challenges. In week 5, students participate in a challenge: mixed student teams design solutions to make the busy Utrecht Science Park a liveable, green and sustainable place for all who use it. The last two weeks of the course, the students apply most of what they have learned to a small project for a real life client, e.g. a municipality; in 2021, this was about town expansion in a highway zone. Across the first six weeks, they develop a research plan for this project.

During the second period of ten weeks, the Sustainability Challenge, students explore the assignment given by a real client, and design smart, creative and innovative solutions, often in the form of a viable commercial proposition. All assignments include project management and communication with the client and are multidisciplinary in character, so that all students can contribute to the solution from their own discipline. There is an opportunity to carry out projects abroad. Examples of past projects are: advise about a substantial reduction in CO_2 emissions from traffic in the city of Alcoy (Spain) or design an effective marketing campaign to promote cycling in the Greater Manchester region (UK).

In parallel to the course, students are given assignments that help them develop into a reflective professional. Based on several personality and group work tests, they write a personal development plan and discuss it with their peers. They receive feedback and monitor their development during the course and the project. They practice and apply multiple methods to reflect on significant situations and record their progress in an e-portfolio.

Table 2. Minor SSC Course Content.

Week	Topic	Contents
1	Introduction	Students get to know their group, activate prior knowledge, have an introductory class on SSC and do their first assignments
2	Design	A4DT design thinking method, analysis with empathy, work with persona's, phases in the double diamond, future probing, value sensitive design
3	People	Quality of life, human needs, behaviour and behaviour change, urban psychology, excursion, World climate game
4	Planet	Energy, carbon footprint, life cycle analysis, circular economy, sustainable mobility
5	Intermission	Students engage in a sustainable campus challenge, organised separately by the Utrecht Challenge Alliance
6	Health	The positive health concept, urban health scan method
7	Profit	Business Model Canvas, including several assignments to elaborate it
8	Smart	Big data analysis, CRISP-DM, GIS analysis
9 / 10	Project	Design innovative, smart and sustainable solutions for an urban sustainability challenge of an external client

4. Method

Students were asked to complete a survey in which they were asked to mention one or two topics from the course that they were most familiar with from their own discipline. Students could also indicate one or two subjects that they found most interesting, that they learned the most about and that they applied most during their work on the highway zone project.

Next, the survey presented the six sustainability competencies, using the descriptions shown in Table 1, and students were asked to assess the extent to which, during the course, they had developed each competency on a four point scale, from 'strongly improved' to 'my level at the beginning of the minor was already beyond the level expected'. With each competency, students could elaborate on their score on the four point scale. In addition, students were asked to also assess their development with respect to multidisciplinary cooperation, analytical skills and design skills. The same scale was used, including space for comments. The survey was held at the end of the last class of the course. Independently, we analysed students' reflections on the program, recorded in their e-portfolios.

5. Results

In the September 2021 course, twenty students had enrolled from six different countries (Finland, Germany, Hungary, the Netherlands, Turkey and the UK) and fourteen different study backgrounds. All students (100%) completed the survey.

Table 3 lists the topics that students found most akin to their own major field of study, that they found most interesting, about which they learned the most, and that they applied most in the project. Topics found to be most akin to the major fields of study were 'planet', 'smart' and social topics. The challenge week was found most interesting, followed by 'people' and 'smart' aspects of SSC. Clearly, design skills were applied most in the highway zone project.

Figure 1 shows students' self-assessment of their competency development. Depending on the competency, 65 to 80 % of students find that they have slightly or strongly improved with respect to the key sustainability competencies. Strong improvement is most often scored for self-awareness (40%), followed by strategic and normative competency (both 25%). With respect to skills, students clearly indicate strong improvement on design and multidisciplinary cooperation skills (45% and 30%, respectively).

When examining the overall reflections in students' e-portfolios, we found that they mostly made comments on generic skills, which is unsurprising, since in the e-portfolio assignments they choose three generic skills from a list to develop and monitor their progress. One student commented: "*I am more creative and innovative than I thought. I gained more organizing skills and found out that I already have some analytic skills that I maybe took for granted*". Another: "*The programme is primarily designed for independent learning, and I think*

Table 3. Minor SSC Course Content.

Topic	Most Akin	Most Interesting	Most Learned	Most Applied
Design	3		5	8
People	6	9	5	2
Planet	9	3	3	5
Challenge	1	11	5	2
Health			3	5
Profit	3	1	2	3
Smart	9	5	2	
Project	3	1	4	
Other				1[a]

a = Sustainable energy

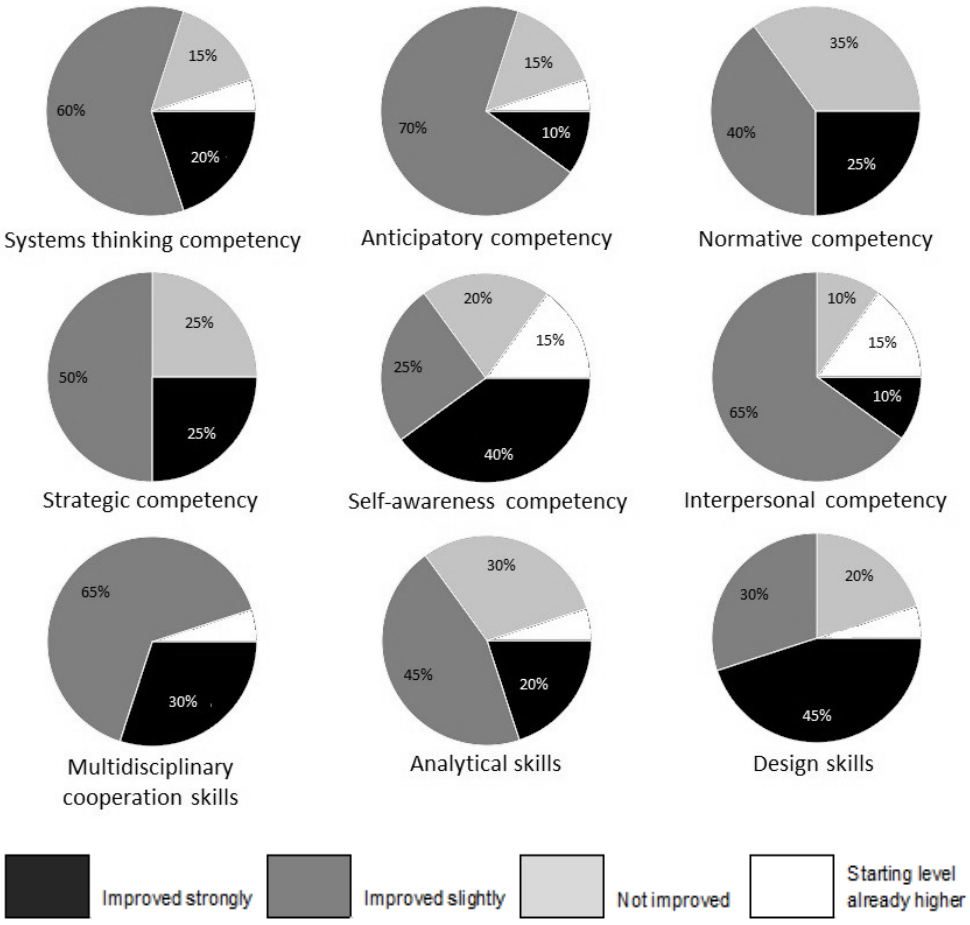

Figure 1. Competency development (students' self-assessment).

that this has helped me personally to develop further. I learned a lot about design processes and scientific methods for finding solutions in the field of sustainability. I especially liked the practical relevance and the fact that new topics were discussed every week, so a broad spectrum of knowledge was conveyed. Through that I gained a lot of new knowledge".

6. Discussion and conclusion

Amidst of the competencies, self-awareness stands out; it is most likely promoted by the reflection assignments students did almost every week. One student commented that they had "*never been so reflective in my entire life*". However, students' comments and e-portfolio reflections indicate that most did not particularly like these assignments and preferred lectures on subjects related to urban sustainability. The strategic competency is also developed by many students. This competency entails action planning and joint problem solving (cf. Table 1). As many students indicated they learned most from either the sustainable campus challenge or the project, it seems quite probable that a challenge- or project-based didactical approach is suited for developing this competency. However, students indicate that they struggle with the seemingly chaotic structure of the minor and the many assignments they have to do in parallel. The relatively high score (25% strongly improved) for the normative competency cannot be readily explained from the elaborations given. It might be caused by the many enthusiastic and pleasant discussions among the students during classes. Further research is needed to find out how our didactical approach stimulated development of this competency. Systems thinking and anticipatory competencies also proved to be developed; the scores for 'improved strongly' and 'improved slightly' add up to 80% for both. As the program does not focus explicitly on complex systems, nor on visions of a sustainable future, but rather on problem analysis and design of solutions, this is not really surprising.

The interpersonal competency was only slightly improved according to most (60%) students, whereas 10% indicated strong improvement. However, 80% of students indicate that they have strongly (30%) or slightly (65%) improved on multidisciplinary cooperation skills, that entail similar capacities. The difference might be explained by the fact that this competency was formulated in more abstract terms (Table 1) than students' own ideas about interdisciplinary cooperation. In comments, students often mention that they have learned to work with fellow students from different nationalities, cultures and major study backgrounds.

With respect to skills, 45% of our respondents indicate strong development. Two students elaborated that they had never done anything similar and, therefore, made a huge leap in their development of this skill. One respondent added that the design classes were applied almost every week of the course. On the other hand, five out of 20 students think they already possessed this skill. This applies to two students from industrial engineering and one from

landscape planning and design, studies that focus strongly on design skills. Both other low scores are a bit puzzling. The high improvement on interdisciplinary cooperation skills is unsurprising in view of the diverse major study backgrounds of the participants of the minor.

We conclude that a minor program in which a diversity of students, with respect to both their major field of study and their nationality / cultural background, are enrolled and are offered tools for analysis and design of innovative solutions, contributes to the development of key sustainability competencies. The focus on design thinking enables many students, especially those that had no prior experience in design, to strongly improve their design skills. A continuous program of reflective assignments, along classes about the 'people', 'planet', 'profit' and 'smart' themes, helps students to develop their self-awareness competencies.

We aim to research students' competency development in more detail by assessing performance on indicators for each competency – rather than by self-assessment. In addition, we aim to clarify the actual mechanisms through which the program's learning activities contribute to competency development, in order to improve the learning effect of the program and increase our shared knowledge about sustainable development education. Also, further analysis of the achieved sustainable development competencies is required by detailing the knowledge, skills and attitudes that are entailed in the six key sustainability competencies.

References

Bibri, S. E. (2018). A foundational framework for smart sustainable city development: Theoretical, disciplinary, and discursive dimensions and their synergies. *Sustainable Cities and Society*, 38, 758-794.

Eweg, E., Rietbergen, M. (2019, October). Shaping future research agenda on Sustainability research within CARPE network. In *Proceedings 5th CARPE Conference: Horizon Europe and beyond* (pp. 119-123). Editorial Universitat Politècnica de València.

Haarstad, H. (2017). Constructing the sustainable city: Examining the role of sustainability in the 'smart city' discourse. *Journal of Environmental Policy & Planning*, 19(4), 423-437.

HU (2017). *Viable Solutions for Smart Sustainable Cities*. Hogeschool Utrecht.

Karhu, T., Rietbergen, M.G. (2020). Design Plugin: Using Design Thinking Approach in Smart Sustainable Cities Education. Paper prepared for the Cumulus Conference Roma 2020 Design Culture(s). 16-19 June 2020, Rome, Italy.

UNESCO (2017). *Issues and trends in education for sustainable development*.

Vandecasteele, I., Baranzelli, C., Siragusa, A, Aurambout, J.P. (Eds) (2019). *The Future of Cities – Opportunities, challenges and the way forward*, EUR 29752 EN, Publications Office, Luxembourg, ISBN 978-92-76-03847-4, doi:10.2760/375209, JRC116711.

Wiek, A., Withycombe, L., Redman, C. L. (2011). Key competencies in sustainability: a reference framework for academic program development. *Sustainability science*, 6(2), 203-218.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14198

Flipped classroom – a solution to teach the unloved iron carbon phase diagram in first year engineering during the Covid-19 pandemic

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Abstract

The iron carbon phase diagram ICPD may simply be described as alloying maps of steels and cast iron in material science. However, the required thermodynamic background knowledge should be high level and understanding of the cooling procedure of ferrous melts as well as microstructure of steels is challenging. Common teaching material presents results, but not how to get there and leaves frustrated first year engineering students behind – especially during the online-semester of the Covid-19 pandemic. The iron carbon phase diagram is required in advanced courses, but seldom handled by students. Applying the "flipped classroom" teaching method as scenario in a blended and fully online learning environment is shown to be a successful method to let the students study how to read and apply the ICPD on their own and then take the time to discuss their questions and do extended hands-on exercises in class. Although summative assessment did not show significant improvement, the learning outcome and problem solving skills related to the iron carbon phase diagram are rated beneficial.

Keywords: *iron carbon phase diagram, lecture films, inverted classroom, flipped classroom, blended learning, online teaching, first year students.*

1. Introduction to the teaching concept "flipped classroom"

Teaching according to the inverted classroom teaching concept is a method to let the students study the science on their own and then take time to discuss their questions and do extended hands on lectures or exercises in class: Pfennig (2018). The method is proved by many authors to successfully gain student`s attention, thus acquire good exam results: Berret (2012), Brame (2015), Pfennig (2018). Gulley et al. (2016) state that the understanding and retention of course material was improved along with effective use of time in class. It is widely reported that students take over more responsibility for their learning progress during the semester which is related to enhanced critical thinking: CSU (2015), Lord (2012). Inverting the classroom may even lead to deeper learning outcomes: Goto and Schneider (2010), Simon et al. (2010) and has a positive effect on self-efficacy beliefs and intrinsic motivation: Thai et al. (2017). However, Setren et al. (2019) indicate success for MINT courses but discuss minor to no advance when the flipped classroom teaching method is applied in economic related teaching.

The blended learning introductory material science course at HTW Berlin is taught to first year mechanical engineering students via the "design-led" teaching approach: Ashby et al. (2013), Pfennig (2018). While the conventional "science-led" teaching approach begins with the physics and chemistry of materials, progresses from the atomistic model through the microstructure to the macroscopic properties the design led approach starts with the needs of the design and then explains why and how properties can be influenced and changed: Pfennig (2018). This teaching concept implements distinct "inverted classroom scenarios" of suitable themes because learning skills and grades improved compared to front classroom teaching methods: Pfennig (2018), Pfennig (2021). Mostly lecture films as main learning resources: Pfennig (2019) to acquire scientific background are offered supported by a variety of teaching material such as micro module lectures, worksheets and worked solution, mind maps, glossaries, memory sheets, online tests and web-based-trainings wbt: Pfennig (2018). It is very important that certain criteria are met to successfully teach inverted: Pfennig (2021) and that students are guided well but at the same time able to study individually, self-directed, location-independent, asynchronously and according to their individual tempo. In class there is time to discuss problems (plenum), work on exercises and engineering related problems in small groups or break-out sessions. Students share difficulties and thoughts with neighbours and classmates discussing the background information acquired during self-study periods.

However, the covid-19 pandemic required to transfer face-to-face time into online-sessions and the important plenary session to fully understand the iron carbon phase diagram had to adapted to the online environment. This paper describes a teaching routine that enhances students`scientific knowledge, responsibility for the learning process, self-efficacy and the ability to solve engineering problems regarding steels and the iron carbon phase diagram.

2. The iron carbon phase diagram: home assignment and contact time

The iron carbon phase diagram ICPD and how to interpret, read and transfer knowledge onto real microstructures of materials seems to be an awful hassle for first year students. Due to the curricula, this theme has to be taught in first year engineering studies at HTW Berlin. The ICPD may simply be described as an alloying maps for steels (Figure 1, left). However, the required thermodynamic background knowledge is high level and understanding the cooling procedure of metal melts as well as microstructure of different steels (iron carbon alloys) is challenging. Common teaching material only presents results, but does not explain "how and why" - frustrating first year engineering students. The iron carbon phase diagram is required in advanced courses, but seldom handled by students. Therefore, it is much more conductive if students engage in practical work and team assignments (break-out sessions) transfering their knowledge rather than only listening and taking notes during class (online-lecture).

Self-studying was assigned via "Moodle" following the guidelines mentioned earlier: Pfennig (2021). Note, that we relate to lecture recording in this paper in contrast to lecture videos: Pfennig (2019). The 4-hour lecture on the iron carbon phase diagram was filmed and cut into 11 videos with distinct headlines, so that each student could easily navigate to understand how to read the iron carbon phase diagram (Figure 1). Additionally 2 lectures were assigned which demonstrated microstructures of various steel qualities helping students to relate theory of crystal and micro structure with the actual engineering material. An extended homework assignment comprised of cooling curves, crystallography and structural behavior of iron carbon alloys was given to the students. Moderated online forums allowed for discussion in closed working groups and extra explanation by the lecturer if needed and requested. Both, lecture films and homework assignment as well as the following contact time directly prepared for an evening online test the following week.

During the online session (as well as in class) phases and microstructures important to understand cooling and heating procedures of steels were described in detail. The open-source software "invote": https://www.invote.de/ was used for class assessment: Simon et al. (2010), Pfennig (2018), to obtain an overview of the student`s knowledge. Students` questions were answered and important issues explained individually using a graphic tablet. Students were divided into groups of 4. 12 assignments of different levels were categorized into: 1.) pass the class, 2.) pass with C or B, 3.) pass with A or even better and provided via Moodle. The students were asked to choose as they felt comfortable. The advantage of teaching small groups was that individual problems were solved and questions of different levels were answered by speaking to the students face to face and meeting her or his needs. Group work was performed via break-out session but "wonder.me": https://www.wonder.me/ allows the lecturer for easier navigating from one group to another.

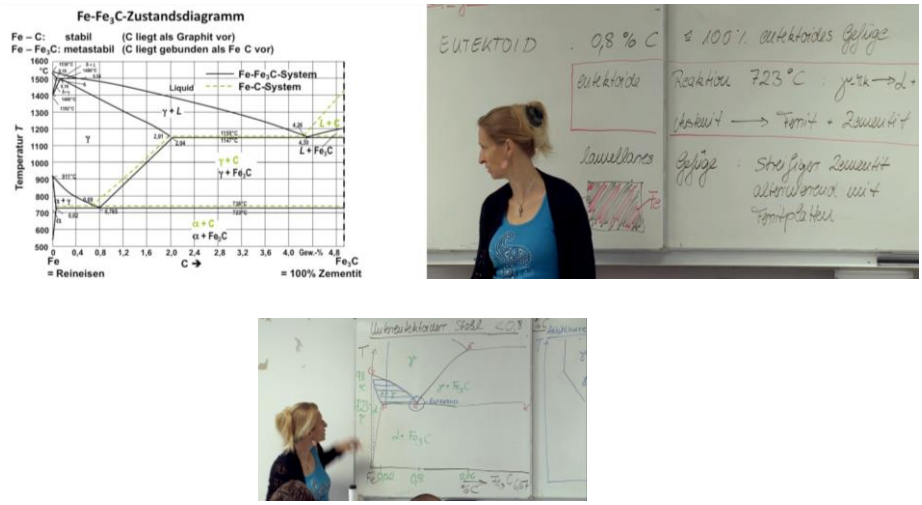

Figure 1. Lecture video: iron carbon phase (11 lecture films) (2:45 hours), (https://www.youtube.com/watch?v=_RdbQFk4jWU&list=PLUOlZMSZYz5yHjaqEAaPj77ignXqACXaD)

Up to 6 groups with their individual guiding requests may be handled well by the lecturer. With more than 25 students different session times were assigned. Students had enough time to work until they fully understood and were able to transfer knowledge correctly in an adequate time

3. Assessment of students learning outcome

A compulsory test adding to the total grade: Pfennig (2018) had to be taken via "Moodle" the following week. Results show clearly that students had a lot of difficulties during the Covid-19 pandemic compared to the previous semester where the small group work was conducted during face-to-face time (Figure 2). Note that in SS2020 the hands-on problems were solved in the online plenum (red) and the small group work was moved to break-out session starting SS2021 (orange). Gathering students in small online-groups in SS2021 leads to a much better understanding how to work practically with the iron carbon phase diagram compared to results of the previous semester. Most students had a good understanding how to read and interpret the iron carbon phase diagram, divide steel classes by microstructural phenomena and relate mechanical properties to carbon content and microstructure.

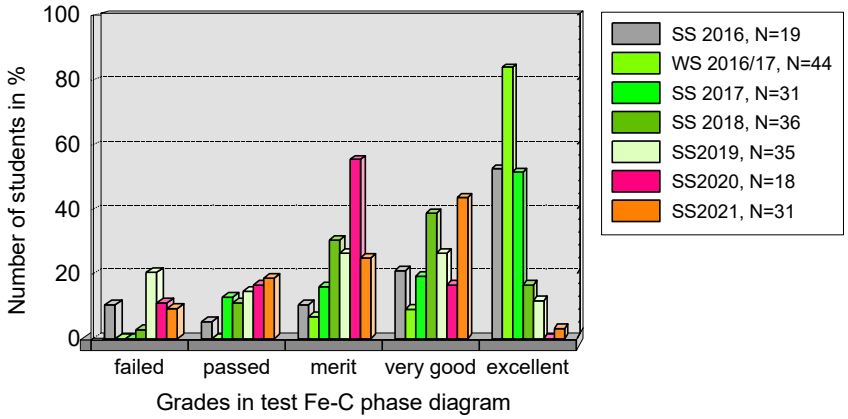

Figure 2: Results of compulsory online exam on the iron carbon phase diagram.

4. Evaluation of self-study period and filmed lectures

Overall students rated the implementation of the filmed lectures as helpful teaching material during the self-study period (65-78% rated good or excellent from summer semester 2020 to winter semester 2021/22). Both, recorded lectures as well as guided questionnaires support their learning process and increase learning output. The repeatability of the film lecture units is rated highly beneficial. After 3 mostly online-semesters only approximately 10% of the students appraise recorded lectures as replacement of lectures in presence; most of the students fear that their study progress will only be enhanced in class. (Note, when presence lecturing was allowed and offered less than 50% of the students showed!!!).

The length of the lecture recordings varied from 1 (crystallography) to 12 minutes (microstructures). The undivided recordings lasts approximately 2 hours and 45 minutes. It is remarkable that Figure 3 allows to assume that each of the students passing the first semester at least watched all lecture films on the iron carbon phase diagram once - regardless of the length of the individual video.

The complete lecture film was clicked on more than 80 times and watched an average of 20 min. (ca. 18%) before students decided to go with smaller units because the individual chapters are much better to handle. The 11 lecture recordings were averagely watched more than 50% meaning that students may not have finished all the way. Note, that statistics also comprise those misclicks where students accidently chose the wrong lecture film and stopped shortly after beginning to watch the film. This adds to small average length of time watched.

No significant relation was found regarding number of clicks or total time the lecture recording was watched and length of the lecture recordings (Figure 3). Therefore, although generally 6 to 10 minutes are the preferred length lecture videos are chosen from the youtube

channel and students rate appropriate in terms of attention, concentration and motivation: Pfennig (2019) the length of the recordings of the iron carbon phase diagram does not negatively influence the study behavior. Students decide according to their individual motivation, interest and need of content (or even expected assessment) when preparing recoreded lectures.

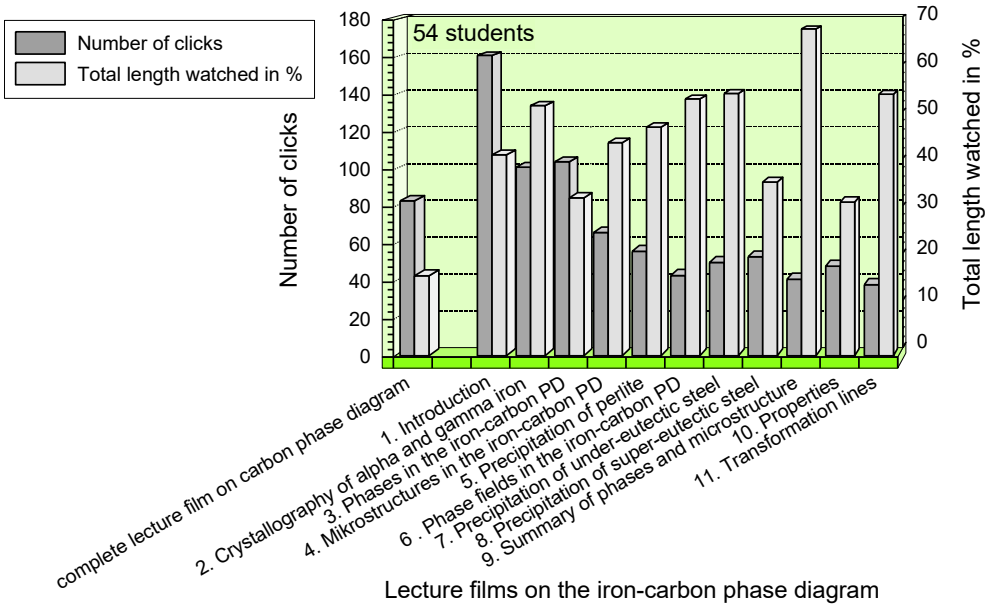

Figure. 3: Clicks and average time in % of students watching lecture recordings as a function of lecture film unit, inverted classroom scenario.

Because most of the students prepared all of the 11 video lectures without picking one particular as best or worst all lectures may be rated equally beneficial regarding the individual learning process. It may be assumed that ordering recorded lectures beforehand is of little to no relevance although some students criticized that during some film minutes whiteboard and slide could not be seen together. A good solution are lightboard videos (writing glass): Pfennig (2021-2) where the writing and explanation is focused on while students are faced directly.

5. Feedback on the “inverted classroom” concept in an online environment

Advantage of lecture recordings as main source of the online “inverted classroom concept” are their multiple independent reuse which applies well in the nowadays student`s way of

achieving skills independent of the Covid-19 pandemic. Time and place independence combines perfectly with the possibility to repeat whole lectures as well as small parts and directly supports individual learning velocity. Despite general bias students worked concentrated within their break-out groups and were open and eager to present their results and discuss. The atmosphere in break-out sessions was described as cooperative and valued. The small groups allow for individual explanations and more personal contact to students. Therefore most important, students did not hesitate to ask questions and stayed focused until they were satisfied with their output. With help of guided self-study period students seize their chance to take responsibility for their learning progress early which encourages critical thinking: CSU (2015), Lord (2012) and results in deeper learning outcomes: Goto and Schneider (2010), Simon et al. (2010).

The loneliness, insecurity and boredom of remote self-study period without contact to fellow students challenges you people tremendously. Even with close guidance students will be lost in inverted teaching, because firstly inability to acquire scientific background knowledge and secondly insecurity to participate during small group work due to personality, group constellation or nescience. Some students have severe difficulties to work on assignments independently at home without the possibility to reassure with fellow students. Lectures need to take into account these various difficulties and that students might be unprepared but at the same time willing to work during break-out sessions. Encouraging these students to participate, working with them for a couple of minutes reassures them that they may contribute well to the group – even with hardly time to repeat content required during self-study period. Posting questions for all students using for example “padlet” or “miro-board” helped students to feel as part of the community and start discussions among them early. The assigned group homework –comprising of highly advanced problems- was solved nearly 100% correctly with only minor mistakes that were discussed in a following online session.

The “flipped classroom” method to teach the iron carbon phase diagram was assessed as beneficial in terms of students` responsibility of their learning process, concentration and attentiveness as well as joy of studying but not necessarily in terms of grades. However, the self-study period needs to be guided close and students exactly need to know what and especially why to prepare the lecture recordings. To let them know the procedure during the online-session and expected common work in a forum or “padlet”, presenting results or posting and answering questions is vital for student motivation during self-study periods. “Feeling lost” was the feared emotion during the Covid-19 pandemic. Lecturers may emasculate these negatively connotated emotions by showing students the importance of their well-being and good performance during self-studying and in online-lectures.

Note, that the time to prepare necessary Moodle activities connected to the iron carbon phase diagram meeting the needs of a diverse first year material science class remains high and the workload approximately doubles. It is worth though, because the material may be reused

every semester due to the immutable content. Contact time outside the classroom/online-session increases in online-semesters due to extra explanations. Also, students need to be reassured that they are doing well or they simply need to stay in contact. Still, positive student feedback and joy of teaching accounts for the flipped classroom method even with first year students and a topic rated very complicated by mechanical engineering students.

6. Conclusion

Implementing the inverted classroom approach also in a fully online teaching environment is successful in terms of learning outcome and problem solving skills related to the iron carbon phase diagram, but not in terms of improving grades. Still, the teaching method clealy enables students to work self-reliantly in comparison to traditional teaching. One factor of success is a close guided self-study period with diversified learning material transparent tasks, time line and expections for the following online-session. Another factor is the calm enforcement of the online-session focusing on students ability to learn and transfer engineering problems at the same time. Although preparation time increaes the positive and more sustainable learning outcome is worth the effort.

References

Ashby, M., Shercliff, H., Cebon, D. (2013). *Materials Engineering, Science, Processing and Design*, 2013: ISBN-13: 978-0080994345, Pub date: Oct 02, 2013 (3rd edition).

Berrett, D. (2012). How 'flipping' the classroom can improve the traditional lecture, The Cronicle of Higher Education.

Brame, C.J. (2015). Flipping the Classroom, http://cft.vanderbilt.edu/files/Flipping-the-classroom.pdf, call: 09/2015.

Colorado State University (2015). Using Peer Teaching in the Classroom. http://teaching.colostate.edu/tips/tip.cfm?tipid=180.

Lord, T. (2012). 101 reasons for using cooperative learning in biology teaching. *The American Biology Teacher,* 63/1, 30-38.

Educause (2016). Educause Learning initiative (2016). THINGS YOU SHOULD KNOW ABOUT FLIPPED CLASSROOMS, https://net.educause.edu/ir/library/pdf/eli7081.pdf, call: 01/2016.

Goto, K. & Schneider, J. (2010). Learning through teaching: Challenges and opportunities in facilitating student learning in food science and nutrition by using the interteaching approach. *J. of Food Sci. Education,* 9(1), 31-35.

Gulley, O.D., Jackson, A.L. (2016). A case study on using instructor-recorded videos in an upper level economics course. *International Review of Economics Education* 23, 28–33.

Pfennig, A. (2018). Improvement of learning outcome in material science through inverted classroom techniques and alternative course assessment. *JFLET Journal of Foreign Language Education and Techn.,* 3(1), 148-162.

Pfennig, A. (2019). "Making it Work" - Practice Examples of Preparation and Embedding Peer-to-Peer Lecture Films in Successful Inverted Classroom Scenarios. *PEOPLE: International Journal of Social Sciences,* 5/1, 640-655.

Pfennig, A. (2021). How flipped classroom teaching methods in first year studying succeed. *Proc. of the 7th Int. Conf. on Higher Ed. Advances (HEAd'21),* 1211-1218. DOI: http://dx.doi.org/10.4995/HEAd21.2021.12792

Setren, E., Greenberg, K., Moore, O., Yankovich, (2019). Effects of the Flipped Classroom: Evidence from a Randomized Trial. *SEII Discussion Paper #2019.07*, MIT Department of Economics, National Bureau of Economic Researc.

Simon, B., Kohanfars, M., Lee, J., Tamayo, K, & Cutts, Q. (2010). Experience report: peer instruction in introductory computing. *Proceedings of the 41st ACM Technical Symposium on Computer Science Education*, 341-345.

Thai, N.T.T., De Wever, B., Valcke, M. (2017). The impact of a flipped classroom design on learning performance in higher education: Looking for the best "blend" of lectures and guiding questions with feedback, *Computers & Education, 107*, 113-126.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14473

From project-based to problem-based learning in engineering disciplines: enhancing Cartography and Geomatics education

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Abstract
Engineering disciplines such as Cartography, Geomatics and Geodesy depend heavily on practical courses and "hands-on" education, both demand a strong "active" component of students and opportunities of systematic interaction loops between teachers and students. In this paper we discuss the enhancement of such classes through switching from a rather project-based learning focus on a problem-based learning mode. Experiences from several classes in this context, especially in the domain of Location-based Services, Cartography and Geomatics, are discussed and reasoning for further development of such a problem-based learning environment is given. The aim of "activating" students can be reached therefore.

Keywords: *Pedagogy, education in Geomatics and LBS; Problem-based Learning (PrBL); Bloom's taxonomy, learning experience; LBS2ITS Erasmus+ CBHE (Capoacity Bulding in Higher Education) project.*

1. Introduction

The usage of PrBL (Problem-based Learning) is currently not common in disciplines with a strong engineering focus. Especially in geomatics education, only a few examples can be found in the literature (Gabela et al. 2022). In GIScience, cartography and related disciplines, most of the courses are usually oriented towards a project-based education – referred to as project-based learning (PjBL) in the following – than to start with a real-world problem leading to a fully immersed PBL course work. Note, in this paper; the abbreviation PrBL is used for Problem-based Learning to better distinguish it from the Project-based Learning approach, which is abbreviated as PjBL here. However, in the literature, the abbreviation PBL is commonly used for Problem-based Learning.

In a project-based learning environment tasks, assignments and action steps are usually defined by the teacher. In contrast, PrBL is rather student-centered and provides self-paced learning modules for the students. Learners are gradually given more and more responsibility in order to become independent life-long learners. Unlike traditional pedagogy methods, which are teacher-centered and where teachers transfer knowledge directly to students, in PrBL, teachers are there to facilitate learning and educational materials to students. Furthermore, it is based on real world problems, sometimes research-oriented, that stimulate learning, integrating and organizing learned information to ensure recall and future application (Retscher et al., 2022).

In this paper, some results of a workshop on e-learning and PrBL pedagogy held in the Erasmus+ Capacity Building in Higher Education (CBHE) project LBS2ITS, short for 'Curricula Enrichment for Sri Lankan Universities Delivered Through the Application of Location-based Services to Intelligent Transport Systems', founded by the European Commission are presented.

2. PjBL versus PrBL Courses

Both PjBL and PrBL courses rely on a student-centered approach. However, PjBL courses assume that the teacher defines the problem and the action steps, while in PrBL courses, this responsibility shifts primarily to students (Cuzelis 2011, Hunt et al 2010). Figure 1 shows the differences and common elements of the two approaches. As can be seen, the major role of the teacher is to act like a guide and mentor, and the students are at the center in both approaches. In terms of real world connections, either the teacher in PjBL or the students in PrBL define and identify the action steps of the problem. To achieve the learning outcome in PjBL, the students usually create a product, such as an LBS application, or in PrBL, more solutions are created. This goes hand-in-hand with the steps of Bloom's taxonomy discussed in section 4 (compare Figure 2): Another important aspect of PrBL and PjBL is the assessment of the students' performance, whereby both approaches include a self and peer

assessment step. In regards to metacognition, which means thinking about thinking and is defined as awareness or analysis of one's learning or thinking process, PrBL is more advanced. Metacognition must be about a retrieved representation of the awareness. Assessment as learning is a process of developing and supporting metacognition for students.

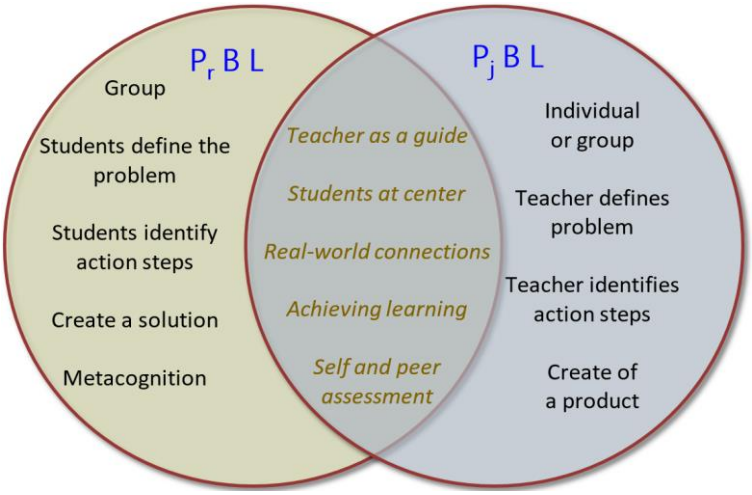

Figure1. Problem-Based Learning (PrBL) versus Project-Based Learning (PjBL).

In the field of Geomatics, most courses are PjBL oriented courses. A typical example was the "Location-based Services" (LBS) course at TU Wien, Austria. It is a compulsory course offered for master students of the Master programme on Geodesy and Geoinformation and to the International Master Programme "Cartography" annually. The course includes a number of theoretical inputs and group assignments on a topic from a list of topics defined by the teachers. Such topics can include aspects of positioning, modelling or mobile cartography. Students work in groups of up to 2-4 members, under the supervision of an academic staff member for a continual period of at least two months. Teachers identify action steps while students combine and exercise their knowledge and develop practical and analytical skills to finish the project technically and methodologically and present it accordingly. The assessment based on teacher-evaluation and an assessment of the students themselves reflects their performance based on multi-criteria list, including the project deliverables, a written exam and the project presentation. Based on several student's evaluation results and feedback rounds the setting of the class was changed into a PrBL mode. While theoretical input was still given as a starter to the topics from the lecturers the students then define the problems themselves, analyse literature and propose a methodological concept and work together on developing solutions. When presenting results a critical evaluation of their approaches is given amongst the students as well as from the lecturers. Anonymous student evaluation results of this class demonstrate the acceptance of this PrBL approach.

A typical example of student-centered courses displaying both PrBL and PjBL elements in the programme at TU Wien refers to "Project Map Creation" courses. These are selective courses offered in the Master programme on Geodesy and Geoinformation and to the International Master Programme "Cartography", that engage students to work individually and to come up with a solution to a real-world problem of producing a professional map ready for print, using their creativity and the knowledge acquired in the previous years of study. The students attending this course combine their knowledge and skills in a multitude of topics, including data acquisition, data modelling, geoinformation analysis, cartographic modelling, map design, layout and pre-press techniques, to produce a complete/self-contained map product. The role of the instructors is mainly of an advisory character, while students share full responsibility for refining and pursuing specific goals and presenting final results. Student assessment is exercised throughout the semester, reflecting their achievements in individual consultations and through presenting final results to the fellow students and instructors. The aim of this course is to allow students to use and apply their learned skills and competences for a problem of their choice, in this case a map production. The students determine the different steps that are required towards the final design of the map. During these steps, the students may face or define particular problems for which they need to find solutions. In this sense they apply elements of PrBL. To produce a map, several questions need to be answered. Students have to define these questions and utilize the relevant background knowledge they have acquired during the study programme to answer them. This procedure is a characteristic of PrBL. The final result, which is the design and assessment of map, is an element of PjBL. The results of this particular course are usually displayed in several public spaces of TU Wien and sent to International Cartographic Exhibitions. Several resulting maps have won international map awards, proving the success of the approach.

The different approach in applying PBL in these two examples stems mainly from the students' level of a priori knowledge the students possess to solve complex problems.

3. The LBS2ITS Project

The Erasmus+ CBHE project LBS2ITS deals with the modernization of curricula modules and courses in the field of Location-based Services (LBS) and intelligent transportation systems (ITS) in the partner country Sri Lanka. For further LBS development and to stimulate collective efforts in the partner country, modern curricula in the geomatics and transportation sector need highly qualified graduates. In addition, transportation systems need to be changed in the partner country to enable safer and greener sustainable mobility (Retscher et al., 2021).

LBS deliver information depending on the location of a mobile device, and the user plays a key role in this mobile information era. Huang et al. (2018) have identified a list of 'key

research challenges' that have to be addressed to bring LBS to a higher level to benefit our human society and environment better. These research challenges can be classified into seven broad areas: (1) positioning; (2) modelling; (3) communication; (4) evaluation; (5) applications; (6) analysis of LBS-generated data; and (7) social and behavioural implications of LBS. Smart transportation is an ideal LBS application since it is based on locating people (e.g. using smartphones) and objects (e.g. cars, trains, etc.). Transport researchers in the consortium of the LBS2ITS project directly support in evaluating user needs in the transport domain. Therefore, LBS applications have a great potential for supporting the work of transport planners and engineers in municipalities, higher-level administrations, private consultancies, academic and further institutions in the field of Intelligent Transport Systems (ITS). Based on the analysis of these various users' needs and in direct collaboration with the transport community, tailor-made LBS services/applications are developed that fully meet users' needs. In the direct collaboration of providers / developers and (potential) users of LBS services, the project spans the whole research cycle: (1) users' needs are investigated as the basis for developing new LBS services; (2) the uptake of these services is evaluated; (3) the results feed into their advancement in the next round of the research cycle.

LBS2ITS aims at a fully immersive and integrated teaching and learning experience in the field of ITS and LBS. The outcome is a digital learning environment supporting synthetic and real-world learning experiences encouraging self-paced learning modules for both teacher and students containing digital resource kits for interaction with modern equipment, continuous assessment and two-way feedback. Webinars and virtual experiences enable real-world PrBL scenarios. Furthermore, new pilot LBS courses will be developed from the project partners by analysing and using experiences from existing courses (Retscher et al., 2021).

4. LBS Education

In this section, the LBS education at TU Wien is briefly reviewed, leading to the newly developed courses for the four Sri Lankan partner Universities in the LBS2ITS project.

PrBL is used and applied throughout the whole programmes of the International Master Programme 'Cartography M.Sc.' as well as 'Geodesy and Geoinformation' of TU Wien, especially in all classes related to programming and applied aspects. For example, in the class on LBS, the focus is on the competences of knowledge acquisition and the development of other skills such as enhanced group collaboration and communication. After theoretical input on all elements of LBS in 8 lectures, students choose a topic based on the real-world research-oriented problem. They work in groups with a size of 2 to 4 students. Starting with a literature review, they present the project aims and scope to the entire group in a mid-term presentation, starting with a literature review. After receiving feedback, the students then adapt the

methodology and they follow a detailed project work plan as a team in order to solve a problem. Teachers are monitoring the process, supporting, helping with problems and steering the students in the right overall direction. At the end of the semester, the groups present their results, and a report must be submitted, which forms part of the course assessment and grading. Over the last ten years, PrBL-based group work within the class of LBS has seen more then 80 projects. The approach of these projects, which incorporate diverse aspects of LBS, have proven to be a successful method for students and teachers, both in achieving the main goal and scope of the course and in the applicability of gained skills (Gabela et al., 2022).

The successful work in the courses at TU Wien builds the foundation for the developing meant of the pilot courses to be taught in the third year of the LBS2ITS project at each of the four Sri Lankan partner universities.

5. Application of Bloom's Taxonomy in the Project

Benjamin S. Blooms together with a group of psychologists developed a taxonomy of learning objectives back in 1956, which can be seen as a major step towards PrBL education (Bloom, 1956). Figure 2 illustrates the verbiage and elements of the revised Bloom's taxonomy. The six levels of the taxonomy are (see e.g. Overbaugh, 2014):

- L1: remembering – can the student recall or remember the information?
- L2: understanding – can the student explain ideas or concepts?
- L3: applying – can the student use information in a new way?
- L4: analyzing – can the student distinguish between the different parts?
- L5: evaluating – can the student justify a stand or decision?
- L6: creating – can the student create a new product or point of view?

Bloom's taxonomy has been applied to variety of situations and is helpful when a teacher desires to move a group of students through a learning process utilizing an organized framework. In the LBS2ITS project it is applied to structure the PrBL courses to be developed. The project provides the opportunity to test PrBL to a wider extent for its further development enhancing educational outcomes not only in Sri Lanka but also at European Universities and worldwide. QA practices focus on creating the right kinds of assessments and associated rubrics to ensure that all levels of Bloom's taxonomy are integrated into the assessments. Especially those relevant verbs associated with active learning and thinking are used. Thus, teaching with an emphasis on learning outcomes is a central theme in the project's approach (Retscher et al., 2022).

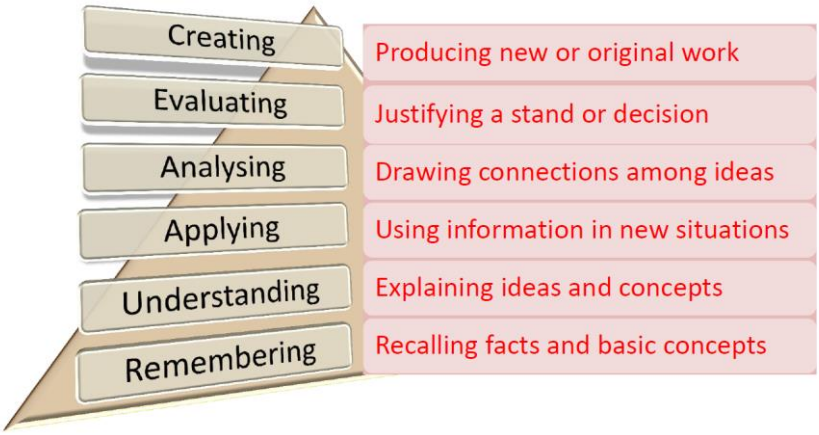

Figure 2. Bloom's taxonomy's verbiage and elements.

6. Concluding Remarks and Outlook

Education has become a very challenging and changing field of concern. Teachers and students are exposed and confronted with additional and innovative ways on how to be exposed to information, technologies, social trends and personal preferences. This leads to a variety of individual solutions, while systematic experiences which are analyzed and assessed are missing still. In this paper some experiences of shifting from a rather project-based learning approach to a more problem-based learning approach in the domains of cartography, geomatics and geodesy are discussed and experiences and results shared. Ultimately the aims is, to enhance the potential in engineering education for motivating and enhancing student learning, which can be achieved through "activation" of students, as shown with some PrBL-approaches applied in engineering courses at TU Wien and NTU Athens.

References

Bloom, B. S. (1956). Taxonomy of Educational Objectives. New York: David McKay.

Gabela, J., Retscher, G., Gartner, G., Binn, A., Gikas, V., Gerike, R., Ratnayake, R., Buddhika Jayansinghe, A., Perera, L., Kalansooriya, P., Hewawasam, C. (2022). Overview of the PBL Education in Geodesy, Geoinformatics and Transport Engineering. FIG Congress 2022, September 11-15, 2022, Warsaw, Poland (submitted).

Guzelis, C. (2011). Problem based learning versus project based learning in electrical-electronics engineering programs. 7th International Conference on Electrical and Electronics Engineering (ELECO), 2011, pp. II-40-II-40.

Huang, H., Gartner, G., Krisp, J., Raubal, M., Van de Weghe, N. (2018). Location based services: ongoing evolution and research agenda. *Journal of Location Based Services*. Vol. 12, 2, pp. 63-93, DOI: 10.1080/17489725.2018.1508763.

Hunt, E., Lockwood-Cooke, P., Kelley, J. (2010). Linked-Class Problem-Based Learning In Engineering: Method And Evaluation. *American Journal of Engineering Education*. Vol.1, Nr. 1. pp.79-88.

Retscher, G., Gikas, V., Gerike, R. (2021). Curricula Enrichment for Sri Lankan Universities Delivered Through the Application of Location-based Services to Intelligent Transport Systems. *FIG e-Working Week 2021*, June 20-24, 2021, 16 pgs. (paper 10865).

Retscher, G., Gabela, J., Gikas, V. (2022). PBeL – Problem Based (e-)Learning of LBS in Online Teaching for Geomatics Students. *Geomatics*, MDPI (submitted).

Overbaugh, R. C. (2014). Bloom's Taxonomy. http://fitnyc.edu/files/pdfs/ CET_TL_BloomsTaxonomy.pdf (accessed December 1, 2021).

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14454

Willingness to Enhance Employability

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Abstract

This exploratory study was conducted across two different institutions in the United States and in Australia. The online surveys applied two instruments: the Trait Emotional Intelligence Questionnaire and the Multidimensional Work Motivation Scale to investigate the correlations between the constructs of employability, emotional intelligence, and motivation. The results showed a positive significant relationship between campus program internship and perceived employability. Further, emotional intelligence was significantly positively correlated with motivation. These results may reinforce institutions in their effort to design or refresh teaching intervention programs improving students' employability. Beyond focusing on skills acquisition, these programs could also aim for enhancing students' emotional intelligence.

Keywords: *Employability; Emotional Intelligence; Motivation; Willingness to Enhace Employability; Internship.*

1. Introduction

Recognizing the importance of educating college students to enter the 21st century workforce in a way that they are prepared for the employment-related opportunities and challenges they will face throughout their adult lives, it becomes incumbent on higher educational institutions to identify what factors help prepare students to become employable. Multiple studies have found that higher emotional intelligence positively relates to work engagement (George et al., 2021). There is an increased attention from organisations on such initiatives. One of the key findings of Google's Project Aristotle is that emotional intelligence with its domains (self-awareness, self-management, social awareness, and relationship management) is essential to productive teamwork (Search Inside Yourself Leadership Institute, 2021). Other studies show that new graduates might not meet employers' expectations for these competencies, and that these skills should be taught as part of their undergraduate education (Mitchell et al., 2010).

The purpose of this exploratory study is to investigate the effects of motivation and emotional/social intelligence on employability success of undergraduate college students. This study examines the main effects and interactions of several factors that have been identified as potentially beneficial to students' employability such as work experience through a campus program internship, paid work or volunteerism. Students were assessed on motivation and emotional intelligence and answered questions about their employability/employment progress. The goal of this study is to identify which of the factors measured in the study are instrumental to students' employment success.

2. Willingness to Enhance Employability

Employers look for graduates with certain skills in communication, teamwork and problem-solving as well as adaptability, initiative, and digital skills as a result of labour market transitions under the global pandemic of COVID-19 (Dyki et al., 2021; Soares & Berg, 2021) putting higher education providers under the pressure of producing even more employable and flexible graduates (Gill, 2018). Employability skills are defined as the skills necessary for a work-ready graduate (Jackson & Chapman, 2021; Suleman, 2018) and as a psycho-social construct of acquiring, maintining, and/or creating work through the use of competencies (Fugate & Kinicki, 2008). Higher education institutions increasingly argue the importance of integrating academic programs into their current offer aiming to enhance such employability skills (Bonesso et al., 2019; Dyki et al., 2021).

Are these employability skills sufficient to prepare employable graduates for the volatile 21st century world of work? How willing are students to take on such initiatives while tackling academic skills, private life issues, and setting career aspirations? Such questions challenge the authors while wanting to engage students in education for responsible individuals. In

addition to the employability skills, personal attributes, which are centering on one's relationship with self and with others, are gaining importance in the creation of the future workforce (Dyki et al., 2021) rendering institutions to create programs addressing emotional and social intelligence competencies (Bonesso et al., 2019).

2.1. The Role of Emotional Intelligence and Motivation in Employability

Emotional intelligence is gaining increasing importance in educational programs targeting a whole person approach (Barbera, Bernhard, Nacht, & Mccann, 2015). The whole person learning approach brings together the learners' personal responsibilities in a high level of active involvement where the learners process skills, attributes and knowledge cognitively, behaviorally and emotionally (Hoover et al., 2010). Numerous studies have investigated teaching interventions to enhance students' emotional/social intelligence with outcomes suggesting that emotional intelligence relates to academic and career success (Dacre Pool & Qualter; 2012; MacCann et al., 2011).

In response, institutions have developed programs of such initiatives in different format, namely, curriculum-based, or extra-curricular programs, internships or work-placements, and other work-integrated learning modules (Jackson, 2015). Students' engagement level in such activities might vary, the major inhibitors of participation being part-time work, lack of information (or promotion) of the activities, unprofessional organisation of the activities, and the competition from curriculum-based activities (Tran, 2017). Although programs aiming to develop employability skills and emotional intelligence competencies are increasingly offered by institutions, motivation seems to be an important factor in improving one's employability. Further investigation is needed on the relationship between emotional intelligence and motivation to support institutions in designing relevant programs.

3. Methods

The pilot study used quantitative methods. The 67-item online surveys were distributed at both institutions after gaining ethics approval at on both research sites. Data collection was organized after the study periods and exams were concluded to minimize the potential for receiving biased or coerced responses.

3.1. Instrument

The survey questions looked at academic achievement defined in Grade Point Average, students' engagement in internships, work experience or volunteerism. It also asked respondents about their perceived employability and whether they had been offered a full-time position related to their studies and/or career aspirations. Emotional Intelligence was operationalized through the self-report Trait Emotional Intelligence Questionnaire (TEIQue) Respondents (n=102) were all in their final year of their undergraduate studies majoring in

arts, business, information technology, and science across an American and an Australian university. Table 1 presents a summary of the sample distribution across relevant demographics.

Table 1: Demographics of the respondents

Variable	Categories	Freq (%)	Motivation score		Emotional intelligence		Employability score	
			Mean (SD)	p-value	Mean (SD)	p-value	Mean (SD)	p-value
Location				**0.001**		0.182		**0.049**
	James Cook	39 (38.2)	3.96 (1.26)		3.56 (1.02)		6.56 (1.83)	
	Siena	63 (51.8)	4.32 (0.93)		3.93 (1.52)		7.22 (2.01)	
Gender				0.195		0.186		**0.043**
	Male	41 (40.2)	4.22 (0.96)		3.79 (1.08)		7.29 (1.65)	
	Female	56 (55.9)	4.17 (1.07)		3.83 (1.21)		6.86 (2.05)	
	Non-binary	5 (3.9)	3.83 (1.31)		3.20 (1.56)		5.25 (3.10)	
Race				**0.006**		0.124		**0.001**
	Caucasian	49 (48.0)	4.21 (1.05)		3.85 (1.08)		7.59 (1.90)	
	Asian	34 (33.3)	4.15 (0.95)		3.61 (1.01)		6.71 (1.43)	
	African/Black	8 (7.9)	3.77 (1.42)		3.86 (1.67)		4.00 (2.00)	
	Hispanic	3 (2.9)	4.78 (0.43)		4.37 (0.86)		5.67 (1.15)	
	Other	8 (7.9)	4.18 (1.04)		3.91 (1.09)		7.75 (1.49)	
Campus program internship				<0.001		0.223		0.001
	Yes	49 (48.0)	4.33 (0.81)		3.95 (1.28)		7.57 (1.90)	
	No	53 (52.0)	4.04 (1.30)		3.64 (1.45)		6.42 (1.87)	
Work experience				0.061		0.232		0.030
	Yes	83 (81.4)	4.21 (1.04)		3.83 (1.27)		7.14 (1.97)	
	No	19 (18.6)	4.04 (1.25)		3.63 (1.39)		6.21 (1.78)	
Volunteer experience				0.010		0.324		0.025
	Yes	62 (60.8)	4.26 (0.98)		3.88 (1.18)		7.27 (1.80)	
	No	40 (39.2)	4.06 (1.23)		3.66 (1.26)		6.50 (2.12)	

Bold text indicates significance difference at 0.05 level of significance.

3.2. Respondents

Respondents (n=102) were all in their final year of their undergraduate studies majoring in arts, business, information technology, and science across an American and an Australian university. Table 1 presents a summary of the sample distribution across relevant demographics.

On sample size sufficiency for the estimation of structural equation modelling (SEM), Kline (2015) suggest at least 100 observations. Sample adequacy was sufficient based on the Kaiser-Meyer-Olkin (KMO) = 0.705. The Bartlett's test of sphericity further produced a p-value = 0.032, indicating that the dataset diverges significantly from the identity matrix, making the dataset suitable for data reduction.

4. Results

The standardized factor loadings for the confirmatory factor analysis (CFA) model, all of which were statistically significant ($p < 0.001$). The observed scores for measures of construct and divergent validity and composite reliability (CR) of the measured constructs were; for emotional intelligence (Cronbach's alpha = 0.891, CR = 0.910, average variance extract (AVE) = 0.507) and motivation (Cronbach's alpha = 0.912, CR = 0.930, AVE = 0.655). The internal consistencies of the measured constructs were good with Cronbach's α and CR statistics lying between $0.7 < \alpha < 0.9$. Convergent validity was achieved across all the five domains, as their observed AVE scores were greater than 0.5.

The measurement model had a good fit ($\chi^2(82) = 132.71$, p-value =0.197), as indicated by the Comparative Fit Index (CFI = 0.806) and the Tucker-Lewis Index (TLI = 0.837) being above the recommended level of 0.90, and Root Mean Square Error Approximation (RMSEA = 0.07) and Standardized Root Mean Square Residual (SRMR = 0.08) being in the reasonable region the cut-off value of 0.08.

Based on the SEM model in Figure 1, there was a positive significant relationship ($p = 0.008$) between campus program internship and perceived employability (see also Table 1). Emotional intelligence was significantly positively correlated with motivation ($p < 0.001$).

A trend toward significance was observed for the following relationships;

- Race and perceived employability (p-value = 0.072) – with Caucasians having a slightly higher perceived employability compared to the other groups.
- Gender and perceived employability (p-value = 0.160) – males slightly perceived employability highly compared to the other groups.
- Race and motivation (p-value = 0.183) – again Caucasian scored slightly higher on their motivation scores compared to the groups.

- Work experience and perceived employability (p-value = 0.137), students with some work experience had slightly higher perception of employability.

5. Future Work & Limitations

5.1 Future Work

Continued research might be extended onto the roles of gender, race, and participation in campus internship programs with special regards to perceived employability and motivation as a function of emotional intelligence.

5.2 Limitations

A convenience sample at two small colleges in different countries present challenges to attempt to generalize results to other, dissimilar, higher educational institutions, locations or the population at large.

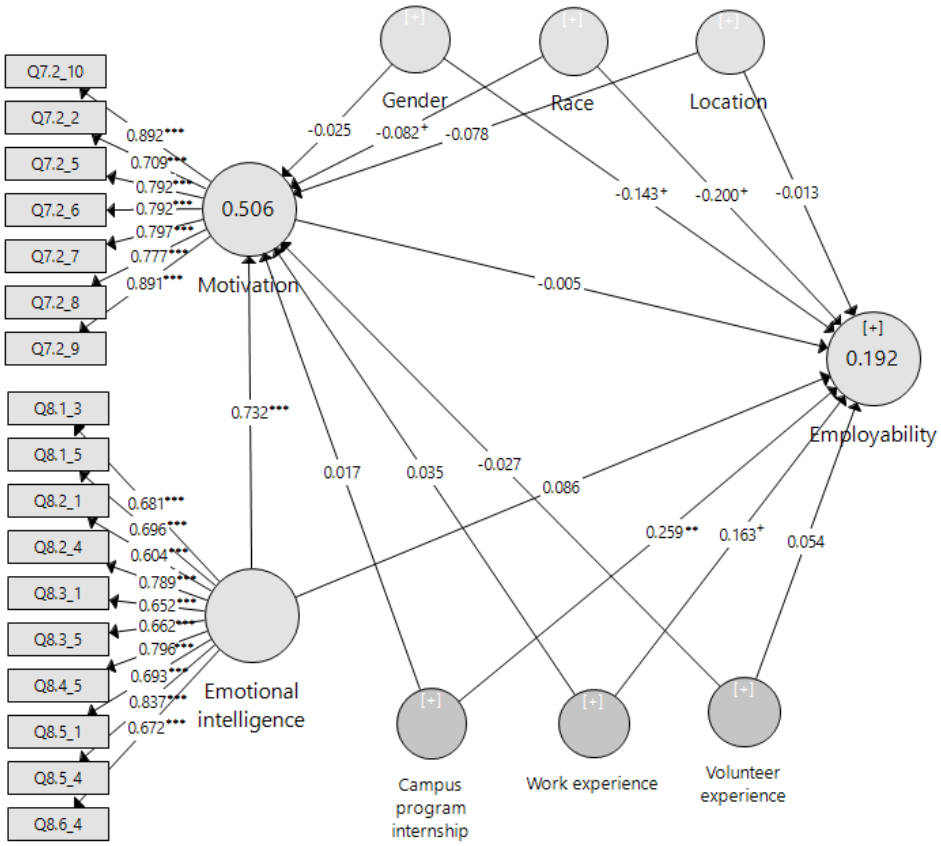

*Figure 1. Standardized estimates with bootstrapped p-values evaluation the fit of estimates of the path model. Note that *** indicates p-value < 0.001, ** , 0.01 < p-value < 0.05 and + indicates a trend towards significance.*

6. Discussion & Conclusion

An exploratory study was called for investigating the potential factors in designing programs with the aim of enhancing students' employability on two different campuses in the US and in Australia. Since emotional intelligence competencies have been increasingly sought by employers, these might be beneficial to be incorporated into existing employability programs. This finding corresponded with the numerous studies that have been done on the positive effects of increased emotional intelligence on work engagement (George et al., 2021) and career success (Dacre Pool & Qualter; 2012; MacCann et al., 2011). The current study produced insightful results regarding the relationships between race, gender, work experience and perceived employability. The key finding was motivation being a function of emotional ingelligence. These have served as a confirmation on refreshing current offers on employability programs.

Throughout the years, academic programs have been implemented to improve students' employability (Bonesso et al., 2019; Dyki et al., 2021) along with internship and work placement opportunities (Jackson, 2015). These academic programs address the desired content to improve students' employability but the authors wanted to search for ways in which students might be more involved in such initiatives to intentionally build competencies related to higher emotional intelligence. The findings of this study was in line with Bonesso et al.'s (2019) initiative on adding emotional intelligence competencies when addressing employability skills in academic programs.

References

Barbera, F., Bernhard, F., Nacht, S., & Mccann. G. (2015). The relevance of a whole person learning approach to family business education: Concepts, evidence, and implications. *Academy of Management Learning & Education 14*(3), 322–346. doi: https://doi.org/10.5465/amle.2014.0233

Bonesso, S., Gerli, F., & Cortellazzo, L. (2019). Emotional and Social Intelligence Competencies Awareness and Development for Students' Employability. *New Directions for Teaching and Learning, 2019*(160), 77–89. doi: https://doi.org/10.1002/tl.20366

Dacre Pool, L. & Qualter, P. (2012). Improving emotional intelligence and emotional self-efficacy through a teaching intervention for university students. *Learning and Individual Differences, 22*(3), 306–312. doi: https://doi.org/10.1016/j.lindif.2012.01.010

Dyki, M., Singorahardjo, M., & Cotronei-Baird, V. S. (2021). Preparing graduates with the employability skills for the unknown future: reflection on assessment practice during COVID-19. *Accounting Research Journal, 34*(2), 229–245. doi: https://doi.org/10.1108/ARJ-09-2020-0285

Fugate, M., & Kinicki, A. J. (2008). A dispositional approach to employability: development of a measure and test of implications for employee reactions to

organizational change. *Journal of Occupational and Organizational Psychology 81*(3), 503–527. doi: https://doi.org/10.1348/096317907X241579

Gagné, M., Forest, J., Vansteenkiste, M., Crevier-Braud, L., van den Broeck, A., Aspeli, A. K., Bellerose, J., Benabou, C., Chemolli, E., Güntert, S. T., Halvari, H., Indiyastuti, D. L., Johnson, P. A., Molstad, M. H., Naudin, M., Ndao, A., Olafsen, A. H., Roussel, P., Wang, Z., & Westbye, C. (2015). The Multidimensional Work Motivation Scale: Validation evidence in seven languages and nine countries. *European Journal of Work and Organizational Psychology, 24*(2), 178–196. doi: https://doi.org/10.1080/1359432X.2013.877892

George, O. J., Okon, S. E., & Akaighe, G. (2021). Emotional intelligence and work engagement: a serial mediation model. *Journal of Organizational Effectiveness: People and Performance*. doi: https://doi.org/10.1108/JOEPP-02-2021-0025

Gill, R. (2018). Building employability skills for higher education students: An Australian example. *Journal of Teaching and Learning for Graduate Employability, 9*(1), 84–92. doi: https://doi.org/10.21153/jtlge2018vol9no1art739

Hoover, D. J., Giambatista, R. C., Sorenson, R. L., & Bommer, W. H. (2010). Assessing the effectiveness of whole person learning pedagogy in skill acquisition. *Academy of Management Learning and Education 9*(1), 192–203. doi: https://doi.org/10.5465/AMLE.2010.51428543

Jackson, D. & Chapman, E. (2012). Non-technical competencies in undergraduate business degree programs: Australian and UK perspectives. *Studies in Higher Education, 37*(5), 541. doi: https://doi.org/10.1080/03075079.2010.527935

Jackson, D. (2015). Employability skill development in work-integrated learning: Barriers and best practice. *Studies in Higher Education 40*(2), 350–367. doi: https://doi.org/10.1080/03075079.2013.842221

Kline, R. B. (2015). The mediation myth. *Basic and Applied Social Psychology, 37*(4), 202-213. doi: https://doi.org/10.1080/01973533.2015.1049349

MacCann, C., Fogarty, G. J., Zeidner, M., & Roberts, R. D. (2011). Coping mediates the relationship between emotional intelligence (EI) and academic achievement. *Contemporary Educational Psychology, 36*, 60–70. doi:10.1016/j.cedpsych.2010.11.002

Mitchell, G. W., Skinner, L. B., & White, B. J. (2010). Essential soft skills for success in the twenty-first century workforce as perceived by business educators. *Delta Pi Epsilon Journal, 52*(1), 43-53.

Petrides, K. V. (2009). *Technical manual for the Trait Emotional Intelligence Questionnaires (TEIQue)* (1st edition, 4th printing). London: London Psychometric Laboratory.

Search Inside Yourself Leadership Institute (2021). *Search Inside yourself*. Retrieved from https://siyli.org/search-inside-yourself/?gclid=EAIaIQobChMIh9_0t-ri9QIVyX0rCh0MgQN2EAAYASAAEgL75_D_BwE

Soares, S. & Berg, J. (2021). Transitions in the labour market under COVID-19: Who endures, who doesn't and the implications for inequality. *International Labour Review.* doi: https://doi.org/10.1111/ilr.12214

Suleman, F. (2018), The employability skills of higher education graduates: insights into conceptual frameworks and methodological options. *Higher Education, 76*(2), 263-278, doi:10.1007/s10734-017-0207-0.

Tran, L. H. N. (2017). Developing employability skills via extra-curricular activities in Vietnamese universities: student engagement and inhibitors of their engagement. *Journal of Education and Work, 30*(8), 854–867. doi: https://doi.org/10.1080/13639080.2017.1349880

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14552

Survive to stay connected: patterns of user experiences in a Life Long Learning digital platform

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Abstract

In an ever-changing world, having the right competences for the job market represents a key challenge for sustained employability. To address this need a growing number of digital platform for life long learning (LLL) has been developed. Anyway, it is less known how users navigate and use these platforms. The present study represents a one of the first attempts to fill this gap, offering a deep analysis for the identification of latent subgroups of learners with similar behaviours on a digital LLL platform. Then, the identified subgroups are described in terms of personal features and survival profiles. Findings reveal three distictive latent classes, with very different survival profiles. The analysis provides interesting insights about how the administators of a digital LLL platform can better personalize their contents according to the type of learner, to support and let them stay on the platform, acquiring the needed skills for the job market.

Keywords: *LifeLongLearning; Survival Analysis; Latent Class Analysis.*

1. Introduction

A better alignment between the skills acquired through education and those required on the job market is becoming of paramount importance today, mainly due to the widespread diffusion of digitalisation, which is deeply transforming all businesses, at an unprecedented speed. Hence, the job market requires a continuous adaptation of people's skills to remain employable in the long term. In line with this perspective, the Digital Agenda for Europe 2020 describes the principles for ensuring the acquisition of digital skills and literacy for all citizens (Levano-Francia et al., 2019). The Future Jobs Report, prepared by the World Economic Forum (2018) predicts that the large number of professions that exist today and in the coming years will require digital skills to be able to perform their work. In this view, educational institutions are called to align their academic offer with the needs of the labor market to increase employability, stay competitive and strenghten the cooperation between university and industry as one of the main drivers of innovation.

The need for a continuous skill alignment and willingness to learn during professional careers has been labelled in the academic literature as Life Long Learning (LLL). It has been firstly defined by Guglielmino (1997) as "self-initiative, independence, and persistence in learning; […]. One who is capable of self-discipline and has a high degree of curiosity." Indeed, LLL requires a stable set of attributes and skills related to self-regulation of continuous learning. The aim of LLL is to offer people the opportunity to acquire, complete or expand their competence and skills to promote their personal or professional development in every moment of their life (Guglielmino, 1997).

Technological advancements have enabled the development of educational digital platforms that can keep the pace of such a fast and evolving need of continuous knowledge update (Perez-Ortiz et al., 2021). However, it is documented that dropout rates of the learners on these platforms are substantially higher than in-presence counterparts (Levy, 2007). In some case, the main predictor of learners' retention in digital LLL platforms is the general level of satisfaction, which represents a proxy of their engagement. Hence, the actual challenge to improve the effectiveness of these platforms is to understand learning paths and learners' behaviours, to identify strategies and tactics that can allow for higher retention and the pursuit of the individual professional and academic goals of the learners.

The present study aims at contributing to the existing academic literature about life-long learners' dropout in digital educational platforms, through the characterization of their behaviour and related survival patterns. The empirical setting for this study is a digital LLL platform developed by the Business School of a leading Italian university, which provides learners with personalised "knowledge nuggets" in line with their career aspirations and their skill gaps. The empirical research is based upon (i) the identification of subgroups of learners with similar behaviours, in terms of engagement and interaction with the platform, and on

(ii) testing whether subgroups differ in their survival curves in the platform. This is done with the purpose of identifying early signals of disengagement before drop-out , that would be relevant to foster the educational potential of LLL digital platforms.

2. The digital LLL platform

The digital platform analysed in this study was developed in 2019 by the Business School of a leading Italian university. The platform, which acts like a "digital mentor", allows learners to settle professional goals along a continuous, personalised learning pathway. The platform is free and open to everyone. Before starting, every learner is asked to fill a short questionnaire about their actual job, role and competences and set the aspirations for future professional career. While the digital, soft and hard skills assessment is optional during the registration phase. According to the settled aspirations, market job requirements, and the skill gaps emerging from the assessments, the digital mentor, using on AI algorithms, provides tailored suggestions and contents to study. The system is able to identify the topics or subjects where the person can bridge the gaps about specific knowledge and skills. The idea is to offer learners a flexible and personalised pathway to support their professional career and improve their employability. The learning experience lasts for six months, after which the learner can set new career aspirations and begins a new learning cycle. Additional features of the platform include challenges, networking with the whole digital community, and job postings from selected companies. The platform proposes three kinds of learning-related activities: daily workout, learning pathway and advanced search. The first relates to short readings or other contents that keep the learner engaged and provide "knowledge nuggets" on a daily basis. The learning pathway has a longer-run perspective, aiming at reinforcing specific compentences and skills of the learner, and lasts until 6 months. Lastly, the search function allows learners to autonomously look for news, courses or other contents they are interested in, by using keywords. The contents indexed and suggested by the platform come from a broad range of sources like MOOC platforms, selected business magazines and blogs. The AI algorithms tailor suggestions also on the basis of the feedback of learners, who may like or dislike proposed contents. The digital mentor allows every learner to reach the settled goals within six months from the registration. This period will be then used as reference to evaluate learner's success (or not).

3. Data and Methods

3.1. The dataset

Data are extracted from the platform and, after the cleaning processing, the number of observations (learners) is 2403. Variables can be categorised into three groups: (i) platform-learner interaction, (ii) learners' characteristics and (iii) learner survival time within the

platform (time between learner registration and final action within six months). The first cluster of variables, described in Table 1, concerns the type of activity the learner carried out in the platform (daily workout, learning pathway or search) and the number and length of sessions (on a daily, weekly or monthly basis). These variables are used to detect latent classes and describe different patterns of learners' interaction with the platform. Then, descriptive information are used to describe the subgroups identified. These variables related to learners' age, citizenship and education. The last set of variables describes the learning path in the platform: the status defines whether the learner completed the learning pathway after six months from the registration and, if he/she dropped out before, when the event occurs. This information is essential to study the survival function of latent classes, in linea with the second research objective.

Table 1. Variables used in the first step of LCA: description and mean.

Variable Name	Description	Mean
avgDailySessions	Num sessions / num active days	1.214
avgMonthlySessionsTotal	Num sessions / total months on Flexa	1.804
avgSessionsDuration	Total duration of sessions	1029.7
percentWeekendSessions	Num weekend sessions / num sessions	0.182
percentSessionsDailyworkout	Num dailyworkout sessions / num sessions	0.276
percentSessionsLearningPathway	Num learning pathway sessions / num sessions	0.15
percentSessionsSearch	Num search sessions / num sessions	0.16
percentOpenContents	# contents opened / # of recommended contents	0.103
percentLikeContents	# contents with like / # of recommended contents	0.049
percentOpenSearchedContents	# open searched content / # searched content	0.081
percentLikeSearchedContents	# content searched with like / # content searched	0.012

3.2. Methodology

Two different methodologies are adopted along the study. First, a Latent Class Analysis (LCA) is used with the aim of detecting hidden patterns in leaerners' interaction with the platform and classify them into latent subgroups (Muthén & Muthén, 2000). By latent subgroups, we mean clusters of observations (in this case, learners), who share underlying common features in terms of important dimensions (in our case, the level of interaction and the type of activity in the platform). Firstly, the latent classes are defined based on 11 indicators described in Table 1, and dichotomised, meaning that a value equal to 1 is assigned when the observed value is above the mean, 0 otherwise. As a result of step 1, each observation is assigned to the group for which the probability of class membership is the highest. The number of classes is selected assessing the goodness of fit of the model through the Bayesian Information Criterion (BIC) and the Lo-Mendell-Rubin (LMR) test (Lo et al.,

2001). In step 2, multinomial regressions are run to characterise the latent classes by means of personal information on the learners.

The second methodology is the survival analysis (Ameri et al. 2016), employed with the aim of studying the survival curves of the identified latent subgroups. The Kaplan-Meyer functions, $S(t_i)$, are estimated to visualise the probability of "surviving" on the platform with time-dynamics. This is a step-function, a non parametric estimation characterised by discontinuities at points given by time events: $S(t_i) = S(t_{i-1}) * (1 - \frac{d_i}{n_i})$. $S(t_{i-1})$ is the probability of being alive at t_{i-1}, n_i is the number of active learners just before t_i and di is the number of events at t_i. The event is defined when at least one learner drops-out (not survive). The underlying assumption is that the drop-out events are uncorrelated.

4. Results

Three is the number of latent classes that proxies data at best, as indicated by the lowest value of the BIC, and the platform-learner interaction profile of each class is presented in Figure 1. The first class is composed by a low share of learners (6.0%) and characterised by a high profile of activity. Their activities mainly relate to daily workout sessions, thus they are often logged in as confirmed by the high number of sessions with a relatively short duration. Also, they open and like contents proposed by the digital mentor, and for this reason are labelled *Platform-engaged learners*. The second class, represented by the 20.5% of learners, report an high number of sessions, but their activity is mainly characterised by searching contents by themselves. For this reason, the can be labelled *Self-engaged learners*. Lastly, 73.5% of learners interact very poorly with the platform. They are the least active and log in few times for long time, thus they can be labelled *Disengaged learners*. To characterise the identified classes, the multinomial regression in Table 2 provides a picture about some of their characteristics. The probability of being a *Self-engaged learner* is higher for young learners, compared to the other groups of learners. For all the other characteristics, *Self-engaged* and *Platform-engaged* learners are rather similar, while *Self-engaged* and *Disengaged learners* differ in terms of citizenship and assessment status – *Disangaged learners* are more likely to have not even started or completed the initial skill assessment. In this respect, *Disengaged learners* tend to be so since their enrolment in the platform. Finally, having followed one or more courses at the Business School does not affect the probability of belonging to a specific class of learners.

To address the second research objective, the Kaplan Mayer curves, in Figure 2, give a visual estimate of how fast the survival probability of each latent class decreases over time. Results suggest that *Disengaged learners* have a completely different survival function compared to the other two classes. The curve registers an initial drop at time 0, meaning that many learners log in the platform one time to never come back. The other two curves are very similar, even

though *Platform-engaged learners* show an initial drop, too. Interestingly, the survival probability of *Self-engaged learners* is higher than that of *Platform-engaged* learners until the 140th day, when the curves overlap and then switch. The probability of surviving until the end of the learning path (after six months) is pretty low (<25%) for all the three classes.

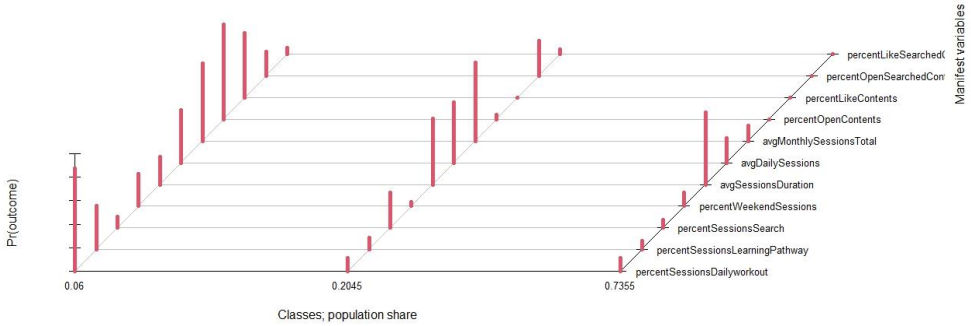

Figure 1: Latent Classes' profiles

Table 2. Multinomial regression to characterise latent classes

	Dependent variable (ref.: Disengaged learners)	
	Platform-engaged learners	Self-engaged learners
age	-0.027*** (0.007)	0.003 (0.011)
Italian	0.304** (0.149)	0.495* (0.257)
learnerTypeStudent	0.748*** (0.136)	0.974*** (0.227)
assessmentStatus: not completed	-0.589*** (0.198)	-1.313*** (0.429)
assessmentStatus: not started	-1.502*** (0.176)	-2.068*** (0.350)
mipEducations_dummy	-0.242 (0.592)	0.029 (1.061)
Constant	-0.779 (0.656)	-3.358*** (1.151)
Akaike Inf. Crit.	2,903.671	2,903.671

Note: *p<0.1; **p<0.05; ***p<0.01.

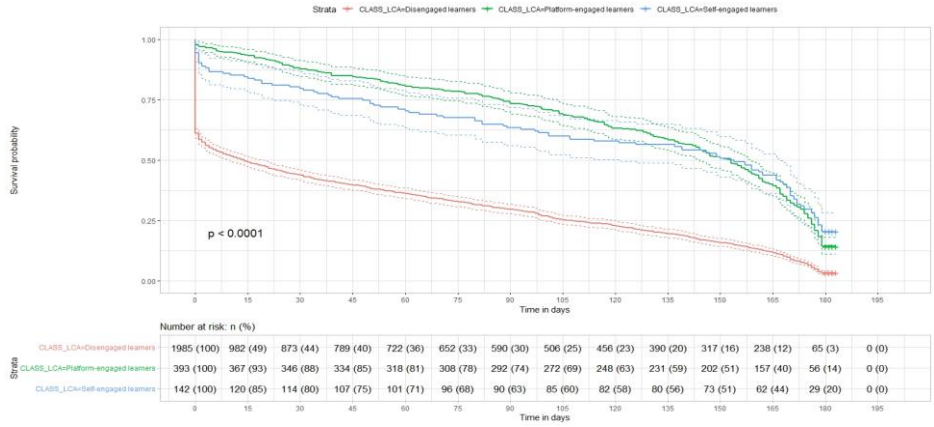

Figure 2: Kaplan-Meyer curves of identified Latent Classes.

5. Conclusions

The paper explores data derived from a digital LLL platform based on AI algorithms to explore the patterns of platform-learner interaction and observe the probability to persist on the platform until the end of the learning pathway. The high drop-out rate and risk of disengagement is a critical issue in digital education (Levy, 2007; Bañeres Besora & Conesa Caralt, 2017), which may undermine the effectiveness even of highly personalised learning experiences (Moreno-Marcos et al. 2020). The investigation of data generated by the interaction of learners on the platform provides relevant insights and contributes to understanding how Life Long Learners – typically professionals for whom bite-sized learning (e.g., Koh et al., 2018) could be highly beneficial, interact with a personalised platform.

Findings suggest that the majority of learners (73.6%) do not even take a step further after registering, a behaviour observed also among MOOC learners (Agasisti et al., 2021). The paper contributes to the academic debate on the identification of digital Life Long Learners' profiles (Binali et al. 2021), showing that despite the high personalisation of contents, it is registered high levels of disengagement, as observed in other digital formats (Korableva et al., 2019). In terms of practioners' implications, findings suggest possible early warning signals that may help prevent learners' dropout, as disengaged students tend to show their attitude since the very beginning. Also, a personalized learning journey can be designed following users' profiles from the LCA and survival patterns. As seen, this research may provide a set of interesting and valuable insights for improving the effectiveness of the platform.

References

Agasisti, T., Azzone, G., & Soncin, M. (2021). Assessing the effect of Massive Open Online Courses as remedial courses in higher education. *Innovations in Education and Teaching International*, 1-10.

Ameri, S., Fard, M. J., Chinnam, R. B., & Reddy, C. K. (2016). Survival analysis based framework for early prediction of student dropouts. In *Proceedings of the 25th ACM International on Conference on Information and Knowledge Management* (pp. 903-912).

Binali, T., Tsai, C. C., & Chang, H. Y. (2021). University students' profiles of online learning and their relation to online metacognitive regulation and internet-specific epistemic justification. *Computers & Education*, *175*, 104315.

Guglielmino, L. M. (1997). Reliability and validity of the Self-Directed Learning Readiness Scale and Learning Preference Assessment (LPA). In H. B. Long, & others (Eds.), Expanding horizons in self-directed learning (pp. 209–222). Public Managers Center, University of Oklahoma.

Koh, N. S., Gottipati, S., & Shankararaman, V. (2018). Effectiveness of bite-sized lecture on student learning outcomes. In *4th International Conference on Higher Education Advances (HEAd'18)*, Valencia, Spain, 2018 June 20-22: Proceedings (pp. 515-523).

Korableva, O., Durand, T., Kalimullina, O., & Stepanova, I. (2019). Studying user satisfaction with the MOOC platform interfaces using the example of coursera and open education platforms. In *Proceedings of the 2019 International Conference on Big Data and Education* (pp. 26-30).

Levano-Francia, L., Sanchez Diaz, S., Guillén-Aparicio, P., Tello-Cabello, S., Herrera-Paico, N., & Collantes-Inga, Z. (2019). Digital Competences and Education. *Journal of Educational Psychology-Propositos y Representaciones*, *7*(2), 579-588.

Levy, Y. (2007). Comparing dropouts and persistence in e-learning courses. *Computers & Education*, 48(2), 185-204.

Lo Y., Mendell N. R. and Rubin D. B. (2001) Testing the number of components in a normal mixture. *Biometrika* 88(3): 767–778.

Moreno-Marcos, P. M., Munoz-Merino, P. J., Maldonado-Mahauad, J., Perez-Sanagustin, M., Alario-Hoyos, C., & Kloos, C. D. (2020). Temporal analysis for dropout prediction using self-regulated learning strategies in self-paced MOOCs. *Computers & Education*, *145*, 103728.

Muthén, B., & Muthén, L. K. (2000). Integrating person-centered and variable-centered analyses: Growth mixture modeling with latent trajectory classes. *Alcoholism: Clinical and experimental research*, *24*(6), 882-891.

Perez-Ortiz, M., Novak, E., Bulathwela, S., & Shawe-Taylor, J. (2021). An AI-based Learning Companion Promoting Lifelong Learning Opportunities for All. *IRCAI Opinion Series Report*, 1-6.

World Economic Forum. (2018). The Future of Jobs Report 2018. Geneva: World Economic Forum.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14625

University contribution to developing generic competences and employment status after graduation: a mediated model

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Abstract

In this study, we analyze whether the university contribution to the development of generic competences is related to the employment status of graduates six months after graduation. Specifically, we propose that there are two mediating mechanisms in the relationship: 1) a sequential mechanism that involves two mediators: the generic competences acquired by students and their core self-evaluations; and 2) a simple mediating mechanism that involves only the generic competences acquired. We tested the research model in a sample of 303 students from a Spanish university. We collected information when students were about to complete their degrees and six months after graduation. Results supported the sequential indirect effect proposed via generic competences and core self-evaluations.

Keywords: *University; generic competences; employment; core self-evaluations; mediation.*

1. Introduction

Generic competences are a form of human capital that increases individuals' employability (Future Work Skills, 2020, Tomlinson & Holmes, 2017). As such, with the goal of fostering the employability of university graduates, the European Higher Education Area has promoted the development of generic competences in university education.

In this study, we analyze whether Universities' Contribution to the Development of Generic Competences (as perceived by students) (UCDGC) is related to employment status six months after graduation by means of two mediating mechanisms that operate sequentially: the generic competences acquired by students and their core self-evaluations (i.e. individuals' fundamental appraisals of their self-worth and capabilities) (Judge et al., 1997). Additionally, because generic competences are highly demanded in the workplace, we expect that generic competences will play a role as a simple mediating mechanism because graduates with more generic competences will have a greater probability of finding a job after graduation. The research model is depicted in Figure 1.

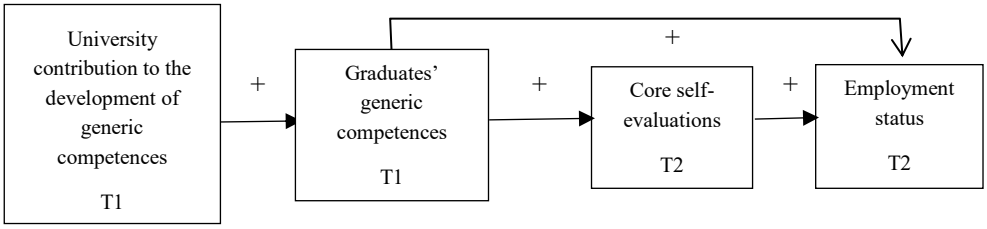

Figure 1. The hypothesized Research Model (Control variables are excluded for the sake of simplicity)

1.1. Generic competences and university contribution to developing generic competences

Apart from the knowledge and skills required to work in a specific field linked to an academic qualification, generic competences are critical in modern organizations, where adaptability, teamwork, and innovation are essential. Specifically, generic competences refer to the knowledge, skills, and abilities a person can apply in different contexts, regardless of the field of expertise (Barrie, 2006). Particularly, we focus on graduates' generic competences required by the labor market, as identified by Hernández-March et al. (2009): 1. oral and written communication skills, 2. problem solving skills, 3. time and resource management abilities, 4. capacity for teamwork, 5. continuous learning, ongoing education, and lifelong learning, and 6. capacity to take on responsibilities. Because these are essential competences sought by employers, university training programs should contribute to fostering them (Sipon, 2003). In this study, we hypothesize that UCDGC should translate into higher levels of graduates' generic competences (Hypothesis 1).

1.2. Generic competences and employment status: the mediating role of CSE

Core self-evaluations (CSE) refer to the fundamental appraisals individuals make about their self-worth and capacity to function in their environment (Judge et al., 1997). This construct encompasses self-esteem, self-efficacy, locus of control, and emotional stability (Judge et al., 1998). According to Rao (2010), generic competences contribute to building self-esteem and self-confidence (both important constituents of CSE). In addition, when people think they possess important competences needed for job success, they have a greater belief in their potential and feel responsible for their actions when entering the job market. Considering these arguments, we expect that graduates' generic competences will be positively related to graduates' CSE (Hypothesis 2). Finally, graduates' positive appraisals of their self-worth and capacity to function in the environment should motivate them to take action to plan, exert control, and exercise influence in their environments in order to achieve their (professional) goals (Erez & Judge, 2001). In fact, according to Rao (2010), self-esteem and self-confidence are important aspects of CSE that contribute to enabling professional advancement. Thus, we expect that graduates' CSE will be positively related to employment status after graduation (Hypothesis 3).

Considering all the arguments presented to justify Hypotheses 1 to 3, we expect that UCDGC will have a positive indirect effect on employment status after graduation via graduates' generic competences and CSE.

Additionally, because employers look for employees who have a variety of competences that foster adaptation, cost reduction, and productivity in modern markets, generic competences such as teamwork, problem-solving, or analytical ability are becoming crucial in recruitment and selection (Curtin, 2004). Thus, given that graduates with these competences are expected to be more attractive to employers, we hypothesize that graduates' generic competences will be positively related to their employment status after graduation (1. Employed; 0. Unemployed) (Hypothesis 4).

Considering the arguments presented for Hypotheses 1 and 4, we expect that UCDGC will also have an indirect "effect" on employment status via graduates' generic competences.

2. Method

2.1. Participants and Procedure

Students from a Spanish public university were contacted via email approximately two months before graduation (Time 1; T1). Those who voluntarily agreed to participate were informed that they would be contacted again approximately six months after graduation to respond to another survey (Time 2; T2). Participants were offered a free seminar of their choice (leadership, team building, or time management) in exchange for their participation.

Because we aimed to analyze the impact of university training on employment success, we excluded graduates who had obtained their jobs before graduation. We also ruled out participants who showed inattentive responses to two out of three instructed response items presented at T1 and T2 (e.g., "please mark the response option I agree"). The final sample consisted of 303 participants: 159 were unemployed (and had not had a job since graduation), and 144 had found a job within 6 months after graduation. The average age was 25.19 (SD = 5.21), and 72.2% were female. Finally, 62% had completed a bachelor's degree, and 38% had completed a Master's degree. All degree fields were represented: Social Sciences (52.5%), Health Sciences (27.1%), Humanities (11.2%), Natural Sciences and Mathematics (7.6%), and Engineering (1.7%).

2.2. Measures

UCDGC and participants' generic competences were measured at T1 by means of six items that captured the key competences identified by Hernández-March et al. (2009): 1. oral and written communication skills, 2. problem solving skills, 3. time and resource management abilities, 4. capacity for teamwork, 5. continuous learning, ongoing education, and lifelong learning, and 6. capacity to take on responsibilities. First, we asked participants to indicate the degree to which the training received at the university had contributed to developing each of the generic competences. Afterwards, we asked participants to indicate the degree to which they had each of these generic competences. Items were responded to on a 5-point graded scale (1. Low degree, 5. High degree). Cronbach's alpha were .83 and .74, respectively.

CSE and Employment status after graduation were measured at T2. To measure CSE, we used the Core Self-Evaluations Scale developed by Judge et al. (2003). The scale consists of 12 items (e.g., "I am confident I will get the success I deserve in life") that are responded to on a 6-point Likert scale (1. Strongly Disagree, 6. Strongly Agree). Cronbach's alpha was .86. Employment status after graduation was measured by asking graduates whether they had been employed since graduation. If graduates responded that they had been employed since graduation, we asked them when they got their jobs. Those who were employed in a job obtained after graduation were classified as "1. Employed". Graduates who reported that they had never been employed after graduation (despite having looked for a job) were classified as "0. Unemployed". As we mentioned earlier, those who had obtained their jobs before graduation were excluded because we were interested in seeing the impact of the university training after completing the degree.

2.3. Analysis

The proposed research model was tested by means of path analysis using Mplus 8. Considering that employment status is a binary outcome, we fitted a probit model using Weighted Least Square Mean and Variance adjusted (WLSMV) estimation methods (see

Muthén & Asparouhov, 2015). Because indirect effects do not follow a normal distribution, we tested for significance of indirect effects by means of Monte Carlo simulation, which provides good Type I error rates and statistical power (Tofighi & MacKinnon, 2016) (https://amplab.shinyapps.io/MEDMC/). Given that our hypotheses were directional (all the relationships are expected to be positive), we carried out one-tail tests (Cho & Abe, 2013), which are often justified in mediation research (Preacher et al., 2010). In addition, we controlled for several relevant variables: gender (0. Female; 1. Male), age, educational level (0. Bachelor; 1. Master), social class (1-4), and degree field (by creating four dummy variables -Engineering was the referent).

3. Results

Table 1 shows the descriptive statistics and correlations among the study variables. To keep the model simple, control variables were introduced as predictors of the mediators and the outcomes only when they showed statistically significant correlations with a particular mediator and/or outcome.

Table 1. Means, Standard Deviations, and Correlations among variables

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11
1. Age	25.19	5.22	—										
2. Social Class	2.63	.74	-.15*	—									
3. Educat. Level	.38	.49	.29**	.02	—								
4. Gender	.27	.44	-.02	-.09	.11	—							
5. Humanities D1	.11	.32	-.11	-.11	-.17**	.02	—						
6. Nat. sciences D2	.08	.27	-.06	.01	.06	.08	-.10	—					
7. Health D3	.27	.45	-.05	.05	-.08	-.08	-.22**	-.18**	—				
8. Soc. Sciences D4	.52	.50	.13*	.02	.15*	-.01	-.37**	-.30**	-.64**	—			
9. UCDGC T1	3.56	.71	-.10	.03	-.07	.03	-.09	-.02	-.03	.10	—		
10. Generic Comp. T1	4.19	.48	.07	.03	.01	-.14*	-.07	-.11	.09	.03	.25**	—	
11. CSE T2	4.21	.74	-.03	.18**	-.00	.01	-.12*	-.13*	.11	.04	.18**	.34**	—
12. ES T2	.48	.50	-.05	.04	.01	.02	.00	-.10	.05	.02	.11	.07	.17**

Note. *p <. 05; ** p< .01. D=Dummy; UCDGC= University contribution to development of generic competences; ES=Employment Status; CSE= Core Self-Evaluations; SD=Standard deviation, T1=Time 1; T2=Time 2.

The proposed model (Figure 1) showed satisfactory fit to the data ($\chi 2$ (9) = 12.44, p > .05; RMSEA = .04; CFI = .95; TLI=.91). The results obtained supported Hypotheses 1, 2, and 3 (see Table 2). The UCDGC was positively related to the level of generic competences (B= .192; p>.001), which in turn was positively related to CSE (B=.504; p<.001), which in turn

was positively related to employment status (B=.244; p<.01). The indirect effect of UCDGC on employment status via generic competences and CSE was .024 (.192*.504*.244). The 90% Monte Carlo confidence interval was [0.006, 0.046]. Because zero is not included in the interval, the indirect effect was statistically significant.

Table 2. Path analysis results.

Effect	B	SE	p	β
UCDGC T1 → Generic competences T1	.192	.04	<.001	.285
Generic Competences T1→ CSE T2	.504	.08	<.001	.327
CSE T2→ Employment Status T2	.244	.10	.008	.178
Generic Competences T1→ Employment Status T2	.046	.15	.382	.022

Note. Only control variables that showed significant correlations were modelled; UCDGC: University contribution to developing generic competences. B coefficients are unstandardized, and p values are one-tail. β refers to standardized coefficients

Contrary to our expectations, generic competences were not directly related to employment status after graduation (B=.046; p> .05). Thus, Hypothesis 4 was not supported. The indirect effect of UCDGC on employment status via generic competences (.192*.046= .009) was not statistically significant. The 90% Monte Carlo confidence interval was [-.039; .058].

4. Discussion

The results obtained show that university contribution to developing generic competences has a positive indirect "effect" on employment status six months after graduation. The mediating mechanism involves two sequential mediators: generic competences acquired according to students' perceptions and core self-evaluations.

4.1. Theoretical implications

We show the importance of considering the interconnection between educational antecedents (UCDGP) and personal antecedents (generic competences acquired and CSE) of finding a job when young graduates enter the job market. In addition, we uncover one of the mechanisms through which university training that fosters the development of generic competences (a valued form of human capital) contributes to finding a job after graduation.

4.2. Practical Implications

Given the indirect "effect" of the university contribution to developing generic competences on employment status after graduation, universities and higher education institutions should

design and implement training programs that contribute to developing critical generic competences. This competence development can be promoted through different learning activities that should, ideally, involve active learning and be integrated into a framework that gradually increases their complexity (e.g., Bautista, 2016). However, young graduates can also acquire generic competences by other means (e.g., additional courses, internships, part-time jobs while studying). Thus, universities' career counseling services should discuss with students and graduates the best ways to improve critical generic competences. By increasing their competences, it is expected that their CSE will improve, and they will be more confident about their potential (even though career counselors should warn students about being over-confident – see Valls et al., 2020).

4.3. Limitations and Future Research

The present study has several limitations. First, UCDGC, generic competences, and CSEs were measured with self-reported scales using a single source (graduates). An objective or external measure of some of these variables, such as students' competences, would make a stronger contribution. Future studies should include these types of measures. Second, we only had two time points instead of the four that would represent the expected causal order. This is particularly troublesome for measures at T2 because finding a job after graduation could also improve graduates' CSE. Future research with more time points should contribute to disentangling these effects. Third, participants come from only one university, which limits the generalizability of our findings. Finally, the fact that generic competences acquired by students are not significantly related to the employment status after graduation suggests that some employers may not be assessing these generic competences (teamwork, time management) for selection purposes because they are difficult to assess. Thus, future research should include the employer's point of view.

4.4. Conclusion

Despite the aforementioned limitations, our study helps to uncover one of the mechanisms explaining why the university contribution to developing generic competences is related to a higher probability of finding a job after graduation.

Acknowledgements

This work was supported by research grants provided by the Spanish Ministry of Economy and Competitiveness (MINECO), the Spanish State Research Agency (AEI), and the European Regional Development Fund (ERDF). [PSI2013-47195-R] and [Ref. PSI2017-86882-R].

References

Barrie, S. (2006). Understanding what we mean by generic attributes of graduates. *Higher Education, 51*(2), 215-241 doi: 10.1007/s10734-004-6384-7

Bautista, I. (2016). Generic competences acquisition through classroom activities in first-year agricultural engineering students. *International Journal of Educational Technology in Higher Education, 13*(1), 1-9.

Cho, H. C., & Abe, S. (2013). Is two-tailed testing for directional research hypotheses tests legitimate?. *Journal of Business Research, 66,* 1261-1266. doi: 10.1016/j.jbusres.2012.02.023

Curtin, P. (2004). Employability skills for the future. In J. Gibb (Ed.) *Generic skills in vocational education and training,* (pp. 38-52). Australian National Training Authority

Erez, A., & Judge, T. A. (2001). Relationship of core self-evaluations to goal setting, motivation, and performance. *Journal of Applied Psychology, 86,* 1270–1279. doi: 10.1037/0021-9010.86.6.1270

Future Worlk Skills (2020). Institute from the Future. https://www.iftf.org/futureworkskills/

Hernández-March, J., Martín del Peso, M., & Leguey, S. (2009). Graduates' Skills and Higher Education: The employers' perspective. *Tertiary Education and Management, 15*(1), 1-16. DOI: 10.1080/13583880802699978

Judge, T. A., Erez, A., & Bono, J. E. (1998). The power of being positive: The relation between positive self-concept and job performance. *Human Performance, 11*, 167–187. doi:10.1080/08959285.1998.9668030

Judge, T. A., Locke, E. A., & Durham, C. C. (1997). The dispositional causes of job satisfaction: A core evaluation approach. *Research in Organizational Behavior, 19,* 151–188. doi: 10.1111/j.1464-0597.2007.00318.x

Preacher, K. J., Zyphur, M. J., & Zhang, Z. (2010). A general multilevel SEM framework for assessing multilevel mediation. *Psychological methods, 15,* 209-233. doi:10.1037/a0020141

Rao, M.S. (2010) *Soft Skills-Enhancing Employability: Connecting Campus with Corporate.* International Publishing House.

Sipon, A. (2003). Educational strategies for the K-Economy workforce. *Journal ofTechnical Education*, 1(2), 1-6.

Tofighi, D.,& MacKinnon, D. P. (2016). Monte Carlo Confidence Intervals for Complex Functions of Indirect Effects. *Structural Equation Modeling: A Multidisciplinary Journal, 23,* 194-205.

Tomlinson, M., & Holmes, L. (2017). *Graduate employability in context theory, research and debate.* Palgrave Macmillan.

Valls, V., González-Romá, V., Hernandez, A., & Rocabert, E. (2020). Proactive personality and early employment outcomes: The mediating role of career planning and the moderator role of core self-evaluations. *Journal of Vocational Behavior, 119*, 103424.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14638

Design-Based Learning and Student Entrepreneurship: How Learning Design Supports Non-Design Students' Aspirations

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Abstract

How does learning design support non-design students' career aspirations? The paper presents a qualitative interview study with undergraduate students from different disciplines in Canada, who shared their design-based learning (DBL) experiences. DBL is students across programs learning design for various educational goals and not to become professional designers. The paper describes a study that shows how learning design benefits students across programs to obtain, pursue and imagine desirable career paths. The paper also discusses how DBL supports students who aspire for technology-related jobs, students who want careers centered around creativity, and students who value work that has a social impact.

Keywords: *Design-Based Learning; Student Entrepreneurship; Education for Employability.*

1. Introduction

Over the past 25 years, the demand for and the number of entrepreneurship education programs has increased (Katz, 2003). Many courses are interdisciplinary and bring science and engineering students together with business and design students to prepare new products and processes for marketization. As a result, entrepreneurship initiatives are in programs close to the market, leading to commercialization. Many entrepreneurship initiatives also incorporate design processes and methods. Design-based learning (DBL) refers to non-design students learning design in formal settings such as said courses, or in other initiatives across campus. For example, management students who learn about product innovation by applying design thinking is an example of cultivating student entrepreneurship through design. DBL, thus, is an educational approach that "borrows the methods of design practice and the pedagogy of design education in teaching a variety of subjects and thinking skills in both K-12 schools and higher education" (Davis, 2017, p. 145).

Studies of DBL at all educational levels argue that it prepares students for the workforce because of the nature of design practice and education (Vande Zande 2010b, 2011). However, what is often absent from these studies is a discussion of students' aspirations for the future. In other words, how can "preparedness for work" be a specific outcome of DBL if research often lacks what students consider being prepared for work and to which types of work students aspire. Without understanding students' experiences of learning design, acquiring skills such as creative problem-solving and entrepreneurial thinking attributed to DBL may seem detached from students' realities and present unattainable goals for university educators across disciplines interested in it as an educational approach. In this paper, the author shares research findings from a qualitative interview study that uncover the links between DBL and preparation for employability. The study presents insights into the value of design to non-design students across disciplines as it connects to their future career aspirations, which in turn, sheds light on the nature of student entrepreneurship in DBL experiences.

2. Background

The paper uses student entrepreneurship as a term to describe when students become both learners and entrepreneurial agents pursuing opportunities to engage with commercial activities. HE institutions cultivate student entrepreneurs through entrepreneurship education programs or entrepreneurial education initiatives at the graduate and undergraduate levels. Entrepreneurial education extends beyond the classroom and includes entrepreneurial incubators established to support students' ideas and prepare them for marketization (Mars, Slaughter and Rhoades, 2008; Mars, 2009).

The term entrepreneurship in studies on the corporatization of HE often describes commercial activities that start in colleges and universities and then move to the private marketplace.

Studies on entrepreneurship in HE also focus on "market-oriented phenomena" with little attention to non-market activities such as student and faculty activism. Academic entrepreneurs can, thus, be redefined as "actors who innovatively leverage internal and external opportunities to not only generate economic resources for their own profit or in support of their academic units and institutions, but also to create with the academy social and political change platforms" (Mars, 2009, p. 444). Meaning faculty and students may also engage in entrepreneurship with social goals, and cross-disciplinary student collaborations that focus on social transformations (Cuyrer, 2005; Winfield, 2005). Student eco-entrepreneurship is an example of a market-oriented activity with ecological conservation and preservation goals (Mars & Loursbury, 2009).

Over the past two decades, universities have also shown an increasing interest in using design in non-design programs. This interest manifests in adopting Design Thinking (DT), a design-led innovation methodology, across HE curricula (Davis, 2017). To understand the rise of interest in design, we can learn from what happened in K-12 in the 1990s, when teachers in the United States adopted DBL in response to calls from the government to cultivate competencies that would prepare students for work in the 21st century (Davis et al., 1997; Davis, 2017). Similarly, the interest in DT in HE rose in the 2000s alongside calls for economic-driven educational goals (Harris & Carter, 2021; Irani, 2018).

Educators in HE started looking for ways to foster students' innovative, creative and entrepreneurial thinking abilities, competencies which governments in the US and Canada have been asking of educational institutions to increase their economic competitiveness (Slaughter & Rhoades, 2014; Wiebe et al., 2018). We can also understand, through this lens, why DT is the form of DBL that educators in HE use most often, and that is because it relates to technology and product innovation (Brown, 2009; Martin, 2009). Since the 2000s, technology firms have also contributed to popularizing DT by associating it with their innovation stories.

3. Methodology

This paper is based on qualitative research that the author conducted from 2018 to 2021. The study included three methods: semi-structured interviews for data collection, constant comparison for data analysis, and visual mapping. The interviews included 15 research participants from six programs at a university in Canada, with one student on exchange from a university in Europe. Participants were mainly enrolled in undergraduate programs with one graduate student. One participant pursued an additional college certification, while some aimed to add minor concentrations and double majors to their degrees. Constant comparison analysis was used to generate categories from the interview texts. It was conducted in three

stages of analysis to arrive at data categories and then at the study's findings. Finally, visual mapping acted as a mode of inquiry throughout the research journey.

4. Results

The study showed that DBL creates opportunities for HE students to advance their career goals by positioning them as experts in design to be more competitive in the job market or by inspiring new business ideas that incorporate design. Research findings reveal three ways in which learning design supports students towards achieving their future aspirations.

The first way includes students' aspirations for employment in the technology innovation sector. Most students connected design with technological advancement. They believed that the nature of work is changing and that some careers will disappear. However, most students saw that design is what one of the research participants described as "here to stay." Students also believed that the world will be highly technological by the time they graduate and that design and technology innovation are connected. Therefore, learning design was a step toward achieving their goals for students interested in careers that intersect with technology and innovation. Students with aspirations for tech-related industries believe design knowledge is advantageous because design skills are valuable for employment in a highly technological future.

The second way DBL supports students is to enable opportunities for creative projects and initiatives. Many students associated design with creativity. After experiencing DBL, their perception of themselves as creative shifted because they completed assignments described as creative. Students explained that by doing creative projects, they became confident creatively. DBL ignited students' interests in careers that involve creative explorations. Thus, students interested in creativity-related careers continued to pursue DBL experiences because they wanted to acquire more abilities to be involved in jobs that center around it. Some of the students also sought DBL experiences to complete projects that showcased their creative potential in ways that might make them attractive candidates for various jobs because they were unsure what they aspired to in the future.

The third way DBL supports students' aspirations is connected to career aspirations where social change is central. Students found in DBL inspirations for careers with a social impact because design lessons encouraged them to pay attention to how their work influences people's lives. For some students, it meant altering previous career plans by focusing on social responsibility inspired by principles they learned in design. For others, it meant shifting career goals toward new horizons or pursuing further studies to explore the intersections of their programs with design, where the social dimensions of these connections are central.

5. Conclusions

The paper described research findings from a qualitative interview study with HE students across programs. It explained how DBL creates opportunities for HE students to advance their career aspirations by positioning them as experts in design to be more competitive in the job market or by inspiring new ambitions. In addition, the paper discussed how DBL supports students who aspire for technology-related jobs, students who want careers centered around creativity, and students who value work that has a social impact. Finally, the results draw our attention to how HE students believe it vital to build meaningful careers and that what constitutes a prosperous career is different for each student. Therefore, while the study reiterates that DBL prepares students for the workforce, findings show that students' perceptions of preparing for work vary.

References

Brown, T., (2009). *Change by design: How design thinking transforms organizations and inspires innovation*. Harper Business.

Cutrer, E. F. (2005). Student social entrepreneurs: A classroom call to action. *Peer Review*, 7(3), 27.

Davis, M., Spilka, G., Mcmullan, B., & Hawley, P. (1997). *Design as a catalyst for learning*. Association for Supervision and Curriculum Development.

Davis, M. (2017). *Teaching design: A guide to curriculum and pedagogy for college design faculty and teachers who use design in their classrooms*. Allworth Press.

Harris, A., & Carter, M. R. (2021). Applied creativity and the arts. *Curriculum Perspectives*, 41(1), 107-112. https://doi.org/10.1007/s41297-020-00127-z

Irani, L. (2018). "Design thinking": Defending Silicon Valley at the apex of global labor hierarchies. *Catalyst: Feminism, Theory, Technoscience*, 4(1), 1-19.

Katz, J. A. (2003). The chronology and intellectual trajectory of American entrepreneurship education. *Journal of Business Venturing*, 18(2), 283-300. doi:10.1016/s0883-9026(02)00098-8

Mars, M. M., Slaughter, S., & Rhoades, G. (2008). The state-sponsored student entrepreneur. *The Journal of Higher Education*, 79(6), 638-670. doi:10.1353/jhe.0.0024

Mars, M. (2009). Student entrepreneurs as agents of organizational change and social transformation: a grassroots leadership perspective. *Journal of Change Management*, 9(3), 339–357.

Mars, M. M., & Lounsbury, M. (2009). Raging against or with the private marketplace? Logic hybridity and eco-entrepreneurship. *Journal of Management Inquiry*, 18(1), 4–13. https://doi.org/10.1177/1056492608328234

Martin, R. (2009). *The design of business: Why design thinking is the next competitive advantage*. Harvard Business Press.

Slaughter, S., & Rhoades, G. (2014). The academic capitalist knowledge/learning regime. *The exchange university: Corporatization of academic culture*, 19-48.

Vande Zande, R. (2010b). Teaching design education for cultural, pedagogical, and economic aims. *Studies in Art Education*, 51(3), 248-261. doi:10.1080/00393541.2010.11518806

Vande Zande, R. (2011). Design education supports social responsibility and the economy. *Arts Education Policy Review*, 112(1), 26-34. doi: 10.1080/10632913.2011.518123

Wiebe, S., Gouzouasis, P., McLarnon, M., Ricketts, K., & Shuman, L. (2018). Introduction: A creativity without gold stars. *Canadian Journal of Education*, 41(1), 1A-7A.

Winfield, I. (2005). Fostering social entrepreneurship through liberal learning in the social sciences. *Peer Review*, 7(3), 15.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14686

Fostering Key Competencies for Sustainability: Development of a Higher Education Teaching Format based on Service Design

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Abstract

Against the background of severe global sustainability challenges, Higher Education Institutions (HEIs) are called to integrate sustainability aspects into research and teaching, hereby supporting the development of sustainability competencies of students (United Nations Educational, Scientific and Cultural Organization, 2017). Within this context, a new teaching format, that applies the Service Design methodology to tackle sustainability-related real-world challenges, was designed and conducted at a German University of Applied Sciences in autumn/winter 2021. The teaching format was evaluated by participating students respective its contribution to the fostering of their sustainability key competencies. This paper describes the developed format and outlines how and why it helped students to develop key competencies. It thereby contributes to a highly relevant and increasingly considered research stream dealing with teaching effectiveness and the impact of pedagogical approaches on sustainability-related competencies (Cebrián, Junyent, & Mulà, 2020).

Keywords: *Education for Sustainable Development (ESD); Service Design; Design Thinking; Key Competencies; Teaching Effectiveness.*

1. Introduction

Higher education institutions (HEIs) are pivotal for preparing their graduates to cope with an increasingly complex and turbulent environment and to develop future decision-makers' competencies to transform our political, social and economic systems towards a sustainable future (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2017). Hence, a growing number of literature is dealing with the effectiveness of different teaching pedagogies and their use within classroom for such a competency development (Redman, Wiek, & Barth, 2021). Within this context, approaches such as active and collaborative learning (Evans, 2019) as well as experiential learning (Lozano, Barreiro-Gen, Lozano, & Sammalisto, 2019; Molderez & Fonseca, 2018) have been highlighted in the past. Recent studies are investigating the potential of Service Design teaching for sustainability education (e.g. Pimpa, 2019; Earle & Leyva-de la Hiz, 2021).

Based on these findings and developments, a new teaching format called "Engaging for Sustainability" was designed, conducted and evaluated in terms of contributing to the development of students' sustainability competencies. This paper aims a) to introduce the designed teaching format in order to showcase the application of Service Design and connected recommended teaching approaches and pedagogies in higher education practice, namely active, collaborative and experiential learning, and b) to assess the potential of this teaching format to enhance sustainability key competencies based on students' self-assessment.

2. Developing and Fostering Sustainability Key Competencies by Service Design

In line with the call for HEIs to enable the acquisition of competencies related to sustainability (UNESCO, 2017), a growing stream of literature addressing questions concerning these competencies can be observed (Lozano et al., 2019). Key competencies in sustainability can be defined as "functionally linked complex[es] of knowledge, skills, and attitudes that enable successful task performance and problem solving" (Wiek, Withycombe, & Redman, 2011, p. 204 based on Spady, 1994 and Baartman, Bastiaens, Kirschner, & Van der Vleuten, 2007). The UNESCO (2017) identifies eight key competencies for sustainability. Table 1 depicts those key competencies and presents definitions for them.

Service Design can be conceptualized as a service-specific application of Design Thinking and design methodologies to immaterial products, i.e. services (Clatworthy, 2017). Design Thinking refers to a human-centred 'open' problem solving process for complex, multifaceted problems, so-called 'wicked problems' (Buchanan, 1992). Service Design targets on designing services and balances the needs of the customer with the needs of the business, aiming to create seamless and quality service experiences (Miller, 2015). It is

increasingly perceived as a catalyst for innovation in national policy, regional development and business and may contribute to social innovation (Yang & Sung, 2016) and sustainable business model innovation (Prendeville & Bocken, 2017).

Table 1. Key competencies for sustainability

Key competency	Definition (from Rieckmann, 2018)
Systems thinking competency	"The ability to recognize and understand relationships, to analyse complex systems, to perceive the ways in which systems are embedded within different domains and different scales, and to deal with uncertainty" (p. 44).
Anticipatory competency	"The ability to understand and evaluate multiple futures – possible, probable and desirable – and to create one's own visions for the future, to apply the precautionary principle, to assess the consequences of actions, and to deal with risks and changes" (p. 44).
Normative competency	"The ability to understand and reflect on the norms and values that underlie one's actions and to negotiate sustainability values, principles, goals, and targets, in a context of conflicts of interests and trade-offs, uncertain knowledge and contradictions" (p. 44).
Strategic competency	"The ability to collectively develop and implement innovative actions that further sustainability at the local level and further afield" (p. 44).
Collaboration competency	"The ability to learn from others; understand and respect the needs, perspectives and actions of others (empathy); understand, relate to and be sensitive to others (empathic leadership), deal with conflicts in a group; and facilitate collaborative and participatory problem-solving" (p. 44).
Critical thinking competency	"The ability to question norms, practices and opinions; to reflect on own one's values, perceptions and actions; and to take a position in the sustainability discourse" (p. 44).
Self-awareness competency	"The ability to reflect on one's own role in the local community and (global) society, continually evaluate and further motivate one's actions, and deal with one's feelings and desires" (p. 45).
Integrated problem-solving competency	"The overarching ability to apply different problem-solving frameworks to complex sustainability problems and develop viable, inclusive and equitable solution that promote sustainable development - integrating the above-mentioned competencies" (p. 45).

Source: Rieckmann (2018).

When using Service Design in sustainability-related teaching, students are in the role of designers that actively and collaboratively search for solutions for real-life problems brought in by companies or other organizations. Hereby, teaching inherently builds on learning approaches that have been identified as effective for sustainability-related teaching, such as active, collaborative (Evans, 2019) and experiential learning (Lozano et al., 2019; Molderez & Fonseca, 2018). Furthermore, certain characteristics of the Service Design process are

nourishing selected competencies of the described UNESCO framework: For example, by following the so-called Double Diamond Process (Design Council, 2020), students explore a wide problem space, which allows delving into multifaceted problems. Students recognize that sustainability-related design challenges involve and affect diverse stakeholders and that their proposed solutions need to consider different subsystems and fit into existing ecosystems. Service Design – especially when used for solving 'wicked problems' (Morelli, de Götzen, & Simeone, 2021) – therefore potentially enhances the systems thinking competency as defined by the UNESCO (2017). By giving students space for experimenting with new and innovative ideas, going through multiple iterations of understanding a human need, and transforming this understanding into new ideas and evaluating the ideas (through prototyping) with the users (Clatworthy, 2017), Service Design possibly also fosters he strategic as well as integrated problem-solving competency. Service Design teams are ideally multi-disciplinary teams composed of experts in different domains and with different demographics, backgrounds and experiences. It is pivotal for Service Design to foster empathy and collaboration among the team members and with users and stakeholders, e.g. by means of interviews, observations and immersions (Miller, 2015) such that a positive impact on collaboration competency is probable.

3. Case Example: Teaching Format "Engaging for Sustainability"

3.1. Teaching format description

The teaching format "Engaging for Sustainability", taught at a faculty for cooperative business administration studies at a German University of Applied Sciences, is linking two originally separated modules – one focusing on sustainability aspects, the other on Service Design – with the specific intent to facilitate "education for sustainability" and reach the following objectives: increase business students' awareness of issues related to sustainability; foster the development of students' (key) competencies related to sustainability and equip them with creative problem-solving techniques to tackle 'wicked problems'; as well as encourage students to turn theory into practice and behave in a more sustainable manner.

To accomplish those objectives, the format is divided into three parts that are supplementing each other and are partly conducted parallel. In the first part students work in teams of four to five persons on real-life sustainability-related challenges brought in by project partners. Each project aims at solving a sustainability challenge by collaboratively applying the different techniques of Service Design. The project work is facilitated by a lecturer with long experience in Service Design and other creativity and innovation methods. 40 hours in presence teaching and approximately 110 hours of self-study are allocated to this part which mainly aims at developing collaboration, strategic, integrated problem-solving, systems thinking and – to a minor part – anticipatory competency. The project work is framed by the

second part of the course, which consists of theoretical inputs and group discussions on the topic of sustainability. Students get acquainted with basic concepts such as sustainability and the Sustainable Development Goals (SDGs), responsibility, ethics and social entrepreneurship and explore selected sustainability issues and their implications. This part should mainly enhance the awareness for (interconnected) sustainability issues, and an understanding of the responsibility of different actors for solving them. The third part consists of reflection tasks and discussions. Students are asked to question their own behavior and attitudes, and their role for contributing to a sustainable development. They are motivated to contextualize their project work in relation to the grand sustainability challenges and stakeholder needs and evaluate the impact of their work on the SDGs. The second and the third part of the course aim more on developing students' self-awareness, critical thinking and normative competency. These parts are guided by a lecturer of the field of management and sustainability and encompass 20 lecture hours and approximately 10 hours of self-study.

3.2. Student evaluation

3.2.1. Methodology

The teaching format was conducted between October and December 2021 at a German University of Applied Sciences. Participating students were asked to complete an online questionnaire after the last session of the teaching format has taken place representing a reflection on their learning process as well as abilities and competencies gathered throughout the teaching format participation. Overall, 26 students completed the questionnaire. Of those, four students needed to be taken out of the data analysis due to quality reasons (i.e. finishing the survey within less than ten minutes). The remaining 22 students were on average 23 years old; eight of them were aged 20 years or younger, ten students were aged between 21 and 25 years and four students were aged above 25. The majority of students was female (i.e. 15 female and seven male students) and almost all students (except three) already had work experience. In one part of the questionnaire students were presented with definitions of the eight key competencies for sustainability and asked to assess respective each competency how strong the teaching format participation contributed to its fostering for them personally using a 5-point Likert scale (ranging from "not at all" to "extremely"). In order to stimulate a thorough reflection and evaluation of the teaching format contribution, students were additionally asked to describe where they had opportunity/opportunities to practice and apply the competency in question throughout their teaching format participation (within or out of the classroom). The definitions provided to the students were developed based on the above introduced definitions presented in Rieckmann (2018), taking other works such as Wiek et al. (2011) and especially results from expert interviews conducted by the authors into consideration. The expert interviews were completed in 2021 with the general goal to develop a comprehensive and sound questionnaire for the student evaluation.

3.2.2. First Results

The analysis in this paper focuses on the question how strong the participation in the teaching format contributed to the fostering of the sustainability key competencies assessed by the students themselves (see above). First results are presented in Table 2.

Table 2. First empirical results

Competency	Average	Median	Frequency (number of students)				
			1[a]	2[b]	3[c]	4[d]	5[e]
Systems Thinking Competency	2.95	3	0	6	11	5	0
Anticipatory Competency	3.05	3	0	5	11	6	0
Normative Competency	3.18	3	0	5	9	7	1
Strategic Competency	3.32	3	0	5	7	8	2
Collaboration Competency	3.09	3	1	4	9	8	0
Critical Thinking Competency	2.91	3	0	7	10	5	0
Self-Awareness Competency	3.14	3	1	4	10	5	2
Integrated Problem-Solving Competency	3.05	3	0	5	11	6	0

[a] not at all, [b] slightly, [c] moderately, [d] very, [e] extremely

Source: Own analysis.

Students indicated on average a moderate contribution of their participation in the teaching format to the enhancement of all sustainability key competencies, which is underlined by the given median values (i.e. for all competencies a median value of 3). There were only two statements that attending the teaching format does not at all contributed to a key competency: one time in the case of the collaboration competency and one time in the case of the self-awareness competency. Overall, this suggests that the teaching format in general has a moderate but positive impact on all key competencies. Comparing the frequencies of statements respective the strength of the impact of the teaching format on the single sustainability competencies, some differences can be detected: A very high or extremely high impact of the teaching format was indicated by ten students for the strategic competency and by eight students for the normative and collaboration competency. Only five students believe that there was a high impact on the critical thinking and systems thinking competency and only six reported this impact for the integrated problem-solving and anticipatory competency.

4. Discussion and conclusion

The present paper aimed at discussing the impact of a teaching format that employs the Service Design methodology for solving sustainability-related real-life problems on the development of eight key competencies needed by "...individuals... to contribute to societal transformation towards sustainability" (Rieckmann, 2018, p. 42). The results of a students' self-assessment indicate - in overall terms - a moderate, but positive impact of the teaching format on all eight sustainability key competencies. This might be explained with characteristics of the Service Design process and its inherent use of active, collaborative and experiential learning approaches. Further investigation on potential drivers of competency development is necessary in order to further improve the effectiveness of the teaching format especially for those competencies for which the impact of the teaching format was less strongly evaluated. An important limitation of the presented study is the subjective nature of the empirical assessment of the teaching format's contribution to the sustainability key competencies: students evaluated by themselves whether taking part in the teaching format has contributed to foster their competencies. Although this approach yields important and interesting insights, it should be complemented by more objective evaluations (e.g. analysis of exam performance) to gain a comprehensive picture in terms of competency development.

Acknowledgement

The creation of these resources has been (partially) funded by the ERASMUS+ grant program of the European Union under grant no. **2019-1-DE01-KA203-005057**. Neither the European Commission nor the project´s national funding agency DAAD are responsible for the content or liable for any losses or damage resulting of the use of these resources.

References

Baartman, L. K., Bastiaens, T. J., Kirschner, P. A., & Van der Vleuten, C. P. (2007). Evaluating assessment quality in competence-based education: A qualitative comparison of two frameworks. *Educational Research Review*, *2*(2), 114-129. doi: https://doi.org/10.1016/j.edurev.2007.06.001.

Buchanan, R. (1992). Wicked problems in design thinking. *Design Issues*, *8*(2), 5-21.

Cebrián, G., Junyent, M., & Mulà, I. (2020). Competencies in education for sustainable development: Emerging teaching and research developments. *Sustainability*, *12*(2), 579. doi: https://doi.org/10.3390/su12020579.

Clatworthy, S. (2017). Service design thinking. In M. Lüders, T. W. Andreassen, S. Clatworthy & T. Hillstad (Eds.), *Innovating for trust* (pp. 167-182). Cheltenham: Edward Elgar Publishing. doi: https://doi.org/10.4337/9781785369483.00020.

Design Council (2020). *What Is the framework for innovation? Design Council's evolved Double Diamond*. Retrieved February 11, 2022, from https://www.designcouncil.org.uk/news-opinion/design-process-what-double-diamond

Earle, A. G., & Leyva-de la Hiz, D. I. (2021). The wicked problem of teaching about wicked problems: Design thinking and emerging technologies in sustainability education. *Management Learning*, *52*(5), 581-603. doi: 10.1177/1350507620974857.

Evans, T. L. (2019). Competencies and pedagogies for sustainability education: A roadmap for sustainability studies program development in colleges and universities. *Sustainability*, *11*(19), 5526. doi: https://doi.org/10.3390/su11195526.

Lozano, R., Barreiro-Gen, M., Lozano, F. J., & Sammalisto, K. (2019). Teaching sustainability in European higher education institutions: Assessing the connections between competences and pedagogical approaches. *Sustainability*, *11*(6), 1602. doi: https://doi.org/10.3390/su11061602.

Miller, M. E. (2015). *"How many service designers does it take to define Service Design?" Practical service design*. Retrieved February 11, 2022, from https://blog.practicalservicedesign.com

Molderez, I., & Fonseca, E. (2018). The efficacy of real-world experiences and service learning for fostering competences for sustainable development in higher education. *Journal of Cleaner Production*, *172*, 4397-4410. doi: https://doi.org/10.1016/j.jclepro.2017.04.062

Morelli, N., de Götzen, A., & Simeone, L. (2021). *Service design capabilities*. Cham: Springer.

Pimpa, N. (2019). Design thinking for sustainability in management education. In C. Tze Haw, C. Richardson & F. Johara (Eds.), *Business sustainability and innovation* (pp. 481-489). European Proceedings of Social and Behavioural Sciences, Vol. 65. Future Academy. doi: https://doi.org/10.15405/epsbs.2019.08.48.

Prendeville, S., & Bocken, N. (2017). Sustainable business models through service design. *Procedia Manufacturing, 8*, 292-299. doi: https://doi.org/10.1016/j.promfg.2017.02.037.

Redman, A., Wiek, A., & Barth, M. (2021). Current practice of assessing students' sustainability competencies: A review of tools. *Sustainability Science*, *16*(1), 117-135. doi: https://doi.org/10.1007/s11625-020-00855-1.

Rieckmann, M. (2018). Learning to transform the world: key competencies in education for sustainable development. In A. Leicht, J. Heiss & W. J. Byun (Eds.), *Issues and trends in education for sustainable development* (pp. 39-59). Paris: UNESCO.

Spady, W. G. (1994). *Outcome-based education: Critical issues and answers*. Arlington, VA: American Association of School Administrators.

United Nations Educational, Scientific and Cultural Organization (2017). *Education for sustainable development goals. Learning objectives*. Paris: UNESCO.

Wiek, A., Withycombe, L., & Redman, C. L. (2011). Key competencies in sustainability: a reference framework for academic program development. *Sustainability Science*, *6*, 203-218. doi: https://doi.org/10.1007/s11625-011-0132-6.

Yang, C.-F., & Sung, T.-J. (2016). Service design for social innovation through participatory action research. *International Journal of Design*, *10*(1), 21-36.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14526

Transform the learning journey in behavioral competency development programs to attain sustainable personal change

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Abstract

Behavioral competencies have become the most in-demand skills in the job market, due to their influence on efficacy and personal and organizational performance. Previous studies highlighted the need not only to involve students in programs that focus on the acquisition and improvement of their behavioral repertoire, but also to provide students with techniques to pursue continuous learning during their life span. The paper illustrates the case of an educational project implemented by an Italian University aiming to deliver innovative learning approaches for the development of behavioural competencies. The project encompasses different educational formats (courses, laboratories, seminars) based on interconnected theoretical frameworks, namely the whole person learning pedagogy, experiential learning theory, and the intentional change theory. The methodologies implemented and the outcomes attained in terms of participation, satisfaction, learning and employability of participants are discussed. Implications for instructors and future advancements are discussed.

Keywords: *behavioral competency development; emotional and social intelligence competencies; experiential learning theory; intentional change theory*

1. Introduction

This study illustrates the design and the implementation of an education project that aims to deliver innovative educational approaches for the development of behavioural competencies, which have become the most in-demand skills in the job market, due to their influence on individual and team superior performance across industries and jobs (Boyatzis, 2006; O'Boyle Jr. et al., 2011; Sala, Druskat, & Mount, 2005). A behavioral competence (also defined "emotional and social intelligence competencies", or "soft skills / life skills") is the set of underlying characteristics of a person that refers to the ability to recognize, understand and manage one's own emotions, and others' emotions, as well as analyze information and situations. These encompass self-awareness, self-management, social-awareness, relationship management and cognitive competencies (Boyatzis & Sala, 2004; Goleman, 1998). Not only these competencies demonstrate to be relevant antecedents for work-related outcomes, but they are also crucial for graduates' employability, as confirmed by recent international employers' surveys (e.g. LinkedIn, 2019; World Economic Forum, 2020). These skills are expected to increase in relevance in the future, especially in the face of automation and artificial intelligence, which are progressively replacing routine tasks and jobs. However, despite the recognized relevance of behavioural competencies in the organizational context, both the literature and the labour market have frequently emphasized the existence of a skills gap (Jackson, 2009; QS Intelligence Unit, 2019).

Considering that behavioral competencies are becoming crucial for the future of work (McKinsey&Company, 2021), we address the following research question: How can higher education institutions integrate in their curricula the development of students' behavioral competencies? Even though, during the last decades, European higher education institutions have promoted initiatives in this field, they seem to have some limitations. First, they aim to develop only one or a limited number of competencies, such as teamwork or leadership, instead of providing students with a methodology for becoming aware of their overall portfolio of competencies and promote its development coherently with their future career objectives. Second, they effectively engage students during the classroom activity, but rarely pursue a long-lasting change in their behaviour. Lastly, these courses are often provided only in management curricula. However, research has shown that behavioural competencies are crucial skills in every job and every sector, thus their development does not pertain only to specific disciplinary areas.

Against this backdrop, an Italian Academic Research Centre of a Public University, established in 2012, implemented a project which has addressed the need to involve students belonging to different educational fields in a programme that focuses on the improvement of their behavioural repertoire. This is achieved by providing them with the methodology and the related pedagogical techniques needed to pursue a long-lasting and continuous learning. The next sections will describe in detail the theoretical framework on which the educational

project is built and the structure of the project. Then, we present the method adopted to analyze the impact of the project, and we provide a discussion of the outcomes attained.

2. Theoretical background

The educational project was designed relying on interconnected theoretical frameworks, namely the whole person learning pedagogy (Rogers, 1980), experiential learning theory (Kolb, 1984), and the intentional change theory (ICT) (Boyatzis, 2006). The engagement of the whole person in education has been described as the essence of experiential learning in developing behavioural skills (Hoover, 2010). Similarly, experiential learning theory claims that learning is a holistic process in which the person adapts to the world through the integrated functioning of the person's thinking, feeling, perceiving, behaving, and interacting with the environment (Kolb, 1984). Bridging the two aforementioned pedagogical approaches, the ICT (Boyatzis 2006) has proposed a learning process which consists of five phases that help the individual acquire awareness of the need to change and improve his behavioural repertoire. The first phase concerns a reflection on one's ideal self, which is one's desired future and leads to the development of a personal vision. The second step refers to the identification of the individual's current behaviours and abilities (real self). Participants carry out a 360-degree assessment of their competencies, which fosters the awareness of their current competency portfolio and enables the comparison between their ideal and real self. In the third phase people are encouraged to draft their personal learning plan, choosing behavioural competencies as learning goals and identifying concrete actions to practice. The fourth stage involves individuals in the experimentation of the concrete actions in real-life contexts. The last phase is focused on identifying and building trusted relationships that support and encourage each step in the change process.

In addition, the project relies on reflective learning, which facilitates the process of analysing the experience and converting it into learning, through the construction of meaning (Boud et al., 1985). This is promoted through self-reflection activities like journaling and peer coaching. Journaling consists of a retrospective narrative of experiences from which thoughts, feelings, actions and outcomes arise (Jefferson et al., 2014). Journaling facilitates the individuals in giving a structure to their experience in practicing new behaviors, searching for the deeper meanings of the events. It also provides a safe environment for examining the situations from multiple perspectives, become aware of the mistakes, understand if and how the behaviors manifested require to be changed in the future and progressively gauge the progress they are making coherently with their learning plan. Peer coaching is a confidential process by which two peers work together to reflect on current practices, expand, refine and build new skills, share ideas, and teach each other (Robbins, 1991). Coaching is intrinsically a reflection effort, as coaches can ask questions that spur the peer's critical reflection (Robertson, 2005).

3. Educational program

This project encompasses different educational formats (courses, laboratories and seminars) that allow students to tailor their training experience coherently with their learning objectives. As personal motivation represents a prerequisite for attaining effective learning outcomes, all the proposed activities are elective. Students can include the activities in their study plan and earn extra university credits (except for the seminars). All activities provide Open Badges that certify the competencies learned by students.

3.1. Courses

Emotional Competencies and Individual Development. It is a course (30 hours plus assignments; 6 university credits) that leads the participants to acquire a methodology to develop behavioural competencies in accordance with their career goals.

Leadership. Through this course (30 hours plus assignments; 6 university credits) students become aware of the different leadership styles that can be adopted to build a resonant relationship with the followers. They also have the opportunity to assess their personal leadership styles, craft an individual leadership development plan and apply in real-life contexts the learned techniques to improve their behaviours.

3.2. Laboratories

Competency Lab. It is a cycle of four interactive lectures (15 hours plus assignments; 3 university credits), whose aim is to increase participants' awareness of the behavioural competencies needed to achieve their professional goals and improve their competitiveness on the labour market, also through conversations with labour market operators. During each academic year, four identical editions of the Lab are offered to students.

3.3. Seminars

Pills of Competencies. The students who attend the "Competency Lab" or the course "Emotional Competencies and Individual Development", are allowed to attend some interactive seminars aimed at nurturing specific competencies. During the year, the following pills are delivered: empathy, adaptability, persuasion, stress management and self-control, achievement orientation, team working, communication, and negotiation. Each pill is delivered in two seminars each lasting 3,5 hours plus assignments.

An *ad hoc* online platform has been developed to accompany students along the training activities, making available a set of tools (questionnaires, personal reflection exercises, 360-degree evaluations). It offers a plethora of exercises and supporting materials that can be accessed during the didactic activities and from which students can monitor their own advancement. The exercises proposed in the platform have been personalized for the specific

target starting from the work of Goleman et al. (2002), and follow the aforementioned steps of the ICT.

Reflection activities are also proposed and scheduled. As for journaling, the instructors deliver a template for the journal in which students are asked to describe in detail their practice of new behaviours, their successes and difficulties. As for peer coaching, the instructors train the students illustrating the role of the coach and of the coachee, and offer some examples of reflective questions to use during the session. After the session students are asked to fill in a form in which they report the benefits attained from the peer coaching session and the difficulties they faced.

Students are stimulated, after the in-class activities, to continue to practice the new behaviours in different contexts, to write their journal and to carry out peer-coaching sessions. From 3 to 6 months after the in-class activities a follow-up session is organized, with the aim to make the students share their experience of practicing and experimenting the learning of behavioural competencies according to a cross-fertilization approach, and to discuss the successes they experienced and how they faced possible difficulties. Table 1 illustrates for each educational format implemented in the project the learning techniques adopted.

Table 1. Learning techniques of the project's offerings

	Ideal Self	**Real Self**	**Plan**	**Experimentation**	**Trust relationships**	**Journaling**	**Peer coaching**
Emotional Competencies and Individual Developm.	x	x	x	x	x	x	x
Leadership		x	x	x	x	x	x
Competency lab	x	x			x		
Pills of competencies				x		x	x

4. Method and results

The impact of the project has been measured considering: i) the level of participation; ii) the level of satisfaction of the participants, iii) their perception on the learning outcomes attained iv) the impact of the project on students' employability.

Since the starting of the educational project in 2013, the number of applications have steadily increased. In June 2021 the project reached a total of 2,908 participants, enrolled in master's degree courses of the University.

At the end of the activities, students are asked to express their level of satisfaction and their perception on the level of learning outcomes on a scale 1-7. Data show that 82.35% of students, involved from 2013 and 2021, indicated that the learning program satisfied their expectations completely or at high level (equal or higher than 6). Concerning the ideal self, 88.79% of the graduates found the self-reflection exercises useful for pondering their desired future. The findings also highlight the effectiveness of the personal vision in supporting students. The activities related to the real self allowed students to understand their level of manifestation of behavioural competencies (87.32% students selected the 6 and 7 response) and to identify those competencies they needed to develop. Not significant difference emerged among different cohorts and students in disciplinary areas. Periodically a survey is sent to gather information on students' capacity to successfully enter the labour market considering both their subjective and objective employability. Subjective employability (SE) is assessed through four items adapted from De Cuyper et al. (2014) on a 1-5 scale. Objective employability (OE) is assessed through the number of job offers received after the end of the educational programs that are coherent with their idea of future career. The results, summarized in Table 2, underlined that who benefited most from writing their personal vision were those that showed a higher perceived employability. Both subjective and objective employability were positively correlated with the ability of the students to identify in their learning plan the set of competencies to be developed.

Table 2. Descriptive statistics and correlations

	Mean	**SD**	**Ideal self**	**Personal vision**	**Real self**	**Learning plan**	**SE**
Ideal Self	6.38	0.75					
Personal vision	6.20	0.95	0.73**				
Real self	6.37	0.78	0.44**	0.50**			
Learning plan	6.19	0.98	0.46**	0.55**	0.68**		
SE	4.64	1.48	0.09	0.17*	0.12	0.18*	
OE	2.35	2.71	-0.06	0.11	0.04	0.20*	0.37**

***p-value < 0.001, **p-value < 0.01, *p-value < 0.05

5. Implications

The project has refined the methodological approach of Intentional Change Theory (ICT) and Experiential Learning Theory (Boyatzis, 2006; Kolb, 1984) and the studies on the behavioural approach of emotional intelligence (Goleman et al., 2002) in different ways. First, the project has advanced the aforementioned frameworks from a pedagogical point of

view, designing educational programs for students attending courses in different disciplinary areas. Second, the project has provided evidence on how behavioural competency development can be introduced in the academic curricula by means of various educational formats (courses, seminars and laboratories). Extant management educational literature has mainly proposed the implementation of courses, neglecting the opportunity to rely on alternative didactic activities that can be delivered several times during an academic year attracting more participants than traditional courses. Moreover, it has demonstrated how in-class lectures and experiential approaches complement each other in favouring self-reflection and action learning. Finally, the project also shows that individual and social experiential approaches like self-reflection, peer coaching, journaling, actual experimentation, and group conversations, can be effectively proposed not only for practicing specific competencies but also to direct the personal learning process toward the definition of the competencies an individual wishes to learn.

Limitations of the current design of the program offer directions for advancing the project. First, the study does not evaluate the effectiveness of the project in terms of change in the level of possession of students' competencies. Future research should address this issue implementing a quasi experimental design aiming to compare course and control group students through a pre- and post competency assessment. Second, the program currently targets Master's degree students, but instructors can evaluate the opportunity to tailor the didactic offerings to bachelor students' training needs. Furthermore, the impact of the specific techniques (peer coaching, journaling etc.) on the learning outcomes could be further explored. Finally, from the methodological point of view, the integration of digital learning technologies can represent an opportunity for increasing learner's engagement and motivation over time. For instance, the translation of the methods and techniques adopted in the program into a digital app could provide a learning experience based on gamification, guiding the individuals in their competency development in the long-term, overcoming the honeymoon effect that compromises the individual continuous improvement once the training activity is over.

References

Boud, D., Keogh, R., & Walker, D. (1985). What is reflection in learning? In D. Boud, R. Keogh, & D. Walker (Eds), *Reflection: Turning experience into learning*. London: Kogan Page, 7-17.

Boyatzis, R. E. (2006). An overview of intentional change from a complexity perspective. *Journal of Management Development*, 25(7), 607–623.

Boyatzis, R., & Sala, F. (2004). The Emotional Competence Inventory (ECI). In G. Geher (Ed), *Measuring Emotional Intelligence*, 147–180. Hauppauge, NY: Nova Science Publishers Inc.

De Cuyper, N., C. Sulea, K. Philippaers, G. Fischmann, D. Iliescu, & De Witte, H. (2014). Perceived Employability and Performance: Moderation by Felt Job Insecurity. *Personnel Review*, 43 (4), 536–552.

Goleman, D. (1998). *Working with emotional intelligence*, Bantam Books, New York, NY.

Goleman, D., Boyatzis, R., & McKee, A. (2002). *Primal leadership: Realizing the power of emotional intelligence*. Cambridge, MA: Harvard Business School Press.

Hoover, J.D., Giambatista, R.C., Sorenson, R.L., & Bommer, W.H. (2010). Assessing the Effectiveness of Whole Person Learning Pedagogy in Skill Acquisition. *Academy of Management Learning and Education,* 9 (2), 192-203.

Jackson, D. (2009). An international profile of industry-relevant competencies and skill gaps in modern graduates. *International Journal of Management Education*, 8 (3), 29-58.

Jefferson J.K., Martin, I.H., & Owens, J. (2014). Leader development through reading a reflection. *Journal of Leadership Studies*, 8(2), 67-75. Kolb, D.A. (1984). *Experiential learning: experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice Hall.

LinkedIn (2019) Global Talent Trends. The 3 trends transforming your workplace. Retrieved from https://business.linkedin.com/content/dam/me/business/en-us/talent-solutions/resources/pdfs/global_talent_trends_2019_emea.pdf

McKinsey&Company (2021). *Defining the skills citizens will need in the future world of work*. https://www.mckinsey.com/industries/public-and-social-sector/our-insights/defining-the-skills-citizens-will-need-in-the-future-world-of-work#

O'Boyle Jr., E.H.; Humphrey, R.H., Pollack, J.M., Hawver, T.H., & Story, P.A. (2011). The relation between emotional intelligence and job performance: A meta-analysis. *Journal of Organizational Behavior*, 32(5), 788-818.

QS Intelligence Unit (2019) The global skills gap in the 21st century. Retrieved from https://www.qs.com/portfolio-items/the-global-skills-gap-in-the-21st-century

Robbins, P. (1991). How To Plan and Implement a Peer Coaching Program. Association for Supervision and Curriculum Development.

Robertson, J. (2009). Coaching leadership learning through partnership. *School Leadership & Management*, 29(1), 39-49.

Rogers, C. R. (1980) *A way of being*. New York, Houghton Mifflin.

Sala, F., Druskat, V. U., & Mount, G. (Eds.). (2005). *Linking emotional intelligence and performance at work: Current research evidence with individuals and groups*. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

World Economic Forum (2020). *These are the top 10 job skills of tomorrow – and how long it takes to learn them*. https://www.weforum.org/agenda/2020/10/top-10-work-skills-of-tomorrow-how-long-it-takes-to-learn-them/

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14555

Let Others Shine: Key Competencies in European Research Infrastructures and Core Facilities

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Abstract

Research Infrastructures and Core Facilities belong to the First Pillar "Excellence in Science" of the European funding schemes, making them a key compentent in research education. Therefore, the European Commission aims to establish a European School for RI management and to develop pan-European curricula. Accordingly, RI:TRAINplus persues to develop evidence-based recommendations for key competencies to be enhanced. We applied a mixed-method approach, combining a quantitative online-survey among 330 members of Research Infrastructures and Core Facilities with 17 qualitative guided interviews among managers from eight structurally selected countries. The results of both sub-studies can be grouped into three overarching categories of required competencies: communication skills on different levels, organisational leadership & staff management, and academic excellence & deeper knowledge of the respective field of science. To ensure future success of RIs and CFs this needs to be an integral part in the field of scientific and research education.

Keywords: *European Research Infrastructures; Key Competencies; Curricula Development; Mixed-method Approach; Scientific and Research Education.*

1. Introduction

Research Infrastructures (RIs) and their services are a vital element for the realisation of the *European Union* as a knowledge-based society. Together with *Core Facilities* (CFs) – existing in many universities, academic research centres and national nodes of decentralised *RIs – RIs* are standing pillars for excellence in science. *RIs* and *CFs* are also at the core of the development of the Open Science, Open Education and Open Innovation strategy, and a major factor if those should succeed. Therefore, their establishment and ongoing work is a significant achievement for European research landscape, developing initiatives, practices, shared facilities, common guidelines, and standards that make it possible for European research to thrive. However, the inter-relationships of *RIs* and *CFs* in the same science domain and across domains, as well as the need to align to and contribute to the *FAIR – Findability, Accessibility, Interoperability, and Reuse* of digital assets – approach, to the *EOSC – European Open Science Cloud*, to equal opportunities (including gender balance and diversity) regarding open science policy, highlight a complex field, that often goes beyond the traditional venues of academic and scientific training.

Consequently we are asking in this contribution what competencies and skills are needed to run modern RIs and CFs? And this will be followed up by the question if and how they may be included in curricula.

Understanding academia, and *RIs* and *CFs* as part it, as field in the Bourdiean (1998) sense, with competing and interrelated interestests and struggles, we used a multi-method set-up to gain data on this question. Our aim is to identify what needs to be included in a proper, sustainable educational and training programme. It should serve the purpose to prepare students and professionals for the work in *RIs* and *CF*, and it should be integrally embedded into the broader framework of science and research education. Accordingly, an aim of RI:TRAINplus is to "create a foundation for the long-term provision of highly qualified personnel for managing research infrastructures, core facilities and other complex scientific operations in academia and industry" (RI:TRAINplus, 2022). With the final goal to the establish a European School for RI management: "The idea is to give students the opportunity to broaden their existing study programmes in order to prepare them for different managerial tasks in Research Infrastructures. The ultimate goal is to set up a European School for RI management" (Marialuisa Lavitrano – Project lead of RI:TRAINplus).

2. Methodology

In order to create an evidence-based data basis for this undertaking, we developed and implemented an "equally mixed-methods" (Morse, 1991) approach. Our aim was to have a "Convergent Mixed Methods Design" (Creswell & Creswell, 2018, p. 217), which benefits from the equal combination of a qualitative guideline survey among heads and leading

managers of *RIs* and *CFs* with a quantitative online questionnaire, which is also addressed to all employees of these institutions (QUAL X QUANT).

2.1. Qualitative substudy

Our qualitative interview study was in field from October 11, 2021, to January 26, 2022. Based on a multi-level selection procedure conducted as a purposeful sampling (see Rapley, 2004, p. 56) we identified 17 key stakeholder in the European research landscape as "information-rich cases" (Patton, 2002, p. 230; h.i.o.), which are defined as cases "from which one can learn a great deal about issues of central importance to the purpose of inquiry". They are managing RIs and CFs in eight countries (Austria, Bulgaria, France, Italy, Spain, Sweden, Switzerland, United Kingdom) which represent the four regions Eastern Europe, Northern Europe, Southern Europe, and Western Europe in accordance to the United Nations Statistics Division (2021).

The guideline comprises four coordinated parts (Science and Research in Europe, Managing a Research Infrastructure or Core Facility, Requirements for Scientific Staff, and Individual Perspectives). It is built on three pillars, the findings of the previous RI:TRAIN project, a literature review (Bourdieu, 1977; Bourdieu, 1989; Bettinger & Hugger, 2020; Schatzki, 2002; Oswald, Gaventa & Leach, 2016), and collaborative discussion rounds among the extended research group. This was followed by several rounds of evaluation and a pretest. For the analysis, a two-stage qualitative content analysis was carried out in the form of focused and contextual analysis (e.g. Paus-Hasebrink & Sinner, 2021, p. 38), based on inductive and deductive coding. MAXQDA 2020 software was used to support the analysis.

2.2. Quantitative substudy

The accompanying quantitative online survey was in field from November 17 to December 24, 2021, resulting in a field period of 37 days. Originally the field phase was planned to last for 30 days, however, based on feedback during this time we extended the time provided to complete the survey. The target population was defined as employees that work in European Research Infrastructure, and in particular the *ESFRI* landmarks and projects. The complete list contains 493 entries covering all of Europe. To contact the individuals a multi-step procedure was used. Firstly, all the defined landmarks and projects were contacted on November 17 via e-mail, sent from the online-survey platform *SOSCI*-Survey. Two reminder waves, distributed directly via e-mail sent from the personal account of an involved researcher, followed between December 2 and December 15 (in accordance with individual out of office notes). Christmas greetings were sent to all contacts on December 20, together with a thank you for their active participation and a final reminder that the questionnaire is still online until December 24. Additionally the coordinators of RI:TRAINplus spread the information that the survey is online. Doing so, the population could be defined and

strategically contacted. This approach made it possible to track and cover who accessed the questionnaire, completion rate and potential methodological issues. Overall, there have been no issues that could be identified. The questionnaire was accessed 1584 times over the course of the field period and 330 useable datasets were generated. Accordingly, we have an efficient translation rate of interview attempt to interview of 21%. Of those 330 more than 70% (235) had no missing values, the rest of the participants skipped some questions, but provided enough data to be included in the analysis.

On a substantive level the questionnaire tracked job details, including position and current tasks, demographic and academic backgrounds, and attitudes towards scientific work as a whole. Examples for specific questions and answers can be found in section 3.1.

3. Results

The results of the evaluation clearly show how diverse and varied *RIs* and *CFs* are. These differences must be considered for the development of curricula, but also for future policy strategies and funding programmes for *RIs* and *CFs* even more than before. In this context, not only the different academic disciplines, such as natural sciences, social sciences, or humanities, play a central role. According to their thematic orientation, the *ESFRI* Roadmap (2021, p. 18) assignes them to the six categories *Computing & Digital Research Infrastructures, Energy, Environment, Health & Food, Physical Sciences & Engeneering,* and *Social & Cultural Innovation*. Those, of course, have a great influence on what the requirements and needs of the organisations are, as they play a special role in the European research landscape. The specific character of the respective RIs and CFs must be taken into account when it comes to their support as well as their infrastructural and personnel resources. We can deduce three different types of organisation with a view to their main task: **Data-generating organisations**, **data-providing organisations**, and **hybrid organisations**.

3.1. Quantitative Results

Although the topic area is still controversial and must continue to be discussed in the future, the evaluation of both part-studies gives broad and deep insight into which key competencies and skills good leaders and managers in RIs and CFs should have, that consequently need to be developed and deepened in the corresponding modules of the curricula. Looking at select quantitative results (for further results see also figure 1), we can distill the following three categories:

- **Communication and engagement:** Here the interpersonal skills and how to talk and communicate with different groups can be highlighted.

- **Leadership and staff management:** Develop and manage structures for leading teams and what is necessary to do so in a strong and decisive way. Here regional and organisational structures need to be reflected on.
- And **positioning in the scientific community:** Most importantly based on how to do empirical and technical work, but also when it comes to writing and preparing communication for the scientific communities, both in the form of publications as well as grant proposals.

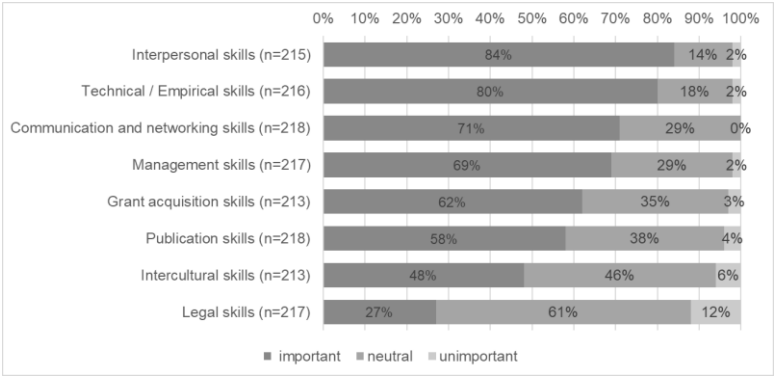

Figure 1. Skills needed to succeed in an RI / Manage an RI.
Q: How important are the followings skills to your work – A: 1 very important to 7 not important at all. Grouping in figure: 1 to 2 is "important"; 3 to 5 is "neutral"; 6 to 7 is "unimportant". Source: RI:TRAINplus survey (2021).

In order to broaden the view and to improve the evidence base, but also to ensure a link with the qualitative survey, we gave participants the opportunity to provide open answers on key competencies and skills of good heads and managers as well. Therefore, we added the open question "Please specify in which other sections managers of RIs or CFs should be trained" to the quantitative survey. The results of the evaluation correspond well with the results of the structured answers. The most frequently mentioned competencies are in the broad field of **employee management**: More **organisational aspects** as "human resource management", "dealing with personnel", and "staff management" on the one hand, and more **team internal aspects** as "leadership", "staff motivation", "team management and development", and "conflict management" on the other hand. A second block of answers can be summarised as **organisational leadership and positioning**, including aspects as "law and legal aspects", "relevant legislation and licensing", "ethics" and "science policy and politics", but also "compliance", "strategic thinking", and "communication". This was of a special interest, as some of those were not seen as common in the more structured answers. A third block is dedicated to answers related to **scientific and technical work, against the background of the RI's or CF's field of activity**: "Acquiring new technical skills", "grant application for

CF", "learn innovative technologies", and "technical info about instrument maintenance, methodology".

3.2. Qualitative Results

The evaluation of the quantitative data allows a clear classification. The combination with the results of the qualitative evaluation gives a proof and makes it possible to record the depth and breadth of the required competencies and skills. While the qualitative responses on desired qualifications for heads and managers of RIs and CFs are diverse, their thrust nevertheless complements well with the findings of the quantitative study. Here we can deduce four key competencies: **Academic excellence & broad and deep academic understanding for the field.** This includes interdisciplinary concerns, developments, and tasks. **Project management & organisation management.** This includes good leadership skills, supporting employees and giving them a high amount of freedom, team building, collaborative work, and modesty. **Deeper knowledge about the field of science and research in Europe.** This includes political and strategic developments, the variety of different funding schemes, opportunities for cooperation between different organisations, and strategical long-term acting. And **Communication skills on different levels.** This includes internal communication (with all staff members), communication with experts (scientists), and communication with external groups and stakeholders (politics, economy, society, technical partners, funding bodies).

Correspondingly, there are also statements from the qualitative study on which skills and qualifications the employees in RIs and CFs should have. Those must also be developed and deepened in the corresponding modules of a curriculum, because heads and leading managers of RIs and CFs are in charge to select, to challenge, and to encourage their staff: **Academic excellence – based on academic education and professional experiences.** This includes qualitative and quantitative methods, and work with data, but also contacts with (former) colleagues and the ability to be perceived and recognised as an insider in the field. **Flexibility and curiosity.** This includes working in international settings, collaborative teamwork, interaction with (technical) partners, and the integration into (specific) scientific communities with special needs and attitudes. **Interdisciplinarity.** This includes the cooperation with and understanding of different disciplines, but also the ability to take a broad view of science and society as a whole. **Communication skills on different levels.** This includes being fluent in English, charismatic appearance, presentation skills, visualising skills, and writing skills in different contexts (proposal, paper, websites, social media etc.). And **Service orientation and support**. This includes diplomatic work, dealing with difficult clients, and the ability to personally step back and enable the research of others ("let others shine").

3.3 A Qualitative Review concerning the Implementation of pan-European Curricula

With a view to developing specific curricula and establishing a European School of RI Management, we can offer evidence-based proposals for key competencies and skills. However, it should be noted that the development and introduction of such pan-European curricula for RIs and CFs is meeting with divided response. Such a step is perceived as an intervention in academic self-administration, while the local organisation is seen as having high competence for the further development of team members. Only a few interviewees reject common curricula on principle. Arguments against are duplication of strategies, excessive bureaucracy, and European over-regulation. It is also critically questioned whether the time is already ripe for this and whether there are not more urgent challenges at the moment. However, many also favour the introduction of common curricula. In some cases, major developments are associated with this, up to and including full Master's courses and even dedicated Ph.D. programmes for Research Infrastructures and Core Facilities. However, a central problem perceived by all interviewees is the huge diversity of different RIs and CFs, and associated with this the diversity of different areas of activity and training needs. It is critically questioned how the diverse and individual needs can be brought together in common modules without these remaining too superficial in terms of content. Another point of criticism, raised by proponents in particular, concerns time resources and workload as well as financial issues. It is not yet clear to the persons interviewed how the programmes and their implementation are to be financed. Furthermore, they are sceptical about how additional courses can be completed in the already tight working hours. Regarding labour law issues, the problem of fixed-term employment contracts is also critically addressed. On the one hand, these employees lack the time and security to complete training programmes. On the other hand, the heads of the institutions fear that they will quickly lose newly trained staff due to fixed-term contracts.

4. Outlook

The development of common curricula and the establishment of a *European School for RI Management* still requires a lot of work and will likely generate controversial discussions. Especially as the high heterogeneity of the field puts a lot of – sometimes highly contradictionary – demands on the indviduals actors, this can also be seen in the fact that most of the expected educational content, is at a very high abstraction level. This highlights that the field at the moment is still gestalting and finding a from on the demands issues towards it. How people interact, how people communicate and how RIs and CFs have to be positioned in the academic landscape and holding on to traditional values like scientific excellence makes it clear that the field is both tied to the academic field on the one hand, while on the other it is currently struggling to find an own position in regards to traditional

boundaries of the field. A curriculum and formalisation would provide the chance to enrich and design this process.

In this regards a lot of convincing will have to be done to reach previously sceptical members of the community and to win them over to the joint project that puts the education for the work on *RIs* and *CFs* at the forefront. This process will have to go hand in hand with further empirical work. The strong involvement of the interviewees and their partly very comprehensive reflections on the question raised also show their enthusiasm for this joint project and their willingness to actively participate in it – they are hoping that science and research education in the future will include the needs and demands of *RIs* and *CFs*. A key element for success will be to continue to take a communicative and integrative approach. All parties involved must be included and there must be continuous opportunities for participation to make one's voice heard. This concerns both, the structural decisions on the curricula and the specific content of the modules. It is important to take into account the diversity of organisations as well as the diversity of areas of activity and needs. A convincing argument in this context will be a free choice of specific courses in order to be able to put together programmes that are as individual as possible. Furthermore, national contexts and difference of the countries involved (Kohn, 1989, p. 20-21) will need to be taken into account.

References

Bettinger, P., & Hugger, K.-U. (2020). Praxistheorien in der Medienpädagogik – Einleitung. In P. Bettinger & K.-U. Hugger (eds.), *Praxistheorien in der Medienpädagogik* (pp. 1-18). Wiesbaden: Springer VS.

Bourdieu, P. (1977). *Outline of a Theory of Practice*. New York, NY: Cambridge University Press.

Bourdieu, P. (1989). Social Space and Symbolic Power. *Sociological Theory, 7*(1), 14-25.

Bourdieu, P. (1998). *Homo academicus*. Standord, CA: Stanford University Press.

ESFRI. (2021). *Roadmap 2021. Strategy Report on Research Infrastructures*. Retrieved January 31, 2022, from https://roadmap2021.esfri.eu/

European Commission. (2021). *Horizon Europe. Excellence Science.* Retrieved January 31, 2022, from https://ec.europa.eu/programmes/horizon2020/en/h2020-section/excellent-science

Creswell, J. W., & Creswell, J. D. (2018). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (5th Edition). Los Angeles, CA: Sage.

Kohn, M. L. (1989). Introduction. In M. L. Kohn (ed.), *Cross-national research in sociology* (pp. 17-31). Newbury Park, CA: Sage.

Morse, J. M. (1991). Approaches to qualitative-quantitative methodological triangulation. *Nursing Research, 40*(2), 120-123.

Oswald, K., Gaventa, J., & Leach, M. (2016). Introduction: Interrogating Engaged Excellence in Research. *IDS Bulletin, 47*(6). doi:10.19088/1968-2016.196

RI:TRAINplus (2022). *Home*. Retrieved April 25, 2022, from https://ritrainplus.eu/

Schatzki, T. R. (2002). The Site of the Social. A Philosophical Account of the Constitution of Social Life and Change. University Park, PA: The Pennsylvania State University Press.

United Nations Statistics Division. (2021). *Geographic Region.* Retrieved January 31, 2022, from https://unstats.un.org/unsd/methodology/m49/

Paus-Hasebrink, I., & Sinner, P. (2021). *15 Jahre Panelstudie zur (Medien-) Sozialisation*. Baden Baden, Germany: Nomos Verlag.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14476

Critical Thinking in Information Literacy Pedagogical Strategies: new dynamics for Higher Education throughout librarians' vision

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Abstract

This work explores the articulation of Information Literacy and Critical Thinking, throughout a preliminary study on the pedagogical strategies used by academic librarians in lecturing information literacy courses. A theoretical reflection is presented about students' skills in Information Literacy, enhanced by Critical Thinking, to acquire the ability to move autonomously in printed and digital information environments, based on their reflective thinking, to transform information into new knowledge. The study aims to compare information literacy pedagogical practices in different subject areas. As such, psychology, education, and health sciences were the ecosystems in which the strategies were explored and applied to analyze common approaches, and ultimately detect and share good practices for pedagogical improvements. The present work results from a qualitative study, based on the interviews regarding the vision of three academic librarians, framed by seven major parameters: metacognition, reflection, analysis, evaluation, inference, and use, as well as dispositions, applied to information management. The objective was to evaluate what kind of strategies were adopted by each librarian and if the pedagogical practices are effective in fulfilling the learning objectives. Overall, all three librarians agreed that libraries have an important role in promoting critical thinking in higher education students.

Keywords: *Information Literacy; Critical Thinking; Higher Education, Academic Skills.*

1. Introduction

Currently, academic students mobilize numerous information resources on which to base their academic work. However, the excess of information has become an obstacle to its good use, since it causes noise in the tasks of searching, using, and communicating information in academic goals fulfillment. Therefore, knowing how to collect, assess and select information is increasingly significant for studying, and for obtaining a master's or doctoral degree. In these academic years, the best choices in information resources provide a more solid basis for theoretical and methodological support. The investigation required is no more than iterative research and will depend only on a process of trial and error, as well on increasingly complex questions that arise from this process, and whose answers develop new questions or lines of knowledge in any subject (ACRL, 2016). This is the context of an intersection that converges and frames the concepts of information literacy [IL] and critical thinking [CT]. How can students benefit from librarians' support? These professionals are already helping in the acquisition of IL, through specific training in this area. Therefore, it is important to ask what pedagogical strategies are used, aligned with CT principles, for this purpose.

2. Information Literacy and Critical Thinking

The mission of higher education has been associated with the transmission and production of knowledge, requiring skills that go beyond knowing curricular contents, focusing on a set of transversal processes essential to academic success and effective integration and performance in several disciplinary areas. It is crucial to have the ability to adapt to new contexts, to know academic institutions, and the services they offer, to have the capacity for personal organization, the ability to communicate, the skills to work in a team and solve problems, as well as to adopt ethically appropriate conduct (Garrido and Prada, 2016), in synthesis, to develop transversal academic skills. Byrnes and Bernacki (2013) explain the importance of adequate informational behavior in the lives of citizens to understand how to research, interpret and use information. The exercise of full citizenship, achieved through the empowerment of the learner and through the mobilization of theoretical and practical knowledge learned, is also an underlying intention of these training (Tett, Hamilton, & Crowther, 2012). Understanding cognitive aspects, particularly information-related, can help librarians prepare their actions in the field of IL (Reece, 2005). These aspects explain how the mind acquires, modifies, or manipulates knowledge in different contexts. There are three aspects that condition, restrict, or direct the performance of mental processes and behaviors: knowledge, processing capacity, and affective orientation. Research in information behavior helps theorize IL in explaining and interacting with cognitive processes, behaviors, and feelings, and together they enable the individual in information skills (Hepworth & Walton, 2013). IL can be seen as a professional construct to provide skills and competencies that

model informational behavior. In this sense, supporting intellectual development is a priority, so that the student has the skills and competencies to deal with both academic and professional contexts successfully. The learning process includes facets, dispositions, and the development of complementary attitudes (Hepworth & Walton, 2013). They are organized around sequential, and logical steps, supported by a reflective predisposition about learning, that starts from simple to complex, and "partial tasks support complex learning and the increasing complexity of tasks corresponds to a gradual decrease in teacher guidance and support so that at the end of the process students are autonomous and proficient" in the skills worked (Cruz et al., 2016, p. 237). Thus, it is possible to associate in detail, the various stages of CT to the conceptual frameworks proposed by ACRL (2016) that structure IL teaching (Table 1).

Table 1. Problem Solving Steps / Conceptual Frames for Information Literacy

Critical Thinking Phases	Information Literacy Conceptual Frames
Understanding the problem – It is necessary to understand the operationalization and design problems to be solved (what is known, what hypotheses already exist, is it possible to test?).	**1. Authority is constructed and contextual** – The need to keep an open mind, be aware of critically evaluating the content, and recognize that there are necessarily problems with the traditional notion of information authority. **2. Information creation as a process** – Critical analysis and evidence search.
Developing a plan – Finding a link between the empirical hypothesis and current knowledge gaps (are there any ideas, projects, or similar?; Is it possible to arrive at a hypothesis that is easy to test?; Can a solution be designed?)	**3. Information has value** – Information can be approved by economic and political research and can be bought and sold. May appear free, but not be. Willingness for personal resources to keep up to date. **5. Scholarship as Conversation** – Academic activity occurs at several levels, the appreciation of the content that emanates from the user, and the understanding that the responsibility for academic creating depends on the contribution of various mechanisms and other types of participation in science.
Assessing and using the results – Examine the design obtained (can we simulate the result? Can we use the data to test other hypotheses? Can we validate the initial hypothesis?)	**4. Research as Inquiry** – Persistence, adaptability and flexibility, the practice of CT, and the recognition that learning and discovery are error-based processes. **6. Searching as Strategic Exploration** – Persistence, adaptability, and flexibility, recognizing the value of navigation and information retrieval methods, understanding that the first research attempts do not always work.

Source: Adaptation from ACRL (2016) and L. Garcia-Marques e T. Garcia-Marques (2016).

It becomes clear that both IL and CT constructs influence also both learning and research strategies. Byrnes and Bernacki (2013) argue that individuals seek information because it helps them to fulfill a goal. Aspects like knowledge, processing ability, and values, change

with age, and these changes lead to differences in the type of information searched, and in the way information is interpreted and used. To know the cognitive characteristics that mold library users' can help information professionals be more effective in the training offered. Using it in a meaningful way, whether in a library context or for personal purposes, is always contextual and disciplinary. The dispositions and attitudes that go along the teaching-learning process must focus on students' preferences regarding how they learn. In the current debate, IL is already recognized as crucial to empower individuals through CT skills development, providing them with the conceptual tools necessary to face the challenges of a more complex and rapidly changing information world (Vezzosi, 2004; Willingham, 2019).

3. Methods

We selected a convenience sample of respondents representing different disciplinary areas. Selected participants are academic librarians from Education, Psychology, and Health Sciences areas. The set of three interviewees corresponds to one male and two female higher education professionals, aged between 46 and 59 years old, with more than ten years of teaching experience. As a qualitative approach, an exploratory interview-based methodology was selected for this study, to open up the possibilities of expression, which are consistent with the object of study, and also because of interviewees' experiences (Brinkmann, & Kvale, 2014). Herein, a structured written interview was used, focusing on teaching experience in higher education. Similar to previous studies, which have already addressed the overlaps between CT and informational competence (Carvalho & Morais, 2017; Cruz et al., 2016; Kong, 2014; Vezzosi, 2004), we sought to list the converging aspects of these two constructs (Table 2), to present the theoretical framework for the study.

Framing various factors - metacognition, reflection, analysis, evaluation, inference or use, as well as dispositions, applied to information management -, the questions were the following, applied to the IL teaching experience:

[Metacognition]	1. What strategies do you include to verify the student's awareness of his/ her cognitive process, namely for problem-solving?
[Reflective Discovery]	2. What exercises do you use to promote judgment and reasoning in the informational context?
[Analysis]	3. How do you recapitulate knowledge and skills trained in increasingly sophisticated exercises to refine research questions or use more advanced research methods?
[Assessment]	4. How are tasks performed to assess credibility, relevance, logic, and bias in the information?
[Inference/Use]	5. How do you verify the students' learning about the importance, relevance, and pertinence of the information to interpret facts and organize ideas?

[Provisions] 6. What criteria do you consider to evidence preferences, attitudes, intentions, and learned abilities to deal with information?

The interview guide was sent individually by e-mail, to the convenience sample selected from participants of a Project in Information Literacy, all of whom are practitioners. In January 2022 the responses were collected. Respondents were informed of the purpose of the interview and had access to the questions beforehand.

Table 2: Converging concepts

Main concepts	Critical Thinking	Information Literacy
Metacognition	Knowledge and awareness of your consciousness, as well as an application of these diseases for learning or solution of placements.	Awareness and understanding of each person's thought processes (the way a person apprehends and processes information, considering consciousness and way of learning).
Reflective discovery/ judgment	Understand the nature, limits, and certainty of knowledge, and how this can affect the way to defend their judgments and reasoning out of context; the opposite of what you know.	The integrated skill set encompasses the reflective discovery of information, the understanding of how information is produced and valued, and the use of information in creating new knowledge and ethically participating in learning communities.
Analysis	The ability to extract an argument and identify the role each projection plays in no argument (e.g. central claim, support, objection, or rebuttal), the source of each projection, and the balance of the overall argument.	The research spectrum ranges from simple questions that rely on basic knowledge recaps to increasingly sophisticated skills to refine research questions, use more advanced research methods, and explore more diverse disciplinary perspectives.
Assessment	The ability to assess the strength of an argument based on the credibility, relevance, logic strength, and bias of its propositions.	The appropriate response of formats to read, see, hear or experience; the structure presented and the adequacy of sources in terms of expertise, reliability, timeliness, perspective, and quality, concerning the information need.
Inference/ usage	Ability to gather analyzed and evaluated preventive evidence to reach a reasonable conclusion or develop an alternative and equal logical force, conclusion, or argument based on available evidence.	Determining importance, relevance, and relevance, deciding on sufficiency, interpreting facts and organizing ideas, and sharing with a community.
Provisions	Tendency or range towards, or about which, I precious or inclined to develop a certain critical thinking skill.	Tendency to act or think in a particular way, a disposition is a set of preferences, attitudes, and intentions, as well as a set of capabilities that allow preferences to materialize).

Source: Adaptation based on ACRL (2016), Dwyer (2020), and Kuhlthau et al. (2007).

4. Results and Discussion

Qualitative content observation is the method to analyze the interviews answers, from Education [R1], Psychology [R2], and Health Sciences [R3]. Regarding metacognition, all interviewees agreed that this is enhanced by searching in databases, with feedback from the trainer, and the repetition of the procedure autonomously. Concerning reflection, all the interviewees mention the comparison. Comparing sources results, search engines, and after that select, and evaluate important results, as well as guiding the search with a script – problem, keywords, planning, selection, evaluation of results, are important to reflection [R3]. Regarding analysis, it is understood that students exercise this ability using filters, different sources, different search strings to compare results [R1], connect ideas, contrast different opinions, examine new experiences, observe other processes feedback in teamwork, and give feedback [R2]. They also observe the results and rephrase the questions, setting steps for a new survey, repeating the exercises with the new knowledge achieved. Assessment requires the use of filters, different sources and search strings to compare results [R1] and understand their importance [R3]. It also implies a focus on credibility, relevance, logic, and information bias. Present and defend opinions, make value judgments about information, observe the validity of ideas or the quality of work based on some criteria, leads to autonomy [R2] and supports the assessment quality. As for inference, it is important to mention the importance of interpretation, understanding, and contextual use, as well as fluency in speech, to refer to and support one's ideas [R3]. Finally, when asked about provisions, the interviews choose resilience and persistence in facing frustration, curiosity, interest, purpose, deliberate practice, as well as CT, evaluation, rigor, and zeal.

In line with the literature (Weiner, 2011; Wertz, et al., 2013; Grafstein, 2017; Zou'bi, 2021), the combination of IL and CT teaching strategies proves to be effective, particularly when associated with curriculum, because it adds profound understanding, assuring significative learning. Students can benefit from converging strategies and growth in autonomy and self-regulation, through more comprehensive and complete training, carried out on several fronts, particularly when dealing with digital information (Goodsett, 2020; Kong, 2014; Reece, 2005). The learning process to acquire information skills must be supported by the recognition of the need for information, and planned based on locating good research sources. This leads to an appreciation of the significant information retrieved in the research. Interpretation is a crucial step in the process of organization of information, and the way it should be communicated. This strategic exploration that characterizes information research must be scrutinized and evaluated towards the questions and research objectives initially made explicit through the information needs. The ethical framework in the good use of information culminates the process, and promotes the replicability of the used strategies. All the main concepts of CT were addressed by these librarians in their IL teaching experience.

5. Conclusions

The dialogue between CT and IL reinforces a chain of events that empowers students to develop skills that can potentially be used in any context. It can be concluded that this is a fruitful and fundamental relationship for the academic students' training, whose purpose must be embraced by librarians and teachers in a collaborative and shared way. The specificity of curriculum content is a feature that consolidates reasoning, anchoring CT, and serves as a basis for IL teaching. Developing skills over the years, in a gradual, iterative, and the increasingly complex way seems to be the key to the successful articulation of these two concepts. Learning based on IL is essential to guarantee the personal and professional growth of individuals and, therefore, of society, since, as people have access to better sources of information and can use them critically, objective, consensual, responsible, and reasonable, puts them in a position to make better decisions than those who do not have this access or who have not developed information skills.

Acknowledgments

This work is financed by national funds from FCT – Foundation for Science and Technology under UIDB/04107/2020- Unidade de Investigação e Desenvolvimento em Educação e Formação, Instituto de Educação, Universidade de Lisboa.

References

Association of College and Research Libraries [ACRL]. (2016). *Framework for information literacy for higher education. American Library Association*. http://www.ala.org/acrl/standards/ilframework

Byrnes, J. P., & Bernacki, M. L. (2013). Cognitive development and information behavior. In J. A. Large, & J. Beheshti (Eds.), *The information behavior of a new generation: Children and teens in the 21st century* (pp. 23-43). Scarecrow Press.

Brinkmann, S., & Kvale, S. (2014). *Interviews: learning the craft of qualitative research interviewing* (3th ed). Sage.

Carvalho, M. M. M., & Morais, T. M. (2017). Desenvolvimento de competências em literacia de informação e pensamento crítico: um mosaico de ideias em torno do trabalho colaborativo em contextos escolar e universitário. In *2º Encontro BAD ao Sul: a criar comunidades, 10 nov., São Brás de Alportel*. https://eventos.bad.pt/wp-content/uploads/2018/01/com14.pdf

Cruz, G., Dominguez, C., & Payan-Carreira, R. (2016). A importância e o desafio de educar para o pensamento crítico no séc. XXI. In J. P. Lopes, H. S. Silva, C. Dominguez, & M. M. Nascimento, *Educar para o pensamento crítico na sala de aula: Planificação, estratégias e avaliação* (pp. 1-22). PACTOR.

Dwyer, C. P. (2020). Teaching critical thinking. In M. E. David, & M. J. Amey (Eds.), *The SAGE encyclopedia of higher education* (Vol. 4, pp. 1510-1512). Sage Reference.

Garcia-Marques, L., & Garcia-Marques, T. (2016). Pensamento crítico: Antes de se aprender a testar ideias é preciso aprender a ter ideias. In M. Garrido, & M. Prada (2016). *Manual de competências académicas: Da adaptação à universidade à excelência académica* (pp. 225-243). Sílabo.

Garrido, M., & Prada, M. (2016). *Manual de competências académicas: Da adaptação à universidade à excelência académica.* Sílabo.

Goodsett, M. (2020). Best practices for teaching and assessing critical thinking in information literacy online learning objects. *The Journal of Academic Librarianship, 46*(5), 102163. https://doi.org/10.1016/j.acalib.2020.102163

Grafstein, A. (2017). Information literacy and critical thinking: Context and practice. In D. Sales, & M. Pinto (Eds*.), Pathways into information literacy and communities of practice: Teaching approaches and case studies* (pp. 3-28). Elsevier. https://doi.org/10.1016/B978-0-08-100673-3.00001-0

Hepworth, M., & Walton, G. (2013). *Developing people's information capabilities: Fostering information literacy in educational, workplace, and community contexts.* Emerald.

Kong, S. C. (2014). Developing information literacy and critical thinking skills through domain knowledge learning in digital classrooms: An experience of practicing flipped classroom strategy. *Computers & Education, 78*, 160-173. https://doi.org/10.1016/j.compedu.2014.05.009

Kuhlthau, C. C., Maniotes, L. K., & Caspari, A. K. (2007*). Guided inquiry: Learning in the 21st century.* Libraries Unlimited.

Reece, G. J. (2005). Critical thinking and cognitive transfer: Implications for the development of online information literacy tutorials. *Research Strategies, 20*(4), 482-493. https://doi.org/10.1016/j.resstr.2006.12.018

Tett, L., Hamilton, M., & Crowther, J. (2012). *More powerfull literacies*. Niace.

Vezzosi, M. (2004). *Critical thinking and reflective practice: The role of information literacy – a literature review.* University of Northumbria, Universitá Degli Studi. https://www.repository.unipr.it/bitstream/1889/91/2/BP100%20Vezzosi.pdf

Weiner, J. M. (2011). Is there a difference between critical thinking and information literacy? Journal of Information Literacy, 5(2), 81-92. https://doi.org/10.11645/5.2.1600

Wertz, R. E., Fosmire, M., Purzer, S., Saragih, A. I., Van Epps, A. S., Nelson, M. R., & Dillman, B. G. (2013, June). Work in progress: Critical thinking and information literacy: Assessing student performance. In *2013 ASEE Annual Conference & Exposition* (pp. 23-1377).

Willingham, D. T. (2019). *How to teach critical thinking.* Education Future Frontiers. https://apo.org.au/sites/default/files/resource-files/2019-06/apo-nid244676.pdf

Zou'bi, R. Al. (2021). The impact of media and information literacy on acquiring critical thinking skills by the educational faculty's students. Thinking Skills and Creativity, 39(2), 100782. https://doi.org/10.1016/j.tsc.2020.100782

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14867

Structuring knowledge as a strategy and tool for learning and evaluation in engineering education

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Abstract

In this proposal, the evaluation activities together with the structuring of knowledge in conceptual maps are considered as dynamic elements to promote the gradual development of a higher level of understanding. The results achieved in this formative experience show us that the use of evaluation and feedback as part of the formative process, and not only as an appendix of measurement, allows students to adjust their training actions to meet course requirements

Keywords: *Structuring knowledge; Hibrid teaching context; SOLO taxonomy; engineering education.*

1. Introduction

As teachers and students, especially in technology-related professions, we face an overwhelming amount of information, which, day by day, increases exponentially. In this context, a teaching oriented to the transmission and coverage of content is an option that promotes the feeling of stress, but, above all, with the ease of access to information, it does not help students learn to manage and take advantage of that knowledge. This does not imply that it is not necessary to base our study on solid knowledge bases; rather, the opposite is true. We need to establish what are the fundamental concepts and their structures of relationship, so, from a broad perspective, approach the deep knowledge of this subject and transfer it to new contexts, outside the reality of the classroom. That is, the capacities of analysis, reflection, generalization and discernment are an integral part of learning to learn.

From this perspective, we can see that learning is not the sole responsibility of the student, but also of the teacher, his conceptualizations and his ways of teaching. Teaching and learning are not two independent processes, but, on the contrary, they are correlated, with two-way influence from each other. For example, several authors state that how teachers evaluate their students provides the direction in which students will orient their activities to reach the level of understanding required to pass the course (Biggs and Collis, 2014; Biggs,2014). From this perspective, we as teachers need to be clear and precise about what it means that something or subject of our course has been learned, and give students the key indicators so they can be aware that they are on the right path to mastering that knowledge. It is clear, from this vision, that evaluation turns out to be a fundamental part of the teaching and learning process; not only to decide if a student has reached the required level, but as an instrument of teaching, guidance, feedback and motivation (Henderson et al., 2019; O'Lynn, 2021). For this purpose, continuous questioning, based on key questions (McTighe & Wiggins, 2013) that motivate reflection, from the teacher and from the students themselves, together with adequate feedback are significant to achieve the expected learning outcomes.

In this article, we present a teaching and learning experience, in small groups and in a hybrid environment (face-to-face and virtual), which focuses on those two key aspects discussed in the previous paragraphs: structuring knowledge and assessment as strategies and tools to stimulate deep learning in engineering students. On the one hand, conceptual networks were used, structured from the vision of threshold concepts and students' notes, as elements of study, along with the use of key questions during class sessions to guide students at the desired depth level. On the other hand, the evaluation, as an essential element of the learning process, consisted of two phases: one of probing and feedback of the levels of understanding reached by the students and the other of scoring and final assessment.

This article is organized as follows. Section 2 presents a brief review of work related to pedagogical proposals based on learning outcomes and threshold concepts. Then, in

Section 3, the teaching and learning experience develops is briefly described. Finally, Section 4 concludes the paper and points out some lines of future work.

2. Background

2.1. Understanding and deep learning

In the literature, we find several works that address the problem of individual variations in academic understanding presented by students. For example, Biggs (2014) proposes so-called learning outcomes, which start from the determination of different levels of understanding. These levels are based on the internal structure and relationships of the different concepts considered in the answers that students present to the questions proposed by the teacher. Therefore, these authors propose five levels of understanding: pre-structural (with material not relevant to the topic), unistructured (where a single aspect of the theme is included), multistructural (where various aspects of the subject are included, but without showing existing relationships), relational (various aspects are shown with their interrelationships, but always from the material addressed in class), and abstract extended (where a generalization and theorization is presented). In that same order of ideas, but including an additional level related to emotional and motivational dimensions, Entwistle (2018) raises six levels: mentioning (with inconsistent pieces of information), describing (showing extensive descriptions of the topics treated in class or from the books), relating (with explanations from various sources, but without greater support), explaining (with the use of relevant evidence to support explanations in a logical and structured way)conceiving (with the development of individual conceptions based on individual reflection and showing a broad understanding of the discipline), and expansive awareness (with the reinterpretation of the understandings reached to be extended to new contexts, with a personal involvement with the phenomenon, rather than a theoretical distancing in the interpretations).

In both cases, since the proposal of Biggs and Entwostle, the first three levels refer to superficial learning, which highlights the lack of structure in the knowledge acquired and without showing the existing relationships between the different concepts that are part of the discipline under study. On the contrary, the higher levels (from the fourth onwards) can be conceived as a form of deep learning. One of the main characteristics that is appreciated is the existence of a coherent and relational structure of the different nodes that form this knowledge, and even producing a transfer to new contexts and the reconstruction of those learnings from a more emotional and personal perspective.

2.2. Assessment and feedback as learning tools

In the tradition of instructional design, assessment has been relegated to the final stage, as a level of measurement of student achievement and, in many cases, the effectiveness of the

teaching process applied by teachers. However, several authors have highlighted the importance of assessment as an integral part of the learning process and not just as a measurement appendix. For example, in the case of the backward design (Wiggins et al.,2005), in which the desired results together with the instruments to be measured are the starting point of the design of the entire instruction process. On the other hand, Biggs (2014) proposes the concept of aligned constructivism, which mixes the conceptualization of constructivism, as the construction of knowledge in the mental structures of each individual, and the curricular theory of alignment, which states that assessment tasks should be aligned with desired learning outcomes. As we can see in both proposals, evaluation becomes central in the design of teaching. However, Biggs' proposal, unlike the reverse design, visualizes the assessment as part of the student's learning path. In this way, the student builds knowledge guided by the awareness of what level of understanding is expected of him/her and stimulated by learning activities that, sequentially, lead him to the achievement of those results.

In the literature, two types of assessments can be seen: summative and formative, together with formative feedback (Henderson, 2019). The first refers to all those evaluation activities that lead to the attainment of some grade that is used to judge the degree of approximation of the student to the expected performance. On the other hand, formative evaluation leads to the generation of some type of feedback for the student, which does not lead to a degree used for the subsequent judgment of the student's performance. A completely related aspect is the formative feedback, which refers to some type of information, process or activity that allows students to stimulate learning based on the comments given to the formative or summative assessment activities.

In this sense, the proposal presented in this paper is based on the design of an evaluation process that is summative and formative, simultaneously. This allows the student to improve their initial grade (summative) through a following reflective process, where the feedback the teacher offers allows them to deepen their learning to reach the desired level in a second evaluative meeting with the teacher.

3. Context of study

In this article, we present an experience of teaching and learning carried out in the subject of Wireless Communications, belonging to the eighth semester, in the degree of Telecommunications Engineering of the Universidad Politécnica Salesiana (Cuenca, Ecuador), during the months of September 2021 to January 2022. Due to the restrictions resulting from the Covid-19 pandemic, the university developed its academic activities in the hybrid modality, so that students could attend classes in person or online, through the platform used for this purpose, so that both students in the classroom and those connected through the telematics platform could interact with the teacher and the exposed content.

For the experience we presented, the course consisted of 20 students, of which 5 students participated in face-to-face, while the remaining number of students opted for the virtual modality. The Wireless Communications course consists of four units.

3.1. Learning process and assessment and feedback activities.

Figure 1 shows the main training activities and processes carried out in the course to achieve the proposed learning outcomes (without considering the activities carried out in the laboratory). The formative process begins with the design and planning of the course, which is based on a collaborative teaching through the Teaching Cloister of Telematics and Telecommunications (an organizational structure of teachers of a specific knowledge area for the development of training and research processes). In this first phase, we establish the expected learning outcomes, proposed according to the SOLO taxonomy (Structure of Observed Learning Outcome) (Biggs and Collis, 2014), the evaluation tools to be used, and share the best methodological practices used so far among the members of the cloister. With these inputs, the teacher proceeds to the planning of his academic activities.

Already in the execution of the developed planning, lectures with teacher-student interaction constitute the moments in which the teacher describes and deepens the analysis of the main concepts and the existing relationships between them, which will allow the student to have a complete vision of the subject under study. Our vision of learning (see Section 2) leads us to the need for the student to structure his knowledge in such a way that he can appreciate the fundamental concepts studied, their interrelationships and possible generalizations of the knowledge reached to other aspects in the field of telecommunications engineering. To achieve this, we rely on three tools: essential questions, study notes and mind maps. Note that, throughout this process, the expected learning outcomes are the main inputs that feed all the formative and evaluative actions.

Our expectation was that students, according to taxonomy SOLO, reach at least a relational level. For this, as part of the feedback process, during the lectures, essential questions were asked to encourage students to contrast and relate the information provided with that studied in the current unit or in previous units, and even, compared to other courses that had been taken by students in the previous semesters. For better orientation of students in their learning and to avoid uncertainty in the process and assessment activities, in the first class session, and at the beginning of each unit, students were informed of the evaluation rubric with the expected results along with the possible scores for each of the levels.

One of the issues that we considered as fundamental to achieve that students reach the levels of learning and the skills required was the need to generate learning routines that allow them to generate and exercise the ability to recognize and extract the fundamental concepts of the subject under study, their relationships and possible applications in other fields outside of those analyzed in class. To do this, we take advantage of the study notes that are typically

generated by the students and which became part of the activities requested for summative evaluation. These class notes should not be a transcription of the slides and notes of the teacher offered as part of the resources provided in the course, but should make explicit the work of extraction and deepening in each of the concepts, characteristics and possible relationships. At this point, the essential questions posed in the classes constituted a first orientation of the teacher towards the expected level of knowledge structuring, allowing students to expand or reorganize their notes.

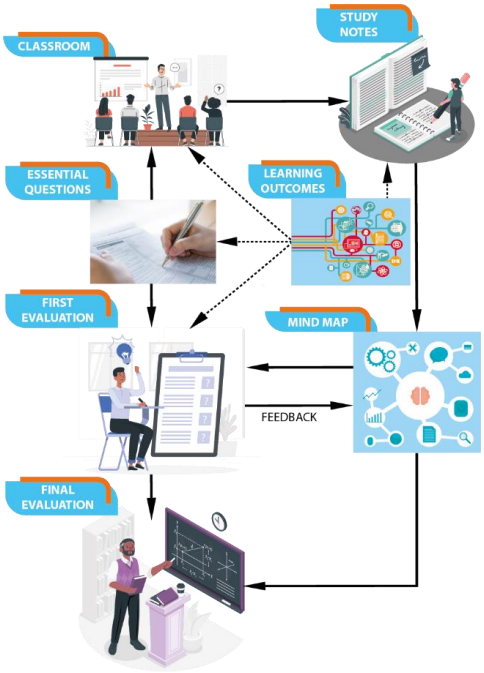

Figure 1: Flow chart of the evaluation and feedback process.

Following this line of action, another evaluation activity constituted the formulation of mental maps, in each of the topics addressed. This material was the only one that could be used by students in the synchronous evaluation process with the teacher. The use of these graphs was intended to enable students to generate an overall view of the structure of the fundamental concepts, existing relationships and awaken in them the awareness of the underlying difficulties in understanding certain concepts and their importance for the level of understanding achieved.

For each of the units, two 60-minute sessions were allocated for the evaluation, with the participation of two teachers of teaching staff. The first session, in which the students received a score according to the level reached, consisted of an individual interview, virtual or face-to-face, according to the modality chosen by the students, with a maximum duration

of 20 min. Based on questions asked by the teacher, the student, with the support of the mind maps generated, proceeded to develop his answer. The response needed to be concise and thorough in its analysis. This first meeting allowed teachers, beyond scoring the level of understanding reached by the student, to offer feedback. The student, if desired, could improve the grade obtained, from the comments offered by the teacher.

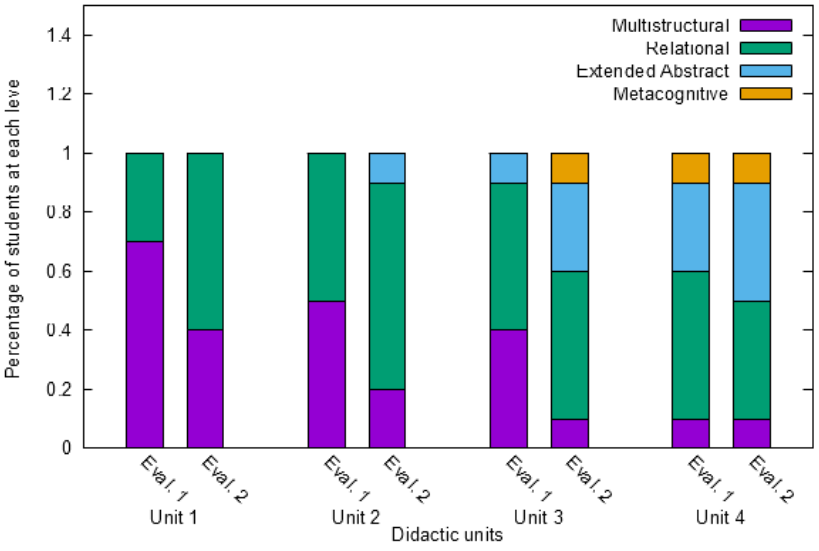

Figure 2: Assessment results for each didactic unit according to SOLO taxonomy.

3.2. Results and discussion.

Figure 2 shows the results of the assessments of the students. In general, an evolution is observed from the level of understanding shown in unit 1, with a majority presence of a multistructural performance to reach relational levels and extended abstraction and even metacognitive, in unit 4. Thus, we observed that in unit 1, the initial level shown in the first evaluative meeting was mostly of a multistructural level; however, in the second evaluation, after the feedback processes, both at the level of mind maps and the responses proposed in the initial interview, many of the students managed to improve their performance reaching the relational level. We observed that, in this unit, no performance was achieved in the responses of students tending to generalization and metacognitive analysis. One of the possible causes for this was the fact that, according to feedback from students, this was the first time they were evaluated in that format, so, despite knowing the expected learning outcomes, they did not focus on improving their level of understanding. Another of the difficulties shown is that, being the first unit, which has a wide mathematical content and without a broader vision of its application already in the technological field, students failed to visualize possible applications in the field of study.

This situation was improved in the following units. For example, in unit 2, we observed that the level of relational understanding was reaching greater presence in the response of the students, and even, in the second evaluation of this unit, you can already see that several students show answers with an abstract extended level. Moreover, in units 3 and 4 we can already see that most students have passed the multistructural level and have achieved deep learning, and even some of them have reached the metacognitive level. This may be because, while the final units have a higher level of complexity; however, they are designed to integrate and leverage the knowledge studied in the previous units and, in addition, it allows students to relate this knowledge to existing technological advances and the possibilities of development that are coming. On the other hand, we could see in the quality of the notes and the mental maps developed, that the students, mostly, adapted their performance and form of study to the demands of the new evaluation process, which allowed them to gain learning routines and thus develop the skills needed to reach the required levels of understanding.

4. Conclusions

In this article we have presented a teaching-learning experience for engineering students in hybrid modality (face-to-face and online simultaneously), in which, from the expected learning results, following the taxonomy, and based on the structuring of knowledge and feedback processes, evaluation activities were designed to be an active part of the student's learning process. The results achieved in this experience show us that achieving higher levels of understanding requires students to establish learning routines, so that, gradually, adapt their study style to the new assessment and approval requirements dictated by the teacher.

References

Biggs, J. (2014). Constructive alignment. HERDSA Review of Higher Education, 1:25.

Biggs, J. B. and Collis, K. F. (2014). Evaluating the quality of learning: The SOLO taxonomy (Structure of the Observed Learning Outcome). Academic Press.

Entwistle, N. (2018). Student learning and academic understanding: a research perspective with implications for teaching.

Henderson, M., Ajjawi, R., Boud, D., & Molloy, E. (Eds.). (2019). The Impact of Feedback in Higher Education: Improving assessment outcomes for learners. Springer Nature.

O'Lynn, R. G. (2021). Designing Effective Feedback Processes in Higher Education: A Learning-Focused Approach (Research into Higher Education). The Wabash Center Journal on Teaching, 2(2).

McTighe, J., & Wiggins, G. (2013). Essential questions: Opening doors to student understanding. Ascd.

Wiggins, G. P., Wiggins, G., and McTighe, J. (2005). Understanding by design. Ascd

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14544

Contextualization courses for engineering students based on sociotechnical thinking

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Abstract

Engineering education faces grand challenges to contextualize societal issues for students. This paper evaluates the contribution of contextualization courses for engineering students based on sociotechnical thinking. Sociotechnical thinking articulates engineering work with social concerns, explicit engineers positionality, and diverse human and non-human actors perspectives. The courses are inspired by a worldwide effort of Engineering, Technology and Society Education. Focus groups based on students reported contributions to understand technology as a human phenomenon, a social constructed system and a dynamic relationship between artifacts, organization, and culture. These courses improve argumentative tools and analytical capacity linked to a wider perspective for design and management technology, and made it possible to enhance situated knowledge on the practice of engineering with conscious social impact.

Keywords: *engineering education; contextualization; sociotechnical thinking.*

1. Introduction

Engineering education faces grand challenges to contextualize societal issues for students. Cultures of disengagement narrow engineering students as technical experts and disconnected from society (Cech, 2014). Sociotechnical thinking articulates engineering work with social concerns, explicit engineers positionality, and diverse human and non-human actors perspectives (Kleine et al., 2021). Courses built upon sociotechnical thinking aims to expand engineers' roles as social agents because their profession organize, design, create, manage and implement societal changing projects through technology (Downey, 2009; Hughes, 1993). Sociotechnical thinking increases accuracy of the portrayal on how engineering occurs beyond the classroom (Claussen et al., 2019).

This paper evaluates the contribution of contextualization courses for engineering students based on sociotechnical thinking. The courses are inspired by a worldwide effort called Engineering, Technology and Society Education (Johri, 2011; Leydens & Lucena, 2017; Lucena & Schneider, 2008). Authors involved in this field agree on the understanding of engineering and its professional practice is the path to comprehend technology's role in our society because that profession is responsible of the development and maintenance of technological systems (Hughes, 1993, 2005). Engineering is also strongly associated with innovative processes. It is the profession where social, organizational and physical components of an innovative process come together (Callon & Law, 1998) and through it the boundaries of technical rationality are analyzed because, in relation with technology, our distinctive feature as a society is an engineering issue (Hynes & Swenson, 2013).

Since 2002 the School of Engineering at Universidad de los Andes (Colombia) offers contextualization courses, as part of the Ciclo Básico Uniandino (Basic Undergraduate Cycle), promoting a reflection on the role of technology in today's society. Some of those courses are Technology and Society, Technology and Globalization, Techno-cultures in Latin America, and History of Technology. Each semester more than 280 undergraduate students from diverse programs these courses, especially from engineering, industrial design, economics and related programs. This paper will focus to evaluate the Technology and Society course. This course enrolls between 60 to 70 students per semester.

2. Course design

2.1. Course main themes

The Technology and Society undergraduate course follows the pedagogical developments of the ARGO Educational Group (Arribas Ramírez & Fernández García, 2001; Grupo, 2003b, 2003a). ARGO focuses on students' reflection of the role of technology in current society trough frameworks inspired in Science, Technology, and Society studies. The reference of

this analysis was the theoretical framework of a systemic vision of technology (Jiménez Becerra et al., 2003; Osorio Marulanda, 2003; Pacey, 2014; Vinck, 2012). The course differenciates between a static to a dynamic approach to technology. A static approach understands technology as neutral and artifactual, in addition to evolving through linear courses of action. Instead, the course shows technology as a social, dynamic, and discontinuous process. The course shows how and where this process is configured; identify modes of production, maintenance and legitimation of technological knowledge, diverse uses and conceptions, showing to what extent and why this can be understood as a social process. The course provide the following main themes:

- Dynamic vision vs. static vision: popular visions of technology show the technological practice as linear, the result of a series of concatenated events that lead to certain results in a "natural" way. From this perspective, the problem of technology would be mainly how to implement certain advances in certain contexts. The courses show another perspective of technology as a social process: technology is created by society and it is essential that it steers its development.
- Technology as a human phenomenon vs. artifactual vision: closely related to the above, expand the popular vision of technology where which technology are only artifacts and tools. The course shows technology as an eminently social phenomenon and proof of this is that currently almost all, if not all, human activities involve technology or are related to it. Human being depends on technology and therefore it is important to reflect on the role that we assign to technology in society, its limits and scope, where it is pertinent to approach to the ethical, moral, and political dimension of human activities based on technology.
- Technology as a tool for social construction: the course shows that the question about technology is also a question about the society we want and the influence that the type of technology used has on the kind of society we are building. Depending on the technology that a society chooses to supply itself (e.g., water), educate itself (e.g., Internet), and who is selected to manage it (e.g., multinationals, the state, the communities), the course shows aspects such as equality, equity, opportunities and its future development in general terms.

2.2. Course goals and sections

The course structure had two linked activities. On the one hand, it was about context and the problematic relationship between technology and society. On the other hand, it was the construction of possible scenarios to implement a solution for a technological controversy through a context design. The general objectives are detailed below.

Table 1. Pedagogical sections of the course.

Main idea	Learning goal	Activities	Assesment
Technology is inherent to the human being and a systemic vision allows us to understand the importance of this aspect.	Students will recall the three major dimensions of technology as a system: organizational, artifactual and cultural (Pacey, 2014; Vinck, 2012)	• Define a systemic vision of technology and its various aspects • Discuss personal experiences of using technology. • Identify issues and controversies in the use of technology.	Students accurately identify technology in systemic terms under every day examples. They identify purposes and relationships of a technology within an known context.
	Students will be able to analyze a socio-technical system in an specific context (e.g., information and communication technologies for education in Colombia) and relevant aspects to take into account from the systemic view.	Elaborate an exploratory text or presentations describing the central elements of a socio-technical system: definition of relevant social groups, history, phases of a socio-technical system.	• Students explain coherently and precisely the relationship between a socio-technical system and Pacey's systemic vision dimension. • Students use sources and course texts to justify this relationship.
Technical artifacts must always be seen "situated". They belong to a specific social and environmental context. Their design must include all social groups who participate in that context.	Students will be able to design core elements of the solution from a socio-technical perspective: user-centered, co-creative (inclusion of relevant social groups).	Students design in group a canvas to describe a technological proposal considering contextual issues in Colombia.	Students present coherent relationships between a social problem, core values of a solution, and strategies to include social groups.

- Introduce an issue and questions about technology and its relationship with society. This introduction is based on personal concerns and experiences of the participants, guest professional experts, and scholars of the field.
- Study a relevant socio-technical system in Colombian society, through an active learning methodology.
- Contribute to the knowledge of the sociotechnical system studied with an emphasis on contextual design.

The course was divided into pedagogical sections, including a main idea, a learning goal, student activities to reach an understanding of the central idea exposed, and assessments to establish that the student reached this understanding. The table 1 summarizes these elements.

3. Evaluation

In the spring of 2019, the course Technology and Society at Universidad de los Andes (Colombia) had a length of 15 weeks, 3 hours a week. There were 65 students enrolled, 67% from engineering and 33% from other programs. By the end of the course, the instruction team evaluated with the students the contribution of the contextualization based on socio-technical systems.

The evaluation team organized heterogeneous focus groups of ten students when possible. A total population of 48 participants took part in the heterogeneous focus groups. The groups were heterogeneous regarding the students' program: 67% engineering, 31% economics and related programs, and 4% social sciences and the humanities. An advantage of this approach was that participants could interact with one another and come up with ideas as a group (Smith & Leith, 2015). Also, a focus group allows accumulating experiences, reactions and attitudes in respect to core topics, making the discussion more meaningful (Gibbs, 1997). Students feel more comfortable and find a more amenable space than having individual interviews (Kitzinger, 1995).

Focus groups offered a qualitative insight on these core topics:

- Dynamic vision vs. static vision: Compare their perceptions between a popular and dynamic vision of technology.
- Technology as a human phenomenon vs. artifactual vision: Inquire if the course expanded the popular vision of technology where which technology are only artifacts and tools.
- Technology as a tool for social construction: Asks how they understood engineers relationship with technology.

In relation to the usefulness of the dynamic vision of technology, 80% of students affirmed that the course helped them to understand a contextual issue. Students reported that

conversations with professional guests who participated in the course and have been part of the design and development of technological systems were informative. They reflected that the course show that not all technology is benevolent or the most appropriate. It is necessary to contextualize the technology according to the place where it is going to be implemented, since the technologies that benefit the population in a first world country, in an underdeveloped country they can be harmful to the population or useless to solve a certain problem.

About technology as a human phenomenon, 58% of the students indicated how significant these aspects are for the design and management of technologies. They emphasized their learning that behind a technological system there are always people in charge of maintenance to ensure its constinous service. For example, one of the special guests showed how the public seem to think technological tools appear "out of thin air," but at the end it was clear that there are human beings providing such service. The focus groups reported that 57% of participants recognize that as our society becomes more technological, engineers take a part as core social agents. Sociotechnical thinking increases engagement of students towards public good and citizenship. Finally, students recognize that technology is a social phenomena.

Regarding contextual problems and a multidisciplinary teams in technological systems design, students emphasized how strategies used helped them to better apply a systemic vision of technology. They thought that class exercises showed them how the question about technology is also a question about plans, purposes and values of our society. Consequently, criteria mentioned by scientists and engineers can interact with community participation for every technological decision, determining equality, equity, opportunities and future development in general terms.

In the focus groups, students also considered that audiovisual material was a valuable complement because conferences offered experts' opinions about weaknesess, positive features, and possibilities of technological systems. Comprehension of the subjects and the empirical experiences of successful cases would have been more complicated without audiovisual material, making it harder to value implemented methodologies, problems and contexts to be considered for a social project.

4. Conclusions

Regarding the vision of technology, the students who have taken these courses state that they have had access to a non-traditional vision or perspective of technology, a vision that seems to correspond to a large extent to what is intended to be shown in the courses as it is a critical, contextualized and non-linear approach. It is equally satisfying that students can identify different approaches by contrast with elements of the traditional view of technology.

These courses improved argumentative tools and analytical capacity linked to a wider perspective for design and management technology, make it possible to enhance situated knowledge on the practice of engineering with conscious social impact. We also believe these types of courses help to create active and dialogic spaces, allowing students to reach significant agreements on the world they want. By this means, there is a contribution to the development of necessary skills for decision-making of socio-technical design and implementation, the analysis of their implications and influences on society, and the role of engineering to build the world.

Participation of professional experts, researchers, decision makers in the courses to exemplify how technology and society relationships occur in our society, increased students' sensitivity around the importance of reflecting on technology and society interactions, both in macro terms, as in everyday life in contemporary society given the high degrees of incorporation of technology.

Contextualization to study complex technological systems has created flexible and autonomous approaches useful for students' learning by visualizing different standpoints of a technological problem and formulating contextual reflections on the relationship between technology and society. There will be a need for new systematizations about this experience from the student's perspective regarding contextual design in this course.

References

Arribas Ramírez, R., & Fernández García, L. E. (2001). ¿Qué hacemos con la basura? La gestión de los residuos urbanos. In *Simulación educativa de un caso CTS sobre el medio ambiente*. Organización de Estados Iberoamericanos para la Educación, la Ciencia y la Cultura (OEI).

Callon, M., & Law, J. (1998). De los intereses y su transformación. Enrolamiento y contraenrolamiento. In M. Domènech & F. J. Tirado (Eds.), *Sociología simétrica: Ensayos sobre ciencia, tecnología y sociedad* (pp. 1–2). Gedisa.

Cech, E. A. (2014). Culture of Disengagement in Engineering Education? *Science, Technology, & Human Values*, *39*(1), 42–72. https://doi.org/10.1177/0162243913504305

Claussen, S. A., Tsai, J. Y., Boll, A. M., Blacklock, J., & Johnson, K. (2019, June 15). *Pain and Gain: Barriers and Opportunities for Integrating Sociotechnical Thinking into Diverse Engineering Courses*. 2019 ASEE Annual Conference & Exposition. https://peer.asee.org/pain-and-gain-barriers-and-opportunities-for-integrating-sociotechnical-thinking-into-diverse-engineering-courses

Downey, G. L. (2009). What is engineering studies for? Dominant practices and scalable scholarship. *Engineering Studies*, *1*(1), 55–76. https://doi.org/10.1080/19378620902786499

Gibbs, A. (1997). Focus Groups. *Social Research Update*, *5*(2), 1–8.

Grupo, A. R. G. O. (2003a). *La controversia de las antenas de telefonía móvil. Simulación educativa de un caso CTS sobre radiaciones y vida cotidiana*. Organización de Estados Iberoamericanos para la Educación, la Ciencia y la Cultura (OEI).

Grupo, A. R. G. O. (2003b). *La polémica de las plataformas petrolíferas. Simulación educativa de un caso CTS sobre fuentes energéticas y sostenibilidad*. Organización de Estados Iberoamericanos para la Educación, la Ciencia y la Cultura (OEI).

Hughes, T. P. (1993). *Networks of Power: Electrification in Western Society, 1880-1930*. JHU Press.

Hughes, T. P. (2005). Technology as Systems, Controls, and Information. In *Human-Built World: How to Think about Technology and Culture* (pp. 77–110). University of Chicago Press.

Hynes, M., & Swenson, J. (2013). The Humanistic Side of Engineering: Considering Social Science and Humanities Dimensions of Engineering in Education and Research. *Journal of Pre-College Engineering Education Research*, *3*(2), 31–42.

Jiménez Becerra, J. A., Guerrero Hernández, J. C., & García Rozo, A. (2003). *Tecnología y sociedad: El salón de clase como lugar de construcción de la sociedad*. La dimensión social de las facultades de ingeniería, Bogotá D. C.

Johri, A. (2011). Global, technological, and environmental challenges for engineering professionals. *Engineering Studies*, *3*(2), 71–77. https://doi.org/10.1080/19378629.2011.613571

Kitzinger, J. (1995). Qualitative Research: Introducing focus groups. *BMJ*, *311*(7000), 299–302. https://doi.org/10.1136/bmj.311.7000.299

Kleine, M. S., Zacharias, K., & Ozkan, D. S. (2021, July 26). *Contextualization as Virtue in Engineering Education*. 2021 ASEE Virtual Annual Conference Content Access. https://peer.asee.org/contextualization-as-virtue-in-engineering-education

Leydens, J. A., & Lucena, J. C. (2017). Pressing Issues for Engineering Education and the Engineering Profession. In *Engineering Justice: Transforming Engineering Education and Practice* (pp. 3–11). John Wiley & Sons.

Lucena, J., & Schneider, J. (2008). Engineers, development, and engineering education: From national to sustainable community development. *European Journal of Engineering Education*, *33*(3), 247–257. https://doi.org/10.1080/03043790802088368

Osorio Marulanda, C. A. (2003). *Aproximaciones a la Tecnología desde los enfoques en CTS*. Cátedra de Ciencia, Tecnología, Sociedad e Innovación, Panamá. www.oei.es/ctsiparaguay/osoriotec.pdf

Pacey, A. (2014). Technology: Practice and Culture. In R. L. Sandler (Ed.), *Ethics and Emerging Technologies* (pp. 27–36). Palgrave Macmillan UK. https://doi.org/10.1057/9781137349088_2

Smith, R., & Leith, K. (2015). Interviewing. In *D-Lab Scale-Ups User Research Framework version 1.2* (pp. 22–31). Massachusetts Institute of Technology. https://d-lab.mit.edu/research-about

Vinck, D. (2012). Pensar la técnica. *Universitas Philosophica*, *29*(58), 17–37.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14401

Use of engineering cases as alternative assessments in material characterization course

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Abstract

Materials Characterization is a Year-4 level undergraduate course introducing both fundamental principles and applications of various characterization techniques. In order to effectively achieve the learning objectives and enhance the competitiveness of undergraduate students in their career choices and in further advanced study, we have introduced engineering cases as alternative assessment methods. This paper has discussed how the engineering cases are designed and constructed for students to apply the acquired knowledge and techniques to tackle practical problems, as well as the benefits of adoption of this pedagogical approach. Components of engineering case are described and the mapping between the components and course contents is also elaborated. Effectiveness of engineering cases is reported.

Keywords: *engineering cases; assessment; effectiveness.*

1. Introduction

Project learning and experiential learning have been widely applied across a diverse range of subjects. When it comes to specific subjects, there are mainly two challenges to overcome. Firstly, there are always areas that needs further customization and refinement for a specific subject. For example, Aziz et al (2008) introduces product engineering cases to freshmen to understand the general mechanical systems. Sheng et al (2014) has shared experiences of using engineering application cases in teaching hydraulic and pneumatic course to improve students' problem solving skills and inspire their passion and enthusiasm in this course. Herget (2020) has explored integrating project-based learning into foreign language learning. In order to guarantee effective learning outcomes, various innovative learning methods such as case studies have also been applied across a wide range of areas. For example, Freeman et al (2020) has developed a live case to carry out analysis of a national tourist attraction. Secondly, the fair and efficient evaluation methods are needed to assess students' work. Tran et al (2020) have adopted test-driven methodology and provided a clear benchmark for project implementation to allow students to self-evaluate their work progress. Bryceson (2020) has compared existing marking scheme for assessing group project with a new marking scheme incorporating peer evaluations. Richards (2017) uses real products as cases to inspire students for critical thinking, decisión making as well as exercising communication skills in a design thinking course.

Materials Technology is one of the key research and teaching areas of our Mechanical and Aerospace Engineering (MAE) department. Materials option is one important in-depth option for undergraduate students in MAE department. Materials selection and application are common core engineering practice and are determined by the mechanical properties and performance, which are in turn strongly dependent on chemical composition, microstructure, and morphology of materials.

Modern mechanical engineering is a highly interdisciplinary field and covers sub – fields such as solid mechanics and dynamics; energy and thermal fluid; design, manufacturing and automation; microsystem and precision engineering; as well as aerospace engineering. Each of these sub – fields involves various innovative materials and calls for different materials characterization techniques. Our students, either during their internships, or during project works in their career, or during research in their advanced study program, are faced with selecting, utilizing, and analysing different materials. For example, the situation may be failure analysis of boiler wall materials in power plants; or microstructural observation of soldering materials in a PCB board; or thermal analysis of certain heat dissipation materials; or phase composition of some novel alloys, and so on. Therefore, knowledge and hands-on experiences of materials characterization are indispensable and serve as a key tool for our students to tackle various materials problems. Materials Characterization is a Year -4 level undergraduate course intended for the above mentioned objectives with various materials

characterization techniques. This course explains both the fundamental principles and the applications of each technique, such as observation of microstructures with light microscopy, SEM, TEM, SPM; application of X-ray techniques to identify crystal structures (XRD) and to identify elements (XRF); surface analysis with XPS, AES, and SIMS; molecular analysis with vibrational spectroscopy; as well as thermal analysis.

In order to enhance the competitiveness of undergraduate students in their career choices and in further advanced study programs, we have designed and constructed four engineering cases for them to crack during the course learning process. The four engineering cases have been used as one of the assessment tools in material characterization course. Each engineering case simulates the real industrial (project work) environment, and is designed in such a way that students have to crack the case using their learned knowledge throughout the course, and finally implement it. In other words, students will keep in mind of the practical aspects of each engineering case and potential applications of each materials characterization topic they are learning in this course.

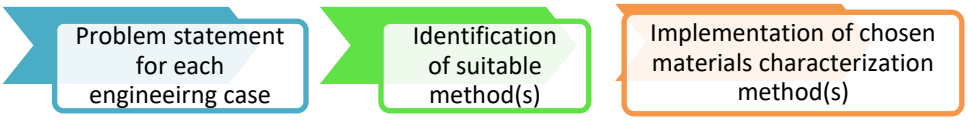

Figure 1. Steps of the process

2. Engineering Cases

The idea of using cases to assist teaching and learning is not new. In fact case studies are widely employed especially in educations in business and law field. Among various learning objectives, application of the acquired knowledge is very important for students to develop their professional skills and prepare for their careers or further studies. The challenges lie in two aspects, i.e. one is to effectively integrate different knowledge modules in this course into various cases; the other is to fairly and effectively grade students' work. In this session, we will describe how we have designed the cases and how we have measured students' learning outcomes.

2.1. Design and construction of engineering cases

Each of the four engineering cases consists of three components for students to work on: i.e. i) "Theoretical Concepts" which are in the format of multiple choice questions and are intended to test students' understanding on the fundamental principles and theories of characterization techniques; ii) "Crack the Case" is a simulated industrial case where an industrial scenario (or a product application or an engineering problem) is described and further analysis requires students identify suitable characterization techniques and elaborate

on procedures as well as interprete provided data; and iii) Extended Reading is a research publication specifically using a certain characterization technique for a specific application. In-depth questions are asked about the testing data. Students are encouraged to help interpret the data and explain reasons for some uqniue results in certain data.

Table 1. Components for engineering cases

Components of each case	Assessment criteria
Theoretical concepts	Able to explain the principles of characterization methods;
Crack the cases	Able to identify suitable characterization methods;
	Able to interpret the experimental data and explain the related phenomena
Extended reading	Able to explain the phenomena with related experimental data and interpret the data;
	Able to justify or question whether current characterization methods are suitable and whether other methods may be better

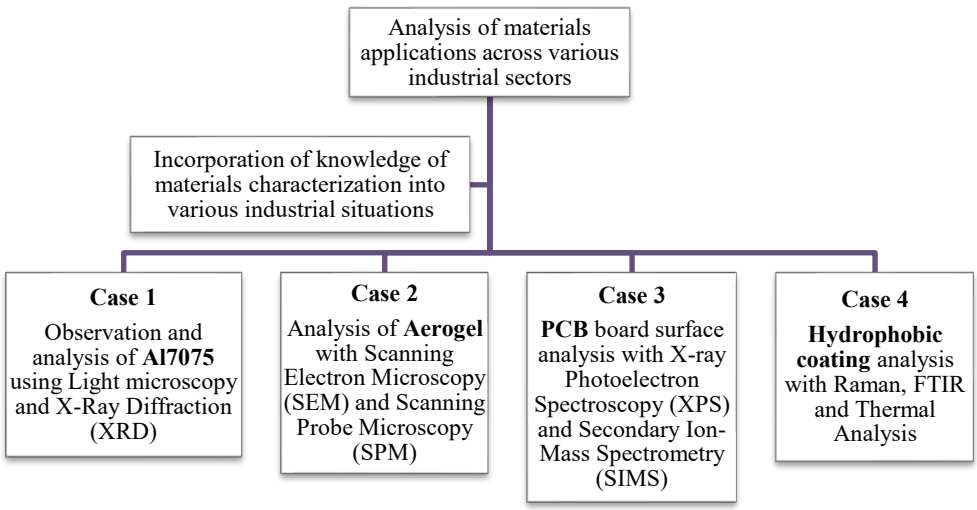

Figure 2. Mappting of each engineering case and the course contents

2.2. Results and discussion

In order to test the effectiveness of using the four engineering cases in this course in helping students achived their learning objectives, we have performed a survey after students

completing each engineering case. The survey questions and scoring scheme are listed in the following Table 2.

Table 2. Survey questions for each engineering case

Survey questions for all four cases	Score range
Assessment (i.e. regarding difficulty level, the workload required, and whether the questions with fixed and predetermined answers fit the course learning objectives)	Min. 1 (Strongly disagree); Max 5 (Strongly agree)
Knowledge comprehension / application (i.e. how the three components of each case helped the students better understand and apply what was taught through lectures)	Min. 1 (Strongly disagree); Max 5 (Strongly agree)
Alignment (i.e. how each case is aligned with learning objectives)	Min. 1 (Strongly disagree); Max 5 (Strongly agree)
Surface learning (i.e. level of memorization needed)	Min. 1 (Strongly disagree); Max 5 (Strongly agree)
Deep learning (i.e. high – level learning)	Min. 1 (Strongly disagree); Max 5 (Strongly agree)

Source: Internal Survey Data

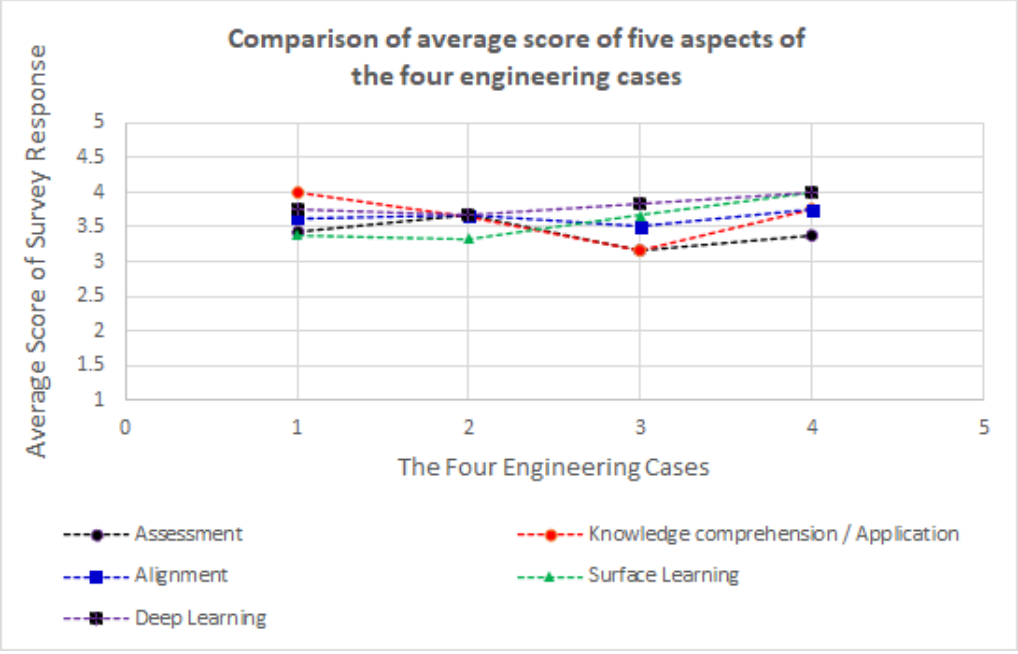

Figure 3. Comparison of average score of the survey data for the four engineering cases

The average score of survey data for each engineering case is plotted in Figure 2 above. It is found that all average scores are within the range of 3 to 4. Regarding the results on "Assessment" and "Knowledge Comprehension / Application", case 3 receives the lowest score probably due to the case complexity and difficulty level increase. This also indicates that case 3 will need re-design in the future. All four cases have received consistent scores for "Deep Learning", which means all four cases help students have in-depth and critical thinking about the application of characterization methods. The consistent scores in :Alignment" also indicates that each case is aligned well with the planned learning objectives.

2.3. Benefits of using engineering cases in this course

When conducted surveys which are not only with numerical scores, but also open-ended comments. The overall comments are positive in terms of the usefulness of the engineering cases in helping students further understand fundamental concepts. Some comments give us constructive suggestions for future course teaching. Below are some comments highlighting the benefits that students have experienced by cracking these cases.

Table 3. Open-ended comments from students

When students were asked if it is necessary for the course to include regular cases to work, the majority noted the usefulness of the cases for their learning:
Yes. It's another form of assignments which help students to consolidate what they learned from lectures.
Yes, I think it is important as it provides a certain application to our learning and makes the study more 'useful' in the sense that I can understand how to actually apply my learning to a real-life problem.
Yes, it can lead us to learn the application and implication of technology.
Yes, as the case studies expose students to more realistic cases after graduation.
It is important to have it as it is not something we can directly copy from the textbook and lecture notes.

Source: Internal Survey Data

3. Conclusions

Four engineering cases are successfully designed and constructed and are mapped with course contents. Assessment criteria are applied to evaluate students' performance in the cases. According to our internal survey results, all four cases have received positive feedbacks from students in all five sets of survey questions. All cases have reflected and well

matched with the course contents. Although most students feel that engineering cases are more difficult than traditional assessment due to the fact that more critical and in-depth thinking is required to crack each case, when an open-ended questions asks if it is necessary to include regular cases, majority of students think it is useful to do so. For example, some said "*Yes, I think it is important as it provides a certain application to our learning and makes the study more 'useful' in the sense that I can understand how to actually apply my learning to a real-life problem.*"; "*Yes, it can lead us to learn the application and implication of technology.*"; "*Yes, as the case studies expose students to more realistic cases after graduation.*"; "*It is important to have it as it is not something we can directly copy from the textbook and lecture notes*". As case 3 receives lowest score in the items of "Assessment" and "Knowledge Comprehension / Application", in the future, case 3 will be re-designed and improved in this two aspects.

References

Aziz, E., Chassapis, C., (2008). Introduction to the ME curriculum through product engineering case studies. 38th Annual Frontiers in Education Conference, 2008, pp. F1F-21-F1F-26, doi: 10.1109/FIE.2008.4720368.

Bryceson, K. (2020). Marking Schemes for an Authentic Group Project – Trial by Statistics - A Case Study. *6th International Conference on Higher Education Advances (HEAd'20),* 847-855. DOI: http://dx.doi.org/10.4995/HEAd20.2020.11159

Freeman, O., Hand, R., and Kennedy, A. (2020). Breaking down Silo through authentic assessment: a live case analysis. *6th International Conference on Higher Education Advances (HEAd'20),* 801-808. DOI: http://dx.doi.org/10.4995/HEAd20.2020.11150

Herget, K. (2020). Project-based learning: A practical approach to implementing memsource in the classroom. *6th International Conference on Higher Education Advances (HEAd'20),* 717-724. DOI: http://dx.doi.org/10.4995/HEAd20.2020.11133

Richards, L.G. (2017). Special session: Learning design thinking using engineering case studies. *2017 IEEE Frontiers in Education Conference (FIE),* pp. 1-3, DOI: 10.1109/FIE.2017.8190560.

Sheng, X.M., Hu, X.W. (2014). Teaching method reform of the hydraulic and pneumatic course based on engineering application cases. *2014 IEEE Workshop on Advanced Research and Technology in Industry Applications (WARTIA)*, pp. 528-531,, DOI: 10.1109/WARTIA.2014.6976313.

Tran, C.H., Truscan, D., Ahmad, T. (2020). Applying Test-driven Development to Evaluating Student Projects. *6th International Conference on Higher Education Advances (HEAd'20),* 1155-1163. DOI: http://dx.doi.org/10.4995/HEAd20.2020.11218

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14416

Practical approaches to delivering pandemic impacted laboratory teaching

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Abstract

#DryLabsRealScience is a community of practice established to support life science educators with the provision of laboratory-based classes in the face of the COVID-19 pandemic and restricted access to facilities. Four key approaches have emerged from the innovative work shared with the network: videos, simulations, virtual/augmented reality, and datasets, with each having strengths and weaknesses. Each strategy was used pre-COVID and has a sound theoretical underpinning; here, we explore how the pandemic has forced their adaptation and highlight novel utilisation to support student learning in the laboratory environment during the challenges faced by remote and blended teaching.

Keywords: *community of practice; laboratory teaching; videos; simulations; AR/VR; datasets.*

1. Introduction

COVID-19 forced higher education institutions to rapidly reconsider their approaches to and delivery of lab-based teaching. As face-to-face teaching was suspended and moved online, one of the main challenges associated with practical-based disciplines, which traditionally have relied on the fundamental development of psychomotor skills, was how to provide meaningful lab experiences for students remotely (Wilkinson *et al*., 2021). #DryLabsRealScience (#DLRS) was set up, by the authors, at the start of the pandemic to address this issue and provide a supportive network for life science educators looking to share innovative approaches to overcome the challenges of being unable to access facilities and equipment. What has emerged is a much richer community of practice that enhances the way that practical delivery is approached in a broader sense (Francis *et al*., 2020).

The network has an international reach of over 200 educators spanning higher and further education, teachers in schools and colleges, students, and commercial education resource providers from a wide range of disciplines, including biosciences to engineering. The network's ongoing success, as measured by continuing participation and resource development, lies in bringing together practitioners by providing an openly accessible platform with an underpinning ethos of freely sharing ideas and resources. This ethos has helped break down siloed teaching and resource development approaches, resulting in a more engaging learning experience for students and enhancing the pedagogic approaches to practical delivery. Over 90% of participants highlighted that attendance at network events had allowed them to influence their departmental policy to dry lab provision (Cramman et al., 2021). Resources developed by the network are collated on lecturemotely.com and YouTube, allowing access to materials beyond the original presentations and reaching the broadest possible audience. The lasting impact of the network is illustrated by the evolving pedagogic approaches to practical class provision as educators adapt to a blended model of teaching delivery.

2. Approaches

Thematic analysis of the content delivered during the #DLRS meetings highlighted four main categories of approaches: videos, simulations, AR/VR, and datasets. These themes clearly overlap each other and have been used in combination to deliver and supplement the practical experience. Each theme has its own theoretical underpinning and application at the macro level. Below we set out the context in which these resources were used pre-COVID, followed by how they have been adapted and utilised to navigate the challenges caused by remote laboratories. Examples will be included as a supplement to the narrative. A conceptual framework describing these themes is set out in figure 1.

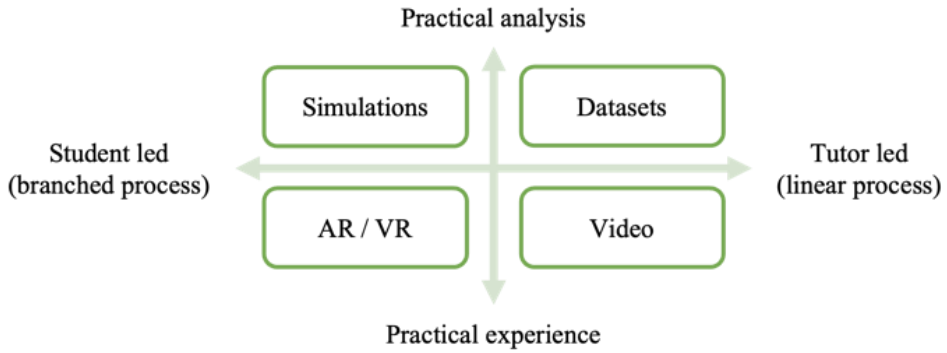

Figure 1. The four main areas of practice can be split along two axes. The first axis describes the pathway for interaction with content: tutor-led (linear process) where a defined outcome is pre-set, and student-led (branched process) where the outcomes are dependent on the actions of the individual. The second axis describes a dry laboratory as either a physical experience where the aim is to replicate or enhance the psychomotor components of conducting a practical, or practical analysis where the aim is to generate or manipulate practical outcomes.

2.1. Videos

Educational videos are integral to many higher education courses, whether integrated as part of the curriculum in traditional courses, as a precursor for 'flipped' courses or as a principal delivery mechanism for blended/online courses. Video has been shown in many studies to be an effective educational tool (e.g., Woolfitt, 2015). They have been used in a wide range of higher education contexts such as teaching (Kay & Kletskin, 2012), tutorials (He *et al*., 2012) or feedback delivery (Mahoney *et al*., 2019). Educational videos have previously been recognised for their potential to supplement or augment practical pedagogies, such as the use of video exemplars and practical guides (Crocker *et al*., 2010; Long *et al*., 2014).

During the COVID-19 pandemic, the initial transition to remote teaching of practical classes and later restricted access to labs led to an intense focus on the use of video to support delivery. The main approaches employed by the #DLRS community can be considered in the three stages of a typical practical i) pre-lab (e.g., health and safety briefings, theoretical background, equipment usage), ii) replacement labs (e.g., videoing a whole practical and live 'point-of-view' experimental run-throughs) and iii) post-lab (e.g., data visualisation / capture and data analysis) (Turner, 2020).

Using video as a medium is not without challenge, Fyfield *et al*., (2019) summarised that video must manage the cognitive load on the learner and maximise student learning by promoting active learning opportunities. Members of #DLRS explored specific active learning approaches to effectively using practical based videos. Examples include:

1. Errors. The introduction of deliberate 'errors' into a practical video. Students watch the video, identify mistakes, and reflect on their impacts. Such exercises can be

supplemented by synchronous discussion activity sharing observations or by watching an additional error-free video (Lab Science Resources, 2022).

2. Silence. The production of a practical video without audio. Students write or record their own explanations to demonstrate their understanding of the processes being demonstrated.
3. What happens next? Create a deliberately incomplete practical video by either stopping the video before the end or leaving out critical steps. Create formative exercises around these, asking the key question, "what should happen next?".
4. You make the choice. Live stream practicals and use student questions or commentary as a learning tool to guide the actions (Lab Science Resources, 2022).
5. Quizzes. Build questions into the video that must be answered correctly before a student can continue watching (Lab Science Resources, 2022).

2.2. Simulations

A simulation is a model that mimics the operation of an existing or proposed system. Within the laboratory practical context, this manifests itself as a recreation of a method or technique, often in a digital form (Jones, 2018). Simulations vary from interactive videos or step through guides because the outcomes are dependent on the start conditions, leading to branched possibilities. Simulations also serve as a means to allow students to gain experience in methods or techniques that would otherwise be time-consuming or limited by accessibility.

The use of simulations in practical teaching is a form of inquiry-based learning (Pedaste *et al*., 2015), where students are focused on iteration within the simulated environment. Students are required to manipulate parameters within the stimulation, record and then analyse the observed outcomes (Gormally *et al*., 2009). Simulations allow students to experience a methodology prior to performing it within a physical laboratory, an approach that has been demonstrated to enhance student learning (Keskitalo, 2021; Blackburn *et al*., 2019). Through passing ownership and control of the experience to the student, they can direct the task, acting in an authentic manner and experience research skills like problem-solving (Bassindale *et al*., 2021). These traits can then be transferred to the physical environment when the student enters the lab as they have, in effect, already experienced what is required to solve a given problem.

Virtual lab simulations can link scientific theory and laboratory practice in the same way physical labs do, in some cases more so, because you can perform many more iterations in one day than in a physical lab. Students report that they develop: data analysis and problem-solving skills, an understanding of correct equipment usage, alongside record-keeping, all of which align closely with the learning objectives for a wet lab module (Bassindale *et al*., 2021). Examples include:

1. Data recording. Simulations are used to generate electronic lab notebooks through a [Do][Explore][Act] framework consisting of three levels of tasks/commands (Bassindale *et al*., 2021).
2. Labster (www.labster.com). Interactive virtual labs allow students to explore a given scenario or method through a gamified 3D learning virtual environment.
3. Virtual learning tools. Benchling (www.benchling.com), a free, cloud-based software platform, was used to provide a virtual lab experience. Originating as a research tool, Benchling incorporates electronic lab notebooks and a suite of molecular biology analysis tools; it was adapted to work as a virtual learning tool, helping to emulate a variety of scientific processes (Lab Science Resources, 2022).
4. OpenSTEM labs (www.stem.open.ac.uk). Online virtual lab in collaboration with the Wolfson Foundation. Investigations are based on onscreen instruments, remote access experiments and virtual scenarios using real data.

2.3. AR/VR

Virtual reality (VR) is a technology that creates a real-time immersive simulated environment. In contrast, augmented reality (AR) integrates digital information allowing simultaneous interaction with virtual objects with the physical environment (Huang *et al.,* 2019). VR as a pedagogic tool is well studied (e.g., Radianti *et al*., 2020) and has been specifically applied in both compulsory science education (Tan & Waugh, 2013) and higher education (Huang *et al.,* 2019). Several international commercial providers (e.g., Labster, Learning Science (www.learnsci.com) and the OU Open Labs) provide virtual laboratories, combining VR, simulations with videos, worksheets, and active learning tools. Although used widely in some disciplines, AR is more emergent as a pedagogic tool in life science, though its potential in this discipline has been explored (Barrow *et al.,* 2019). The #DLRS community recognised the benefits of VR/AR to replace and supplement practical teaching. However, it acknowledged several barriers to initial adaptation, including the cost of equipment, IT infrastructure of the institution, access by students to IT hardware and technology skill set. Specific examples of VR/AR include:

1. The creation of 360º videos using ArcGIS StoryMaps for virtual field trips allows students to connect with multiple fieldwork sites (Lab Science Resources, 2022).
2. The development of a virtual marine field trip using ThinkLink. The VR field site allows students to navigate a coastal landscape and conduct real-time experiments by using embedded videos and experimental tools (Lab Science Resources, 2022).
3. Enhancing both physical and VR coastal survey experiences by creating AR specimens as they appear when undertaking data analysis (Lab Science Resources, 2022).
4. The creation of four AR protein structures to help students visualise key concepts from lectures. Created using Zapworks by exporting crystal structure of proteins from Pymol (Lab Science Resources, 2022; Reeves *et al.,* 2021).

2.4. Datasets

Fundamental to the laboratory practical experience is the analysis of data sets. Pre-COVID, much of the practical experience in physical laboratories was concerned with generating numerical data sets or images, which were later processed and analysed. Within the post-laboratory teaching settings, statistical analysis is typically applied to the data set, allowing meaning to be extracted. As such, the ability to work with data is a key practical skill. Within the #DLRS context, datasets are tutor generated using simple coding strategies in R, C++, or HTML, rather than practically generated and analysed by the students.

In this way, each student was assigned their own numerical data set to work with, with solutions provided to the tutor based on the initial parameters. By providing effectively limitless data sets, students have the opportunity to develop their skills in data processing and analysis, with unique data sets limiting the opportunities for collusion. Specific examples of datasets showcased by the #DLRS community include:

1. Automatically generated data sets were created in R. Specific variables were randomised, with a set range and errors introduced to create the data set. Each data set was given a unique identifier linked to a solutions sheet (Lab Science Resources, 2022).
2. HTML Interactive experiments generate datasets on a range of core biological topics within a web page environment. Students analyse and input these datasets into the web page for automatic marking (Lab Science Resources, 2022).
3. Smart worksheets are held within a virtual learning environment. The worksheets were commercially generated by LearnSci and were used to develop students' mathematical abilities. Each worksheet is unique to the student and provides feedback based on the submitted answer (Lab Science Resources, 2022).
4. High Content Image Analysis students were provided with existing cell images and used the open-source CellProfiler to perform image analysis (Lab Science Resources, 2022). Images were unique to the student.

A potential downside to computer-generated datasets is a lack of ownership felt by the students and, therefore, more limited engagement with the data. Synthetic datasets may not exactly mimic trends seen in laboratory-generated data and there can be an increased marking burden for staff unless work is electronically marked (Lab Science Resources, 2022).

3. Concluding remarks

COVID-19 forced a rapid evolution of the pedagogical approaches underpinning practical class delivery. As educators began to adapt to the challenges posed by the pandemic, new ways of integrating the different strategies described here were adopted. During the initial transition to online teaching, many of these approaches were adopted in isolation; however, we are now seeing a more joined-up approach with multiple approaches combined to

dramatically enhance the pre-and post-laboratory experience for students. The strategies described here cannot fully replace practical provision, nor should they try to, as the kinematic skills developed during laboratory classes are essential skills required in science-based disciplines. However, where they add immense value is in scaffolding the preparatory phase, allowing students to better appreciate the theory and application of techniques prior to even setting foot in the laboratory. Data analysis and interpretation are core skills for any scientist, and here, again, student learning can be enhanced post-class allowing for a far richer educational experience.

Although the approaches are described here in the context of biosciences, they are applicable to many other disciplines within and beyond STEM. The main benefit of communities such as #DLRS is the provision of an inclusive, open platform that promotes the free sharing of ideas and resources, allowing the adoption, refinement, and enhancement of teaching strategies. The impact of the networks will last long beyond the end of the current pandemic, fundamentally changing the pedagogic thinking around laboratory provision based on the continuing use of resources following a return to more normal laboratory delivery methods.

References

Barrow, J., Forker, C., Sands, A., O'Hare, D., & Hurst, W. (2019). *Augmented Reality for Enhancing Life Science Education*. Paper presented at VISUAL 2019 - The Fourth International Conference on Applications and Systems of Visual Paradigms, Rome, Italy.

Blackburn RAR, Villa-Marcos B, Williams DP. (2019). Preparing students for practical sessions using laboratory simulation software. *J Chem Educ* 96:153–8. https://doi.org/10.1021/acs.jchemed.8b00549.

Cramman H., Burnham J. A. J., Campbell C. D., Francis N. J., Smith D. P., Spagnoli D., Stewart M.I and Turner I. J. (2021). COVID as a catalyst: Uncovering misaligned power dynamics and the importance of new Professional Learning Networks for Higher Education science laboratory teaching. https://doi.org/10.35542/osf.io/tjphr

Croker, K., Andersson, H., Lush, D., Prince, R., & Gomez, S. (2010). Enhancing the student experience of laboratory practicals through digital video guides. *Bioscience Education*, *16*(1), 1-13. https://doi.org/10.3108/beej.16.2

Fyfield, M., Henderson, M., Heinrich, E., & Redmond, P. (2019). Videos in higher education: Making the most of a good thing. *Australasian Journal of Educational Technology*, *35*(5), 1-7. https://doi.org/10.14742/ajet.5930

Francis, N.J., Smith, D.S. & Turner, I.J. (2020, Sept 8). *It's a Brave New (Educational) World*. *Advance HE.* Available at: https://www.advance-he.ac.uk/news-and-views/its-brave-new-educational-world

Gormally C, Brickman P, Hallar B, Armstrong N. (2009). Effects of inquiry-based learning on students' science literacy skills and confidence. *Int J Scholarsh Teach Learn* 3. https://doi.org/10.20429/ijsotl.2009.030216

He, Y., Swenson, S., & Lents, N. (2012). Online video tutorials increase learning of difficult concepts in an undergraduate analytical chemistry course. *Journal of Chemical Education*, *89*(9), 1128-1132. https://doi.org/10.1021/ed200685p

Huang, K. T., Ball, C., Francis, J., Ratan, R., Boumis, J., & Fordham, J. (2019). Augmented versus virtual reality in education: An exploratory study examining science knowledge retention when using augmented reality/virtual reality mobile applications. *Cyberpsychology, Behavior, and Social Networking*, *22*(2), 105-110. https://doi.org/10.1089/cyber.2018.0150

Kay, R., & Kletskin, I. (2012). Evaluating the use of problem-based video podcasts to teach mathematics in higher education. *Computers & Education*, *59*(2), 619-627. https://doi.org/10.1016/j.compedu.2012.03.007

Keskitalo T. (2012). Students' expectations of the learning process in virtual reality and simulation-based learning environments. *Australas J Educ Technol* 28. https://doi.org/10.14742/ajet.820

Lab Science Resources (2020). *#DryLabsRealScience Webinar Recordings*. Retrieved from https://www.lecturemotely.com/labcourses

Long, J. M., Thomas, S. K., Campbell, A., Crawford, T., Sian, R. K., Stannard, W. B., ... & Joordens, M. A. (2014, January). Video presentations in engineering-physics practicals to increase the efficiency of teaching and learning. In *AAEE 2014: Proceedings of the 2014 Australasian Association for Engineering Education Conference* (pp. 1-9). Australasian Association for Engineering Education. https://doi.org/10.13140/RG.2.1.1602.7605

Jones, N. (2018). Simulated labs are booming. *Nature*, 562(7725), S5-S5. https://doi.org/10.1038/d41586-018-06831-1

Mahoney, P., Macfarlane, S., & Ajjawi, R. (2019). A qualitative synthesis of video feedback in higher education. *Teaching in Higher Education*, *24*(2), 157-179. https://doi.org/10.1080/13562517.2018.1471457

Pedaste, M., Mäeots, M., Siiman, L. A., De Jong, T., Van Riesen, S. A., Kamp, E. T., ... & Tsourlidaki, E. (2015). Phases of inquiry-based learning: Definitions and the inquiry cycle. *Educational Research Review*, 14, 47-61. https://doi.org/10.1016/j.edurev.2015.02.003

Radianti, J., Majchrzak, T. A., Fromm, J., & Wohlgenannt, I. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. *Computers & Education*, 147, 103778. https://doi.org/10.1016/j.compedu.2019.103778

Reeves, L., Bolton, E., Bulpitt, M., Scott, A., Tomey, I., Gates, M., & Baldock, R. A. (2021). Use of augmented reality (AR) to aid bioscience education and enrich student experience. *Research in Learning Technology*, *29*. https://doi.org/10.25304/rlt.v29.2572

Tan, S., & Waugh, R. (2013). Use of virtual-reality in teaching and learning molecular biology. In 3D immersive and interactive learning (pp. 17-43). Springer, Singapore.

Turner, I. J. (2020, July 7). Using videos to support laboratory practical classes. *View from the Socs.* https://www.viewfromthesocs.com/post/using-videos-to-support-laboratory-practical-classes

Wilkinson, T. S., Nibbs, R., & Francis, N. J. (2021). Reimagining laboratory-based immunology education in the time of COVID-19. *Immunology*, *163*(4), 431–435. https://doi.org/10.1111/imm.13369

Woolfitt, Z. (2015). The effective use of video in higher education. *Lectoraat Teaching, Learning and Technology Inholland University of Applied Sciences*, *1*(1), 1-49.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14268

High school mathematics knowledge level of technical university students

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Abstract

The lack of knowledge of high school mathematics is one of the key problems for students at technical universities. They face this problem not only right after entering the university, but they fight with this handicap during their whole studies. In the first part of this paper, we introduce the results of the questionnaire survey among first-year students which consists of the comparison of their subjective opinion on the level of their knowledge with the true results of the entrance test. The second part of the paper is dedicated to our new online courses of high school mathematics for our students. We believe that our effort will become an effective way how to supply the students with the knowledge, which they should already have and which is expected for further extension in regular university courses.

Keywords: *Mathematics; technical studies; survey; online course.*

1. Introduction

Our technical university provides education for engineers in multiple fields, e.g., civil, safety, mining, mechanical electrical engineering, and material sciences. All studying programs share the same crucial fundamental ingredient - mathematics. Based on our long-standing experience, students are coming to our technical university with various knowledge of high school mathematics. The mastering of this skill is critical in passing more advanced university math courses. Our primal endeavour is to encourage them to discover and identify their deficiencies and reduce them as soon as possible to be able to follow regular university lectures. During our research, we are also interested in their personal and subjective option on their knowledge in boarding at university. It is the reason why we asked them to fill out the anonymous self-evaluation questionnaire, where we asked them how confident they feel in various areas of mathematics. Please, see Section 2 for details. Afterwards, we would like to know their true level of knowledge and therefore, we give them the test consisting of problems typical for high school mathematics. The content of the test is described in Section 3. We compare the results of the self-evaluation and the real results in Section 4. The results are the primal impulse for creating a new online course that covers these topics. Building customized E-learning programs places high demands on design, programming skills, and time (Kotzer & Elran, 2012). The prepared material is available to all students of our university and we hope that they will use it in the case of any problem with high school mathematics in our university. See Section 5 for details. Finally, Section 6 concludes the paper and presents our future work.

2. Self-evaluation survey

We divided selected areas of high school mathematics into short thematic units. In the questionnaire, students answered 40 questions from individual topics. They asked to perform the self-evaluation consisting of grading themself a grade 1-5 based on personal opinion about the given topic. With our survey, we addressed all university faculties, where the members of our Department of Mathematics are teaching, i.e., Faculty of Civil Engineering, Faculty of Mining and Geology, and Faculty of Safety Engineering (Dlouhá, Pokorný & Dlouhá, 2019). Although most of the studying programmes do not require the entrance examination from mathematics, the content of all courses supposes the knowledge of mathematics at least on the level of typical high school. Since the content of this knowledge is defined by the Ministry of Education of the Czech Republic, this assumption is easy to satisfy. However, each high school defines the number of classes of mathematics per week individually based on the type of school, therefore the final level of true knowledge differs. Moreover, the final high school exams from mathematics are not mandatory. This is the reason why we asked students for filling the questionnaire. It has

been finished by 325 students before the deadline, which was set to the first two weeks after boarding the university.

3. Test

One week after finishing the questionnaire, we gave students the entrance test consisting of tasks and problems based on the thematic units corresponding to the survey. Using this way, we compared the subjective opinion of students before the test with the real results after the test.

The test consisted of 20 closed questions, where students could choose between 4 options. In each problem, exactly one answer was correct. The problems were chosen from the following areas:

- sets and set operations,
- basic arithmetic operations with numbers,
- the simplification of algebraic expressions,
- solving equations and inequalities,
- the domain of a function,
- graphs and properties of functions,
- the computation with percentage,
- planimetry,
- stereometry,
- analytical geometry of space.

Students worked on the tests without any previous preparation and the computation had to be performed without a calculator or Handbook of Mathematical Formulas. We were interested in their active knowledge. Students should answer only the questions, where they knew the answer surely to suppress the influence of random guessing. The test was entirely anonymous, therefore students solved problems responsively and without the stress of possible loss of credit. We prepared the content of the test based on our previous experiences (Dlouhá & Kozlová, 2019).

4. The comparison of survey and test results

At first, we divided the students into groups according to the faculties and according to whether they were full-time or part-time students. After collecting data, we shared the results within the groups as well as with the management of the corresponding faculties. However, the differences between the individual faculties were not very significant and therefore, we decided to present in this paper the results for several selected areas as a collection.

In the case of the unit "Basic arithmetical operation with numbers", we observed minor problems in the computation with the substitution. This problem is solved by 63% of students. The problem with compound fraction and exponentiation is solved by 78%. The self-evaluation of students from the survey is corresponding to the success rate in the test.

The problem of "Editing algebraic expressions" is the long term problem with which students coming to our university have problems. Confirming our assumption, the task of this type belonged to the hardest problems in the case of full-time students as well as part-time students. In the case of our test, the correct result was achieved by only 48% of students. The result of self-evaluation was overestimated, students believed in their abilities in 70%.

Additionally, we were interested in the topic of "Solving equations and inequalities". One of the presented problems was an equation in product form, where one of the terms was a quadratic triplet. This problem was successfully solved by 53% of students and therefore, the difficulty of this problem can be considered as moderate. Since the offered options of possible answer were presented in the form of product of roots, it was not sufficient to only straightforwardly substitute into the given original equation. The problem was necessary to solve.

Based on the results, the logarithmic equation with square root was the fourth hardest problem and its solution was successfully passed by 48% of students. This number approximately corresponded to the results of the survey. The simple equation with absolute value was solved by 65% of students. Since the question was again about the product of roots, we could suppose that the problem was truly solved. The success rate corresponded to the survey.

We included two inequalities in the test. Based on the results, we could imply that the simple system of linear inequalities belonged to the simplest problems and that most of the students had no problem in finding the solution (it was correctly solved by 83% of students). On the other hand, quadratic inequality was the serious problem for students and only 52% were successful. Overall, students achieved better results in the real test than they were expecting in the self-evaluating survey (45%).

The next topic, which is a long term well-known problem for students, is the "determination of the domain of the given function". The analysis of the results showed that this was also the hardest task in our test. The first problem, where the domain was defined by the solution of one trivial linear inequality, was solved only by 52% of students. Moreover, we observed an even more significant drop in the case of the second problem, which solution was not as trivial. This problem was solved only by 33% of students. On the other hand, 70% of students in the survey thought that they know how to solve this type of problem and they hardly overestimated their true knowledge. This type of problem is particularly

important for us since the first course in mathematics in our university starts with the mathematical analysis of the real functions of one real variable and determination of the function domain plays a crucial role. Additionally, this course consists also of the determination of function properties and graph drawing of a given function. In the test, we covered these topics with two additional questions. We were pleased to see the results, 78% of students could handle the graph of a linear function and 73% of students were familiar with the graph of a quadratic function. In the case of this question, the results corresponded to the survey.

The conclusion of the comparison is clear - students can self-evaluate their knowledge quite objectively. However, this evaluation is rather insufficient for studies at a technical university. We aim to help incoming students clarify their real knowledge of high school mathematics as soon as possible and allow them to eliminate any shortcomings quickly. They have to be able to focus on the extension of high school topics rather than burying into the basics.

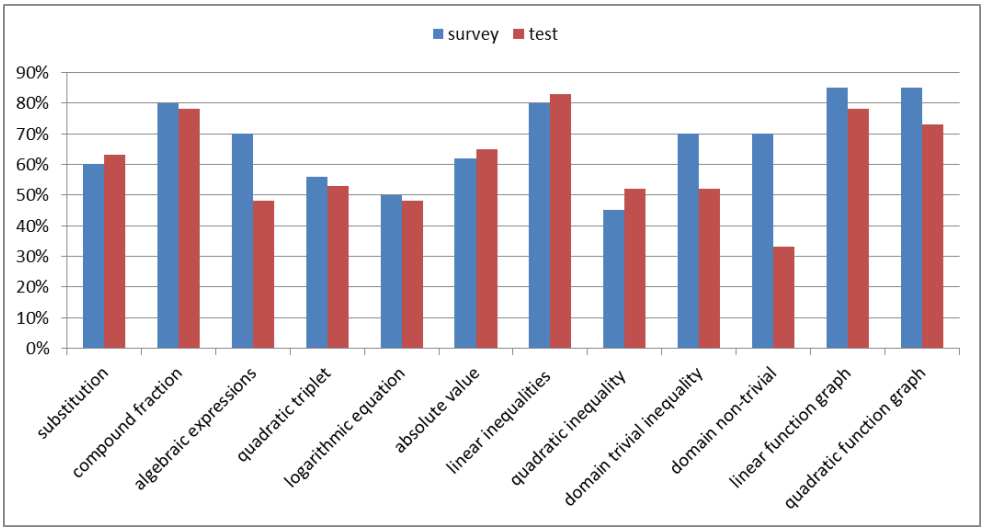

Figure 1. The comparison of survey and test results of selected problems discussed in the paper. Source: own.

5. The supplement of knowledge

For the knowledge level supplementation and facilitation of further studies for our students, we create a new e-learning course in LMS (Moodle-based university online platform), which is accessible for all students and employees of the university. This LMS-embedded online environment is interconnected with the school portal for students and employees (Dlouhá, Pospíšil & Dlouhá, 2021).

Students can begin or end their studies in the online course by the test, which evaluates the student's level of knowledge of the basics of mathematics. If the results are insufficient in some topics, the students can directly click through the hyperlinks to online worksheets. This studying material guides students through theoretical background (approximately 60 pages) followed by the practical exercises that are dedicated to practical computation (around 260 problems). Additionally, visitors of worksheet pages have an opportunity to watch prerecorded videos with commentary on the solution process (120 problems). Our survey proved the prevailing trend of our times: “When I do not know something specific, I will check YouTube.” (Hamříková & Dlouhá, 2017). We did our best to meet the demands of students and therefore, we have incorporated videos as one of the key features. After the study, a student can practice newly gained knowledge on exercises without a given solution process, but with a given solution for final verification (520 problems). After finishing the chapter of the e-learning course, the student has an opportunity to verify the understanding of the problematics by the test.

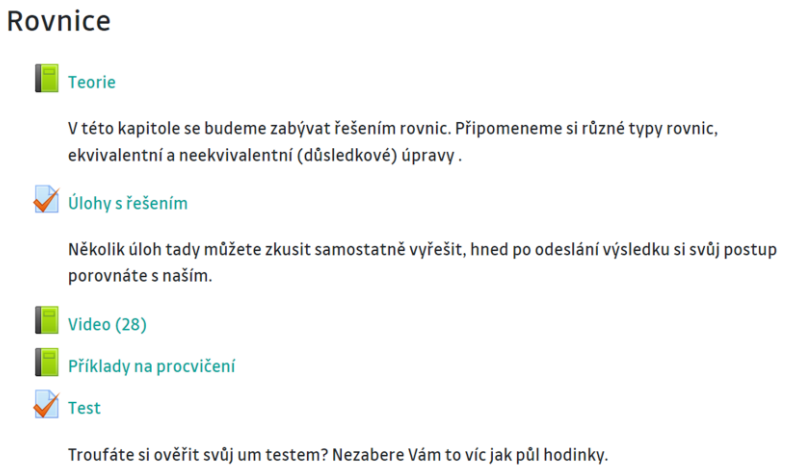

Figure 2. Example from our new e-learning course: we provide several types of studying material; students choose from theory, problems with solution, video with voice commentary, problems without solution process, or tests. Source: own.

All theories and solved examples are embedded directly in the LMS environment. We recorded videos with voice commentary on a tablet with the ProMotion function. The style of the video is chosen so that the notation and explanation of the solution process mimic the regular school teaching on the board as close as possible. The solution process is written using the application Notability, the screen is recorded by the iPad Control Center, the voice commentary is recorded via the "Record it!" application, and the final video is edited in "iMovie".

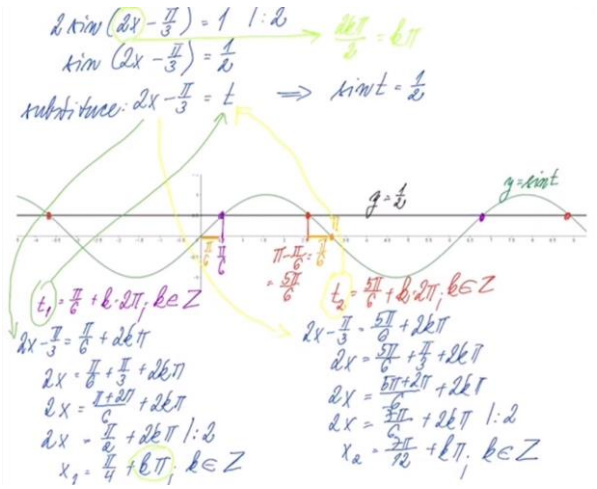

Figure 3. Example from our new e-learning course; the snapshot of video: the problem is real-time solved on the screen with corresponding voiceover. Students can stop, rewind, or fast forward the video. Source: own.

Problems in the test are designed in such a way that students are asked to write or assign the correct result or choose one of the predefined options of answer.

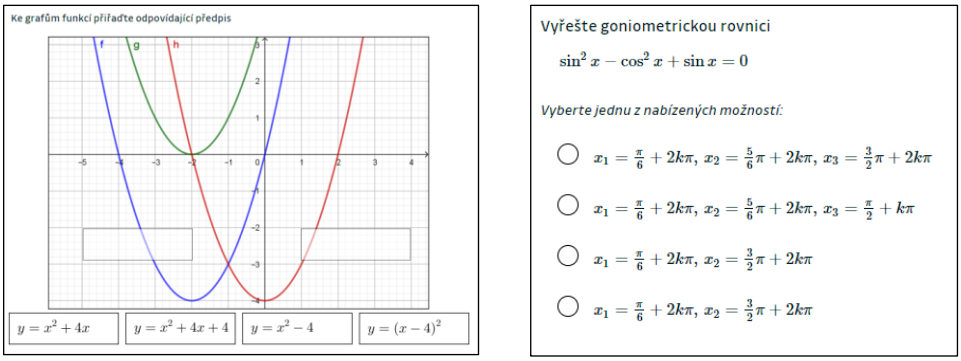

Figure 4. Example of test questions: students are asked to assign formula to the graph (left), choose right solution of goniometric equation (right). Source: own.

6. Conclusion

In this paper, we shared the results of the survey performed at our technical university, which suggest that students can identify the shortcomings in their knowledge of high school mathematics. To help them to overcome the first difficulties in their studies, we designed and implemented the new online course. We hope that our work will help them to reduce their lack of knowledge as soon as possible. However, our course is entirely new, and therefore, we are looking forward to the first feedback to be able to summarize the

consequences of our attempt. In the case of success, we will continue in the preparation of online material also for the following courses of mathematics at our university.

Acknowledgments

This paper has been completed thanks to the financial support provided by the project "Technology for the Future 2.0" CZ.02.2.69/0.0/0.0/18_058/0010212. The authors would like to express special thanks to the Department of Mathematics at the Faculty of Civil Engineering, VŠB-TU Ostrava, and our students for their cooperation with the survey.

References

Dlouhá, D., & Kozlová, K. (2019). Knowledge asessment of student's high school mathematics. *18th Conference on Applied Mathematics (APLIMAT 2019)*, 243-252. ISBN: 978-1-5108-8214-0.

Dlouhá, D., Pospíšil, L., & Dlouhá, K. (2021). Active involvement of VŠB-TU Ostrava students in distance education of mathematics and descriptive geometry. *Active Learning in Digital Era: How Digital Tools promote a Conscious, Open-minded, Creative and Social-Oriented Thinking (DisCo 2021)*, accepted

Dlouhá, D., Pokorný, J., & Dlouhá, K. (2019). Necessity of knowledge about math in safety engineering. *E-learning: Unlocking the Gate to Education around the Globe,* 380-386. ISBN: 978-80-86302-85-0.

Kotzer, S., & Elran, Y. (2012). Learning and teaching with Moodle-based e-learning environments, combining learning skills and content in the fields of Math and Science & Technology. *1st Moodle Research Conference (MRC2012)*, 122-131.

Hamříková, R., & Dlouhá, D. (2017). YouTube in Teaching Geometry. *Systems Supporting Production Engineering,* 6(4), 252-256.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14470

Mathematics' wars - real or imaginary?

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Abstract

This paper investigates different methods to solve a mathematics task attempted by students enrolled for a first-year mathematics module in South Africa (n = 182). The paper examines an expected calculus solution approach and examples of interesting alternative student solutions. Task solutions were analysed according to the number of conceptual and procedural steps used to solve the task. Each step in the task solutions is described by a problem-solving category, based on the knowledge approaches used to solve the task. The results confirm that solution methods are not unique. Task solutions require both procedural and conceptual steps, and problem-solving steps are sometimes iterative. The analyses demonstrate that mathematical questions cannot be uniquely described as mainly conceptual or procedural. The analyses suggest that lecturers could consider explanation and comparison of multiple solution strategies as a way to enhance mathematical proficiency.

Keywords: *Mathematical task solution analysis; conceptual knowledge; procedural knowledge, student work, teaching strategies.*

1. Introduction

The literature describes different perspectives pertaining to how mathematics should be taught – should the focus be on concepts and application or procedures? According to Star (2005, p. 404):

> *Whether developing skills with symbols leads to conceptual understanding, or whether the presence of basic understanding should precede symbolic representation and skill practice, is one of the basic disagreements between the opposing sides of the so-called math wars.*

The concept-driven versus skills-orientated perspectives have led to the so called '*math wars'* between mathematics education researchers globally (Brown, Seidelmann, & Zimmermann, 2002; Sowder, 2007; Star, 2005; Wu, 1999), as well as in South Africa (Engelbrecht, Bergsten, & Kagesten, 2009; Engelbrecht, Harding, & Potgieter, 2005). The concept-driven view accentuate the understanding of mathematics and the use of it to solve problems (Sowder, 2007), emphasizing reasoning, critical thinking and problem-solving skills. In the contrast, the skills-orientated perspective promote the development of skills as necessary vehicles to promote conceptual understanding (Wu, 1999). This paper examines different problem-solving approaches used to solve a mathematics task, focussing on procedural and conceptual steps. The following research questions are explored:

1. *Can we categorise the mathematic task as mainly conceptual or procedural?*
2. *What are the implications of different solution approaches for teaching?*

The content analysis is performed as part of a larger study that investigated the knowledge types required to solve 33 calculus tasks (Hechter, 2020). The study is located within a mathematics module for first year engineering in South Africa. The analysis includes the view of the researcher and written student solutions.

2. Conceptual and procedural knowledge

Conceptual knowledge is described as concepts, and relations between concepts and operations (Kilpatrick, Swafford, & Findell, 2001). Procedural knowledge is the ability to accurately perform step by step procedures to solve problems (Star, Rittle-Johnson, & Durkin, 2016). Procedural flexibility involves both types of knowledge, and is described as knowledge of multiple methods and choosing the most appropriate method based on specific problem properties (Kilpatrick et al., 2001; Rittle-Johnson, 2017; Star, 2005). Mathematical proficiency requires both types of mathematical knowledge and procedural flexibility (Rittle-Johnson, 2017).

A comparative study between South Africa and Sweden investigated teaching emphasis in undergraduate mathematics courses for engineering students (Engelbrecht, Bergsten, & Kaĝesten, 2012). The study stated that mathematical problem-solving approaches was classified as either mainly conceptual or mainly procedural (Bergsten, Engelbrecht, & Kågesten, 2017):

Conceptual approach: This includes translations between verbal, visual (graphical), numerical, and formal/algebraic mathematical expressions (representations); linking relationships; and interpretations and applications of concepts to mathematical situations.

Procedural approach: This includes symbolic and numerical calculations, employing (given) rules, algorithms, formulae, and symbols.

The description of being 'conceptual' or 'procedural' is not necessarily a property of the task itself, but rather a description of the solution of the task (Engelbrecht et al., 2009). Mathematical solution approaches could be described as bidirectional, causal relations since solution methods show that procedural and conceptual steps alternate, (Rittle-Johnson, Schneider, & Star, 2015), but in no specific order (Rittle-Johnson, Fyfe, & Loehr, 2016). Furthermore, solution methods indicate that some steps repeat, showing iterative relations between concepts and procedures (Rittle-Johnson, 2017). Procedures could be connected to concepts through reasoning and different representations, e.g. graphs (Davis, 2005). Comparing and explaining numerous strategies for solving the same problem promotes student learning (Star et al., 2016). Comparing different methods for the same task develops conceptual and procedural knowledge and advances procedural flexibility among students with some prior knowledge of one of the methods (Durkin, Star, & Rittle-Johnson, 2017).

3. Methodology

This paper examines solutions to a first-year calculus task on application of differentiation:

If a stone is thrown vertically upwards, the position function of the stone is given by $s(t) = 30t - 5t^2 + 20$, where s is in metres and t is in seconds. Calculate:

a) the time t when the stone will reach its maximum height

b) the maximum height of the stone (before it falls to the ground).

The task was selected since student work (n = 182) presented alternative methods and provided rich data. Students are given the position function of an object and required to answer questions regarding the maximum height that an object will travel. The researcher expected that students would find the extreme value(s) where the derivative function (velocity) is zero, therefore using calculus to solve the task. The paper shares evidence and analyses of the researcher's expected response and student work that provides interesting alternative solutions.

3.1. Data Analysis

The categorisation expands the conceptual and procedural approaches described by Bergsten et al. (2017) for the topics of functions and differentiation. Table 1 shows the categories used to solve a given task, e.g.:

C_{3D}: conceptual category - involves the *interpretation* of concepts related to *differentiation,* **P_{2D}**: procedural category that involves use of *differentiation rules.*

Table 1. Conceptual and procedural problem-solving categories

Step	Conceptual and procedural problem-solving categories
C_1	translations between verbal, visual, numerical, and algebraic mathematical expressions
C_{2F}	linking relationships wrt functions: functions $\Leftrightarrow$ inverse functions, equation of a function
C_{2D}	linking relationships wrt differentiation: $f \Leftrightarrow f' \Leftrightarrow f''$, $D_{f'} \subseteq D_f$, $f'(x) = 0 \Rightarrow$ f local extrema, $f'(x) > 0 \Rightarrow$ f increasing, $f'(x) < 0 \Rightarrow$ f decreasing, $f''(x) = 0 \Rightarrow$ possible point of inflection, $f''(x) > 0 \Rightarrow$ f concave up, $f''(x) < 0 \Rightarrow$ f concave down, link position function (displacement) $\Rightarrow$ velocity (speed) $\Rightarrow$ acceleration
C_{3F}	interpretation of concepts wrt functions: definitions, functions and relations, inverse, domain and range, restrictions, inequalities (quadratic and higher order), incl. concept of intersection and union, turning point of a parabola (min/max), axis of symmetry, *x*-intercepts
C_{3D}	interpretation of concepts wrt differentiation: gradient, continuity, differentiability, point of inflection, concavity
C_4	applications of concepts to mathematical situations
P_1	symbolic and numerical calculations, substitution
P_{2F}	rules wrt functions, expressions e.g. division by zero, equations e.g. $a.b = 0 \Rightarrow a = 0$ or $b = 0$, inequalities e.g. division by -1, exp laws e.g. $a^0 = 1$, log laws, graph of parabola, factorisation
P_{2D}	differentiation rules
P_3	algorithms (set of rules), e.g. long division or completing the square
P_4	formulae, e.g. quadratic formula and turning point formula
P_5	symbols (including notation)

Source: Extracted from Hechter (2020)

Each task solution is analysed according to the number of conceptual and procedural steps used to solve the task. The number of problem-solving categories is coded and counted, resulting in a label for each approach. A problem-solving category is only counted *once* when the *exact* procedure/concept is repeated for a particular approach in a task solution - the category for the repeated step is shaded in grey. A problem-solving category should be counted more than once when the *same* category requires *different thinking skills* for a procedure/concept in a particular step in the solution.

4. Results

The expected solution responses of the given task are shown first. Secondly, the author shares evidence of written student solutions since student work presented alternative methods that can inform teaching practices. Solution approaches are not uniquely described since the task have different solution methods. Table 2 display the content analysis of the task by the author.

Table 2. Approach 1

Approach 1		**Conceptual steps = 5, Procedural steps = 3**
$s(t) = 30t - 5t^2 + 20$ (position function)	**C_4[1]**	$C_4[1]$[1]: context - position function stone
$s'(t) = 30 - 10t$ (velocity function)	**P_{2D}**	P_{2D}: differentiation rules
$s'(t) = 0$ (velocity function = 0)	**C_4[2]**	$C_4[2]$[1]: context – velocity: time $_{\text{velocity zero}} \Rightarrow$ time $_{\text{max height}}$
$\Rightarrow 30 - 10t = 0$	**C_{2D}[1]**	$C_{2D}[1]$: link $f'(x) = 0 \Rightarrow f$ local extrema
$\Rightarrow -10t = -30$	**P_1[1]**	$P_1[1]$: numerical calculations
$\Rightarrow t = 3s$		$C_4[3]$[1]: context - position function: max height $\Rightarrow$ time $_{\text{velocity zero}}$
$s(3) = 30t - 5t^2 + 20$	**C_4[3]**	$C_{2D}[2]$: link position function (max height) and velocity (zero) at t = 3
(position function at t = 3)	**C_{2D}[2]**	$P_1[2]$: substitution into position function
$\Rightarrow s(3) = 90 - 45 + 20$	**P_1[2]**	$P_1[1]$: numerical calculations,
$\Rightarrow s(3) = 65\,m$ (max height)	**P_1[1]** **C_4[1]**	$C_4[1]$: context - position function stone

Approach 1 is demonstrated in Figure 1 where student work refers to position and velocity.

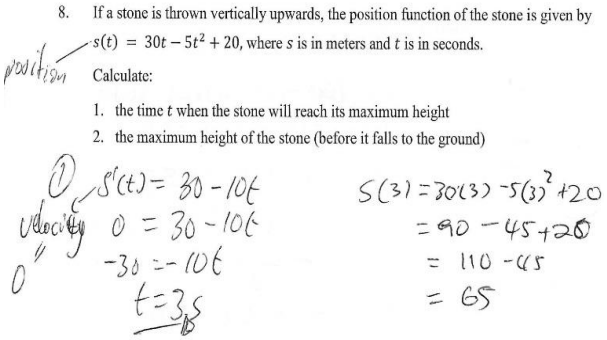

Figure 1 Approach 1 – analysis and evidence of student work.

Students suggested using the turning point (Figure 2, Approach 2) and axis of symmetry of a parabola (Figure 3, Approach 3) methods. The analyses are shared in Table 3.

[1] C_4 are different for position function, velocity function and maximum height, and requires different thinking skills

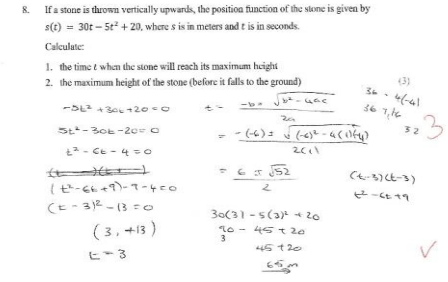

Figure 2 Approach 2 – evidence of student work.

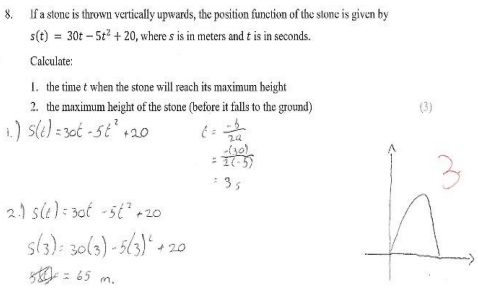

Figure 3 Approach 3 – evidence of student work.

Table 3. Approach 2 and Approach 3

Approach 2: Turning point formula	**Conceptual steps = 2, Procedural steps = 5**
$s(t) = 30t - 5t^2 + 20$ **P1[1]** $\Rightarrow t^2 - 6t - 4$ **P3** $\Rightarrow (t - 6t + 9) - 4 - 9$ **P2F** $\Rightarrow (t-3)^2 - 13$ TP: (3,-13) **P4** $\Rightarrow$ maximum height at $t = 3s$ **C3F C4** $\Rightarrow s(3) = 65m$ (max height) **P1[2] P1[1]**	P1[1]: numerical calculations (division by -5) P3: completing the square P2F: factorisation P4: Turning point formula C3F: interpretation of turning point $(p;q)$ of a parabola: $p \Rightarrow$ (time; max height) C4: contextual applications: (time, max height) P1[2]: substitution, P1[1]: numerical calculations
Approach 3: Axis of symmetry	**Conceptual steps = 2, Procedural steps = 3**
$s(t) = 30t - 5t^2 + 20$ $\Rightarrow x = \frac{-b}{2a}$ **P4** $\Rightarrow x = \frac{-30}{2(-5)}$ **P1[1]** $\Rightarrow x = 3$ **P1[2]** $\Rightarrow$ maximum height at $t = 3s$ **C3F C4** $\Rightarrow s(3) = 65m$ (max height) **P1[1] P1[2]**	P4: formula for axis of symmetry P1[1]: substitution into formula P1[2]: numerical calculations C3F: interpretation of axis of symmetry of a parabola (x; extreme value), C4: context – (time, max height) P1[1]: substitution P1[2]: numerical calculations

Table 4 summarises the 182 students' approaches to do the task.

Table 4. Analysis of student strategies to do the task

Method	**n**	**%**
Calculus	172	94.5%
Turning point formula	3	1.7%
Axis of symmetry	7	3.8%

Most students used calculus knowledge to do the task (94.5%), but some used secondary school knowledge to solve it. These students used the turning point formula (1.7%) and the axis of symmetry (3.8%) of a parabola to calculate the time of maximum height. Approach 1 suggested five conceptual and three procedural steps (C > P), however, some student solutions suggest more procedural than conceptual steps steps (P > C).

5. Findings and discussion

The task cannot be described as mainly procedural or mainly conceptual since approach 1 suggests more conceptual than procedural steps (C=5 P=3, C > P), and approach 2 and 3 propose more procedural than conceptual steps (C=2 P=5, C=2 P=3, C < P). Most students used the position and velocity function answer the question (94.5%). However, it is important to note that 5.5% of students used the turning point and the axis of symmetry of the parabola in order to reach the correct answer. Approaches 2 and 3 only could be used since the position function is quadratic – it is not possible if a polynomial of a different degree were chosen. There are two main findings that emerged from the task analysis:

Finding 1: The task cannot be categorised as mainly conceptual or procedural

The analyses confirm the task solutions suggest more than one problem solving approach. Procedural and conceptual steps within task solutions are integrated (Kilpatrick et al., 2001) - knowledge categories alternate (Rittle-Johnson et al., 2015), some repeat (Rittle-Johnson, 2017), in no specific order (Rittle-Johnson et al., 2016). The task analyses provide evidence that disagrees with the statement that the approach used to solve a mathematical task is classified as either mainly conceptual or mainly procedural (Bergsten et al., 2017). The categorisation is further compicated since what is conceptual (and unfamiliar) for one student could be procedural (and familiar) for another, depending on whether the task has been seen before. Many students (procedurally) know that $s'(t) = 0$ indicates where the local extreme value(s) will be found.

Finding 2: Comparing and explaining of multiple solution strategies to promote learning

Students' work suggested additional methods using the turning point or axis of symmetry of a parabola for solving the contextual problem. The derivative of the position function method (where $s'(t)$ represents where the local extreme value(s)) could be connected and compared to the turning point and axis of symmetry methods to enhance conceptual understanding of the contextual problem and promote student learning (Star et al., 2016). This practice could enhance students' procedural flexibility, and development of conceptual and procedural knowledge amid students with prior knowledge of one of the methods (Durkin et al., 2017).

6. Recommendations

The concept-driven and skills-oriented perspectives should not stand in opposition to each other, in fact, teaching and learning strategies should focus on both concepts and procedures. Lecturers should refer to relations between concepts and procedures, and teaching strategies should explain and compare multiple problem-solving methods. Furthermore, I recommend analysing more empirical evidence of student solutions using the defined problem-solving categories to investigate different methods and possibly suggest additional teaching practices.

References

Bergsten, C., Engelbrecht, J., & Kågesten, O. (2017). Conceptual and procedural approaches to mathematics in the engineering curriculum - a comparative analysis of junior and senior students in two countries (Open access) (Publication no. 10.12973). Available from EURASIA, from EURASIA Journal of Mathematics Science and Technology Education

Brown, S., Seidelmann, A., & Zimmermann, G. (2002). In the trenches: Three teachers' perspectives on moving beyond the math wars. *Retrieved from httpzllmathematicallysane. com/analysis/trenchesasp*.

Davis, J. D. (2005). Connecting Procedural and Conceptual Knowledge of Functions. *Mathematics teacher, 99*(1), 36-39.

Durkin, K., Star, J. R., & Rittle-Johnson, B. (2017). Using comparison of multiple strategies in the mathematics classroom: lessons learned and next steps. *ZDM, 49*(4), 585-597. doi:10.1007/s11858-017-0853-9

Engelbrecht, J., Bergsten, C., & Kagesten, O. (2009). Undergraduate Students' Preference for Procedural to Conceptual Solutions to Mathematical Problems. *International Journal of Mathematical Education in Science and Technology, 40*(7), 927-940.

Engelbrecht, J., Bergsten, C., & Kågesten, O. (2012). Conceptual and Procedural Approaches to Mathematics in the Engineering Curriculum: Student Conceptions and Performance. *Journal of Engineering Education, 101*(1), 138-162.

Engelbrecht, J., Harding, A., & Potgieter, M. (2005). Undergraduate students' performance and confidence in procedural and conceptual mathematics. *International Journal of Mathematical Education in Science and Technology, 36*(7), 701-712.

Hechter, J. (2020). *The relationship between conceptual and procedural knowledge in calculus.* (PhD (Mathematics Education)). University of Pretoria, Pretoria. Retrieved from http://hdl.handle.net/2263/78457

Kilpatrick, J., Swafford, J., & Findell, B. (2001). *The strands of mathematical proficiency*. Washington.

Rittle-Johnson, B., Schneider, M., & Star, J. R. (2015). Not a one-way street: Bidirectional relations between procedural and conceptual knowledge of mathematics. *Educational Psychology Review, 27*(4), 587-597.

Rittle-Johnson, B. (2017). Developing mathematics knowledge. *Child Development Perspectives, 11*(3), 184-190.

Rittle-Johnson, B., Fyfe, E. R., & Loehr, A. M. (2016). Improving conceptual and procedural knowledge: The impact of instructional content within a mathematics lesson. *British Journal of Educational Psychology, 86*(4), 576-591.

Sowder, J. (2007). What are the "Math Wars" in California all about? Reasons and Perspectives. *Mathematically sane: Promoting the rational reform of mathematics education*.

Star, J. R. (2005). Reconceptualizing procedural knowledge. *Journal for research in mathematics education*, 404-411.

Star, J. R., Rittle-Johnson, B., & Durkin, K. (2016). Comparison and explanation of multiple strategies: One example of a small step forward for improving mathematics education. *Policy Insights from the Behavioral and Brain Sciences, 3*(2), 151-159.

Wu, H. (1999). Basic skills versus conceptual understanding. *American Educator, 23*(3), 14-19.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14630

OPS4Math project -Optimization and Problem Solving for Teaching of Mathematics: teaching strategy, organization and objectives

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Abstract

Several initiatives have been implemented worldwide to foster student interest towards STEM disciplines. These initiatives are based on the awareness that mathematics is essential for scientific and technological advancement: it trains to reasoning and reflection, stimulates logical capabilities and intuition, improve investigation attitude. Most of them recognize also that mathematical problem solving represents an effective way to support teachers and students in their teaching and learning activities, respectively. In this context, this work is aimed at presenting OPS4Math (Optimization and Problem Solving for Teaching of Mathematics), a training project for Secondary School teachers, supported by Italian Ministry of University and Research. The driving idea, widely discussed by the scientific community, is to operate a reversal of the didactical perspective: starting from phenomena/problems to introduce concepts of data, variables, relationships and functions in an appealing way. We present project organization, structure and aims, to give useful hints for its replication.

Keywords: *Problem solving; optimization; teaching and learning strategy.*

1. Introduction and project context

Nowadays, the teaching of science, technology, engineering and mathematics, i.e., the so called STEM disciplines, represents a relevant topic of discussion given their boosting role for the economic growth of any developed and developing country. Roughly speaking, we can say that teaching STEM disciplines can be conceived as teaching skills and subjects in a way that resembles real life. Indeed, through STEM education, students learn facts and a method of thinking/reasoning that can be applied to solve real complex and multidimensional problems. Becoming a STEM professional requires may years of preparation to gain academic and job-specific knowledge through higher learning institutions and field training. Such knowledge defines the so called hard skills or technical skills. However, this knowledge is not sufficient if it is not integrated by the acquisition of the so called professional soft skills and competences, which are fundamental to succeed in a career path (e.g., communication skills, problem-solving, critical thinking, teamworking, and digital skills) (Lavi et al. 2021). Such skills, deriving from personal habits and personality, define the way one works on his own and with the others. As reported in Szabo et al. (2020), the importance of such skills has been widely discussed at several levels by OECD (Organization for Economic Co-operation and Development), and by EU (European Union). As further confirmation, in many job descriptions, employers often ask for a combination of hard and soft skill. Thus, without fear of being proven wrong, we can say that this combination represents a key enabling and competitive factors to face the STEM challenges of modern societies.

In this context, the need arises of accompanying and supporting the hard skill education at school and university level with the introduction of soft skills in classical STEM education curricula (Falloon et al. 2020). This target is shared but it is also recognized that teaching soft skills is much harder with respect to hard skills. As evidence of this, numerous studies highlight that there continues to be a skills mismatch between graduates and job market.

This work deals with problem solving, and more precisely, on mathematical problem solving, which is likely one of the most discussed soft skills in literature, given its central role in STEM professions because of its relationship with mathematics teaching and education. Moreover, we will focus only on the Italian situation. The literature is rich of problem-solving definitions differing in the number of actions to be performed. However, all of them, share the following concepts and phases defined by Pólya (1945) in his so-called heuristic method: problem and goal definition; problem solution and generation of the solutions; implementation of one or more solutions; evaluation of the results and feedback operations for continuous improvement. These concepts can be easily transferred to the mathematical problem solving. Indeed, it is widely recognized that learning mathematics concern reasoning not memorization, or in other words, it concerns the development of processes to reach a solution, rather than the application of a set of procedures. Thus, problem-solving can be considered as a mean to engage students on complex tasks with the aim of: developing the

strategic thinking; providing a deeper understanding of mathematical concepts; fostering the appreciation of the relevance and usefulness of mathematics.

This view of teaching and learning mathematics in relation with problem solving and its application in STEM disciplines has been largely discussed also in Italy, where national institutions recognize the importance of promoting STEM education and the need of enhancing cross-curricular integration of mathematics (Ceselli and Righini, 2017). In this context, several national actions have been put in place. Among the others, we cite here: the "Scientific Degrees Project" (Progetto Lauree Scientifiche, PLS), started in 2004, by which the government offers incentives to students who enrol in STEM curricula; the initiative "Alternanza Scuola-Lavoro (ASL)", started in 2015, which foresees secondary school students to spend a prescribed yearly number of hours in companies and other institutions rather than at school; finally, from 2018, the initiative "PCTO – Percorsi per le Competenze Trasversali e l'Orientamento", which foresees training paths of at least 210 hours in the last high school three years, aimed at the development of student personal and transversal skills. Moreover, other local actions have been made in these years, more focused on the problem-solving skills and its connection with operations research. For the sake of the brevity, we address the interested reader to the work by Raffaele and Gobbi (2021). However, most of these initiatives are more focused on "*teaching mathematics for problem-solving*" rather than "*teaching mathematics through problem solving*". Thus, they do not reflect directly in actions devoted to the insertion of problem solving in school curricula, thus confirming the mismatch between the mathematics education provided by school and university and the required problem-solving skills.

This work is aimed at presenting a project providing a contribution in filling this gap. It is devoted to the presentation "OPS4Math – Optimization and Problem Solving for Teaching of Mathematics", a training project for Secondary School teachers organized by the University "Federico II" of Naples, financed by Italian Ministry of University and Research (D.D. 1662 del 22.10.2020), and supported by Campania Regional Education Office. The project driving idea, resembling the "teaching mathematics through problem solving" approach, consists in operating a reversal of the didactic perspective in classical curricula: starting from phenomena/problems to introduce concepts of data, variables, relationships and functions in an appealing way, providing new materials for mathematic teachers of Secondary School. We present project organization, structure and aims, to give useful hints for its replication at national and international level.

The rest of the work is organized as follows: *Section 2* briefly discuss the mathematical problem-solving approach, its usage in Italy and its implementation in OPS4Math project; *Section 3* is devoted to the presentation of the organizing team background and describes the overall project; finally, *Section 4* reports conclusions and a discussion about project future outcomes and challenges.

2. Problem-solving and teaching of mathematics

Nowadays, mathematics education provides the student with the set of mathematical tools and techniques (e.g., axioms, theorems, proofs, formulas, etc.) required by the school curricula. In other words, we could also say that it focuses on the essentials ingredients of mathematical knowledge and understanding the student is expected to manage when solving and practicing on the solution of given exercises (Schoenfeld, 2016).

However, two situations often occur in mathematical learning in Italy. On one side, it is widely recognized that mathematics appears to the students as a difficult subject. On the other side, students apparently know everything they need to know, but they are not able to transfer their mathematical knowledge in other situations. Both situations reflect a poor knowledge of mathematics which appears today as a weakness condition in all the situations where a numerical approach has to be adopted to solve problems arising in real life complex systems.

Mathematicians have always understood that problem-solving, allowing the application of mathematics in everyday life, has a central role in mathematics education since without a problem there is no mathematics. At the same time, it is also clear that mathematics teaching cannot be reduced to just reality-based examples. In this context, the mathematical problem-solving teaching approach arises as a good comprise solution between the applicative and theoretical aspects of mathematics teaching. Its main aim is to engage the students in applying their knowledge of mathematical concepts to real life problems, integrating and connecting isolated pieces of mathematical knowledge, making connections between problem information and mathematical operations, patterns, and rules (Klang et al, 2021). Problem solving and mathematical problem solving have been widely treated in literature over the past fifty years, starting from the work of Pólya (1945). A review of the complete body of research is beyond the scope of this work. Thus, we limit ourselves to address the interested to the contributions by Schoenfeld (2016) and Stohlmann and Albarracín (2016).

In the following, we will just focus on two different usages of mathematical problem-solving with respect to teaching of mathematics. Two main strategies are discussed in literature (Charles, 2009, and Klerlein and Hervey, 2019): "*teaching mathematics for problem solving*" *(TM-for-PS)* and "*teaching mathematics through problem solving*", (*TM-through-PS*).

As discussed in Schoenfeld (2016), *TM-for-PS* implies the following five underlying usages of problem solving: as a justification for teaching mathematics; to provide specific motivation for subject topics; as recreation; as a means of developing new skills; as practice. Thus, problem solving mainly represents a mean to facilitate the mathematical teaching and practicing mathematical instruments. Instead, *TM-through-PS*, is based on the conviction that introducing new concepts and skills in problem-solving context inspires thinking and reasoning about mathematical embedded ideas. Thus, problem solving represents a mean to teach mathematics in a way that makes sense to students.

It is easy to understand that both strategies should play a relevant role in mathematics teaching and education. However, most of the initiatives, made at Secondary School level in Italy in the last 15 years, are mainly focused on *TM-for-PS*. 1. To the best of authors knowledge, no initiative in Italy, has been focused on TM-through-PS.

2.1. Problem Solving approach in OPS4Math

The previous discussion on mathematical problem solving and related teaching strategies has a twofold aim: one side, motivating the need of developing a teaching strategy which well balances *TM-for-PS* and *TM-through-PS*; on the other side, highlighting the lack of *TM-through-PS* initiatives in Italy. Concerning this lack of *TM-through-PS* with respect to *TM-for-PS* initiatives, the main reasons can be summarized as follows:

1. The conviction that *TM-for-PS* initiatives have a faster impact on the pursued objective of improving the results of Italian students at OCSE-PISA tests.
2. It is easier for teachers to include *TM-for-PS* subjects in the current mathematics curricula. Such inclusion is also coherent with the way schoolbooks are written.
3. The usage of *TM-through-PS* strategy requires a significant change in the way lessons have to be made. Thus, teachers require professional learning and training experiences to support this change.

OPS4Math project, "Optimization and Problem Solving for Teaching of Mathematics", is aimed at supporting the integration of *TM-for-PS* and *TM-through-PS*, providing a contribution in terms of teachers training and material drafting, coherently with the issues raised in Anderson (2005) and Akhter et al. (2015). More precisely, it provides a training activity for Secondary School teachers of Mathematics in Campania Region, to present the mathematics curricular subjects by a problem-solving approach.

In this scheme, a special attention will be devoted to the didactical strategy and therefore to the relation between deductive and inductive reasoning. The Italian (mathematical) tradition is historically linked to the deductive approach, preferring a didactical path which starts from definitions and hypotheses to reach a thesis and a rule, applicable, whereby necessary, to the explanation of a physical or natural phenomenon and to the solution of a real problem. This approach determined the development of a rigorous (and necessary, sometimes compulsory) formal language, which does not encourage the approaching to mathematics and even facilitates the removal (estrangement) from it. This happens increasingly in this historical phase which sees the transition from the "*learning for reading"* to the *"learning for hearing and vision*". In the second half of the last century the relationship of Mathematics with real problems strongly developed, in connection with Computer Science, Artificial Intelligence and Data Science. Consequently, the teaching of Mathematics is subjected to a transformation process, devoted to put in contact the student with its application. Thus, in this moment, the

inductive reasoning appears to be more suitable to push students towards mathematics, appreciating his capability to analyse phenomena, modelling and solving real problems.

OPS4Math project operates in this direction. The mathematical problem-solving approach, and more precisely *TM-through-PS* strategy, allows to operate what we call the "*reversal of the didactical perspective*". Starting from phenomena and problems allows to introduce the concepts of data, variables, analytical relationships and functions in an appealing way. Mathematical modelling can be used to define the mathematics contents in a way which is not abstract and conceptual but linked to the reality. Simple decisional problems can be conceived as samples of real complex problems in the fields of traffic, transportation, environment, health and all other economic sectors. Thus, identifying and building models and developing action plans are crucial matters of the problem-solving approach to acquire mathematical knowledge. In this context, great relevance will also be given to optimization problems, solution algorithms and computational thinking, which are key elements for STEM disciplines. Thus, the name of the project OPS4Math, recalls its 4 pillars: Problem Solving, Optimization, Algorithms, Didactical strategies.

3. OPS4Math project

OPS4Math project will be developed by the Operations Research Group of the Optimization and Problem-Solving Laboratory (OPSLab) of the University "Federico II" of Naples. Such project arises from the experience gained by the group in the last 15 years of collaborations with education institutions. More precisely, the group participated in the following initiative. The Education Department of Campania Region promoted two courses, "Logimat" and "Logimat2" (in the period 2008 – 2010), focused on the logical-mathematical learning. The scope was to train mathematics teachers of Secondary School, within a deal between Public Education Ministry and Campania Region. After this experience the Campania Office of Education Ministry conducted another initiative devoted to developing the problem-solving approach in teaching of Mathematics in Secondary School. The project "OCSE PISA 2015 - Objective 500", had the aim to increase proficiency of the fifteen years old students of Campania to reach the score 500 at the OCSE PISA test. The project was biennial, and 80 schools participated to the initiative. Later, "Science Center of Naples" promoted the "LogicaMente", a national project to support the improvement of scientific, logic and mathematical skills of the students. In the last six years, the University "Federico II" of Naples constituted the F2S group ("Federico II in School") to build a link between School and University, with the aim of preparing students to tackle the university experience.

OPS4Math project is aimed at "*making a system*" of previous experiences. Indeed, as done in "Logimat" and "Logimat2", a training activity for teachers is foreseen, and, as done in

"OCSE PISA 2015 - Objective 500", a validation with students in classroom will be made. The following subsections will provide the project organizational details.

3.1. Phases of the project

The project is organised in 4 phases.

Phase 1: Preparatory phase and activity planning

- Meeting with the Regional Education Office for selection of the involved schools and teachers
- Meetings with the directors of the selected school
- Preparation of the educational material, software and multimedia instruments

Phase 2: Training of the teachers

The training activity will be performed through lessons and seminars held by experts in the field of mathematics, statistics, physics and operations research. They will focus on:

- Data collection and analysis, time series and graphical representation
- Introduction of mathematical relationships and functions by the definition and solution of real problems
- Topics of the curricular programme presented with a problem-solving approach
- Modelling of real decisional problems and related algorithms
- Software for teaching of mathematics

The class will be composed by 25-30 teachers. At the end of the course, the selected teachers, individually or in team, with the supervision of an expert, will prepare a short seminar/working paper, where they present a curricular subject by a problem-solving approach. Such material will be one of the outputs of the project.

he course is structured in 15 meetings, so defined: opening and project presentation; training lessons of about 4 hours; final meetings for the presentation of the work made by the teachers. Seminars and lessons will be held in blended form, to prevent the covid-19 risk and to support the participation of teachers living far from the venue of the meetings.

Phase 3: Field testing of the didactical strategy

A field testing of the didactical strategy will be performed with the teachers and the students of a set of schools selected in cooperation with the Regional Education Office. The students will be invited to express their opinion about the proposed didactical strategy and their appreciation to promote their participation in the didactical trial. The field testing foresees fifteen 2-hour meetings in the selected schools. The trained teachers could become trainers of other teachers, so activating a mechanism of pyramidal dissemination aimed to reach a larger number of students.

Phase 4: Dissemination of the results

A final workshop will be organised to present the results of the project, to debate on the theme and to hand the attendance certificate to the teachers. The results of OPS4Math will be broadly diffused through the website of the project (*ops4math.dieti.unina.it*), together with the didactical material, video, multimedia, tests and links to the literature.

3.2. Objectives

The main objectives of the project can be summarized as follows:

- Showing teachers and students that an alternative way of teaching of mathematics is possible, by studying and analysing phenomena and solving real problems.
- Verifying in the classrooms the response and the reaction of the students to the proposed didactical approach.
- Stimulating the study and the practice of the mathematical modelling, algorithms and software, to foster the study and the learning of mathematics and, more generally, STEM disciplines.

3.3. Contributors

Two scientific associations, working in the education field at school and university levels, are involved in the project: AIRO (Italian Association of Operations Research), established from 1961, to which Operations Research teachers and researchers join, mostly from the University; Mathesis (Italian Society of Mathematical and Physical Science), established from 1895, to which Mathematics and Physics teachers join, mostly from the School.

Several experts coming from these associations will be involved in the training phase. During the project other associations and institutions could be involved in the project, with the aim of activating working groups, coordinating experiences and disseminating best practices.

4. Conclusions

In this work we presented OPS4Math, an Italian training project aimed at supporting the integration of the problem-solving approach in the mathematics teaching at Secondary Schools in Italy. The main aim of the project is to foster the "*teaching mathematics through problem solving*" strategy. Such aim will be pursued by what has been defined as the "*reversal of the didactical perspective",* i.e., starting from phenomena and problems to introduce curricular mathematical concepts in an appealing way. This is a very challenging task, since it requires a re-thinking of the classical way mathematics teaching is done in Italy (Akhter et al., 2015 and Foster, 2019). However, the authors are convinced that such approach is fundamental to foster STEM disciplines. Obviously, the authors are also aware that such "*reversal of the didactical perspective"* should be integrated and complemented

with other actions related to re-thinking also the way schoolbooks are written and the assessment system.

References

Anderson, J. (2005). Implementing problem solving in mathematics classrooms: What support do teachers want. Building connections: Theory, research and practice, 89-96.

Akhter, N., Akhtar, M., & Abaidullah, M. (2015). The Perceptions of High School Mathematics Problem Solving Teaching Methods in Mathematics Education. Bulletin of education and research, 37(1), 55-77.

Ceselli, A. & Righini, G. (2018). Innovative Education: "Ottimizziamo!" ("Let's optimize!"). https ://pubso nline .infor ms.org/do/10.1287/orms.2018.04.11/full/.

Charles, R. I. (2009). The role of problem solving in high school mathematics. Research into Practice Mathematics.

Falloon, G., Hatzigianni, M., Bower, M., Forbes, A., & Stevenson, M. (2020). Understanding K-12 STEM education: a framework for developing STEM literacy. Journal of Science Education and Technology, 29(3), 369-385.

Foster, C. (2019). The fundamental problem with teaching problem solving.

Klerlein, J., & Hervey, S. (2019). Mathematics as a complex problem-solving activity: Promoting students' thinking through problem-solving. Generation Ready White Paper.

Klang, N., Karlsson, N., Kilborn, W., Eriksson, P., & Karlberg, M. (2021). Mathematical Problem-Solving Through Cooperative Learning—The Importance of Peer Acceptance and Friendships. In Frontiers in Education (p. 324). Frontiers.

Lavi, R., Tal, M., & Dori, Y. J. (2021). Perceptions of STEM alumni and students on developing 21st century skills through methods of teaching and learning. Studies in Educational Evaluation, 70, 101002.

Pólya, G. (1945; 2nd edition, 1957). How to solve it. Princeton: Princeton University Press.

Raffaele, A., & Gobbi, A. (2021, March). Teaching Operations Research Before University: A Focus on Grades 9–12. In Operations Research Forum (Vol. 2, No. 1, pp. 1-32). Springer International Publishing.

Schoenfeld, A. H. (2016). Learning to think mathematically: Problem solving, metacognition, and sense making in mathematics. Journal of education, 196(2), 1-38.

Stohlmann, M. S., & Albarracín, L. (2016). What is known about elementary grades mathematical modelling. Education Research International, 2016.

Szabo, Z. K., Körtesi, P., Guncaga, J., Szabo, D., & Neag, R. (2020). Examples of problem-solving strategies in mathematics education supporting the sustainability of 21st-century skills. Sustainability, 12(23), 10113.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14258

Development of a Muon detector for educational purposes

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Abstract

In the effort to communicate modern physics to a vast audience, the flux of cosmic ray muons is commonly mentioned as the most abundant, naturally available particle/radioactivity source. The detection of atmospheric muons can therefore make up a powerful workbench for educational purposes, allowing many laboratory experiences in different topics of modern physics like special relativity, cosmic rays, statistics and particle detection. Unfortunately, a particle detector being suitable for cosmic-ray muon identification is typically expensive, cumbersome and requires high voltage, thus preventing its widespread application in laboratory sessions based on cosmic ray muons, ex. gr. for undergraduate courses. Here we describe the project for a low-cost muon detector based on a plastic scintillator coupled with silicon photomultipliers, whose signals are acquired and preprocessed via a common FPGA evaluation board. Besides the detector, which was developed by supervised master students, we describe some possible physics measurements.

Keywords: *Muon Detector; Scintillator; Data Acquisition; FPGA.*

1. Introduction

Modern society, economy, health and politics are strongly influenced by scientific developments. For this reason, effective science communication is important to enabling informed decision-making and participation of citizens in society and political discourse. However, modern physics communication, ranging from public talks to participatory projects, often reaches only limited parts of society. This could be sometimes attributed to the very faint effects involved by quantum mechanics or special relativity; the absence of macroscopic quantum/relativistic phenomena in the everyday life limits modern physics communication to a theoretical/phenomenological description and often, for the vast audience, most of the modern physics concepts are misspelt or distorted by science-fiction. In the effort to communicate modern physics to a vast audience, as an example, the flux of cosmic ray muons is commonly mentioned as being the most abundant particle/radioactivity source naturally available in our environment. The detection of atmospheric muons could be a powerful tool for educational purposes, allowing many laboratory experiences in different topics of modern physics like special relativity, cosmic rays, statistics and particle detection. Unfortunately, a particle detector, suitable for relativistic muon identification, is typically expensive, cumbersome and requires high voltage, this prevents widespread laboratory demonstration sessions or public talks based on the detection of cosmic rays. As an example, the Extreme Energy Events (EEE) project (Abbrescia et al. 2018) is a joint educational and scientific initiative and operated 50 muon telescopes distributed in Italian high schools. Each EEE telescope is built at CERN by high school teams under the supervision of researchers and technicians, and is a high-performance particle detector with an area of 0.82×1.58 m^2 and requires continuous gas fluxing and the use of 10kV voltage bias. Beyond the costly production and operation, a similar gas detector cannot be simply moved or transported, for this reason, more recent educational projects for muon detection are based on plastic scintillators coupled to a silicon photomultiplier (SiPM) that allows avoiding risks related to high voltage in the didactic tool. Aramo et al. (2017) installed an educational muon telescope based on a plastic scintillator and SiPMs in the Toledo Metro station of Naples; this is a portable detector, but it is still expensive and complex being able to track the muon direction thanks to 200 SiPM readouts, the detector was developed at the Gran Sasso National Laboratory (LNGS-INFN). Both these projects are characterized by high cost and high complexity and the detector construction and track reconstruction cannot be pursued simply by the students but requires advanced expertise developed at CERN or LNGS. On the other hand, cheap and simple projects for portable muon detectors exist, they use microcontrollers like Arduino (Bocci et al. 2015) or Raspberry Pi (He et al. 2019) for data acquisition (DAQ) of a single (or few) SiPM readout connected to a plastic scintillator, similar projects can be fully developed by supervised students. The main drawback of the microcontroller-based DAQ is the necessity for the development of a custom interface board for the SiPM readout

and the relatively low achieved sampling frequency. In our project, we choose to develop a muon telescope DAQ using a commercial Field Programmable Gate Array (FPGA) development board (Xilinx Spartan-3A/3AN) this avoids the necessity of additional custom boards and allows much faster sampling frequency, maintaining the overall cost as low as the microcontroller-based detectors. Moreover, this FPGA development board allows the simultaneous acquisition of two readout channels permitting the coincidence of two scintillators in a telescopic configuration, this is a major educational virtue concerning the single SiPM Arduino based DAQ. The detector design, software, test and prototype development are performed by supervised students during a laboratory stage session within the course "Laboratory of Advanced Electronics" held at the University of Trento. We use these muon telescopes for cosmic ray laboratory measurements in another course: "Experimental Techniques in Nuclear and Subnuclear Physics" at the same University, moreover thanks to the portability and usage simplicity, such a muon telescope is suitable for the measurement of zenith angle muon distribution performed by high school students during the yearly outreach event "International Cosmic Day" worldwide organized by DESY (Hutten et al. 2017).

2. The Plastic Scintillator and the Silicon Photomultiplier (SiPM)

Particle detection is one of the pillars of modern experimental physics. The particle detector used for the muon telescope described here is a plastic scintillator EJ-200 from Eljen Technology, consisting of the polymer base Polyvinyltoluene. The working principle of the scintillator is summarized as follows: when a charged particle crosses the detector material, it releases energy in the form of ionization, a small part of which produces several visible photons proportional to the deposited energy; for EJ-200 material we expect an average number of 10 photons/keV released within few ns from the particle ionization. For the prototype of the portable muon detector described here, a plastic scintillator bar with dimensions 18x4x1 cm^3 was used, while the detector was coupled to two Silicon Photomultipliers (SiPM) placed at the centre of each side of the bar. The raw side of the scintillator bar was smoothed using (thin) sandpaper and polished using a common plastic headlight restoration kit. An example of a raw and polished scintillator along with two SiPMs is shown on the left side of Figure 1. In this prototype the 4x4mm^2 NUV-4S-P SiPM produced by AdvanSiD was used; we suggest using SiPM mounted on small PCB boards.

Figure 1. Left) Example of raw and polished EJ-200 plastic scintillator bars and two commercial SiPM boards. Right) The scintillator is equipped with SiPMs and wrapped with black tape to avoid external stray photons.

To improve the optical coupling and avoid the presence of small air gaps, the gel couplant EJ-550 was applied to the SiPM surface. The SiPM is an electronic device that can convert light photons into electrical pulses whose amplitude can be acquired by suitable DAQ electronics. From the electrical point of view, the SiPM is made of many cells containing avalanche photodiodes connected in parallel (see Fig. 2 left). Each SiPM is reverse biased to a negative voltage of about 30 V. When a bunch of photons hits the SiPM cells, a current pulse, proportional to the number of hit cells, is generated. In this application, to match the 245 kHz FPGA sampling rate (see below), a sufficiently long recovery time of the SiPM signal is desired. For this reason, a 100kOhm load resistor was used to match the parasitic capacitance of the SiPM. An example of different SiPM pulses, due to muons and acquired by an oscilloscope, is shown in Fig. 2 right.

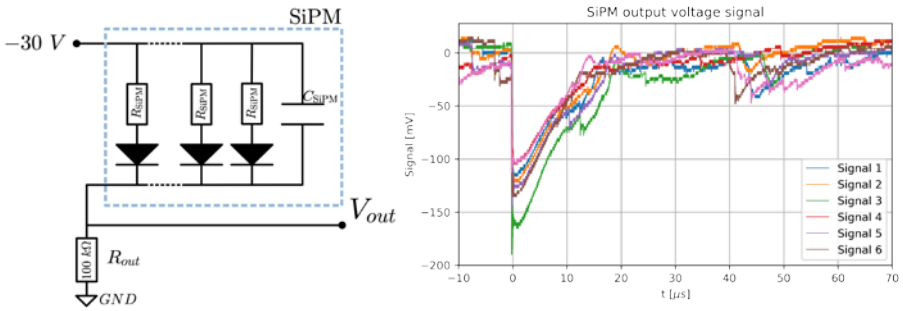

Figure 2. Left) Simplified electrical model of the SiPM in reverse bias polarization. Right) Some examples of voltage response of the SiPM after the arrival of a muon acquired by an oscilloscope.

Finally, the plastic scintillator was wrapped with both white teflon tape to improve the photon collection along the bar and with black tape to obtain a light-tight envelope that minimizes the occurrence of environmental stray photons (Fig. 1 right). In the case of a still significant residual environmental light, the related noise could be rejected by requiring the coincidence of signals in both SiPM. However, the use of an additional light-tight external box, possibly 3D printed, is suggested.

3. Data acquisition through an FPGA development board

As anticipated above, for the data acquisition of this portable muon detector a *Xilinx Spartan-3A/3AN FPGA* development board was used. It has however to be stressed that other cheaper and faster FPGA development boards are presently available, sometimes providing even more analogue inputs. An FPGA is a device containing a large number of basic logic cells, gates and flip-flops, whose interconnections can be programmed by using a hardware description language. As a result, by relying on an FPGA, it is possible to implement many kinds of digital electronic circuits and even processors. We have chosen this kind of tool to acquire and process signals, and send the results to a computer. Our development board provides two analogue input channels, each one equipped with a pre-amplifier whose gain can be programmed from 1 to 100. Each amplified signal is then inverted and digitally acquired by a 14 bit Analog to Digital Converter (ADC) working in the range 0.4-2.9V. The resulting digital number is processed by the FPGA. Figure 3 summarizes the DAQ chain.

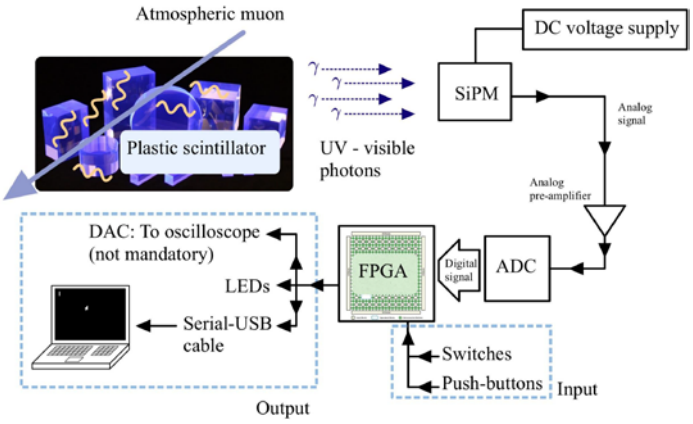

Figure 3. Block diagram of the proposed muon detector showing the roles played by the scintillator, the SiPM, the FPGA, and all the I/O devices integrated on the FPGA development board

The FPGA software was developed by using Verilog HDL codes. The first task is to determine the signal baseline, namely a relatively small DC voltage component due to the currents flowing within a biased SiPM when no photon is impinging on the detector. For each channel, the signal baseline is determined by evaluating the moving average of 1024 samples of the signal digitized at a 245 kHz sampling rate. Thereupon, when a sample of one of the two channels crosses a threshold preset by the user above the baseline, the maximum value of the resulting signal is stored and replaced (peak detector). When the signal returns below the threshold, the recorded value is sent to the DAQ management system and the peak detector goes back to its *idle state*. The coincidence detection among the two channels is implemented within the DAQ system whenever the signals stemming from both channels are simultaneously above the thresholds. At this point, a suitable chronometer records the time

of the events, and the resulting information is sent to the serial interface together with the two signal amplitudes described above. To collect, visualize, and analyze data, the FPGA board is connected to a PC via a serial USB cable by using the UART protocol. The PC serial ports of the PC can be read by using common software like *GTKTerm* on *Linux*, or *Instrument Control Toolbox* on *MATLAB*, as well as via *Python* routines that use the *PySerial* package. Finally, the LCD display placed on the FPGA development board can be used to count the muons. Suitable switches and pushbuttons allow resetting the counts.

4. Example of measurements performed with a portable muon detector

In this section, some didactic activities offered to the students of the course "Experimental Techniques in Nuclear and Subnuclear Physics" are summarised; the cooperative learning approach was adopted in the laboratory by organising students in small groups. The first measurement that can be performed with the portable muon detector is the integrated muon flux at the ground, which is obtained by dividing the detector count rate by the detector surface (in this case 72 cm^2). Performing this measurement in Trento (200 m above sea level) led us to obtain a muon flux $\phi_0 = (113 \pm 1)$ m^{-2} s^{-1}. This value is in reasonable agreement with the expected muon flux reported by Particle Data Book (Zyla et al. 2020) for horizontal detectors at sea level. We note that small variations in the muon flux might be due to different latitude, altitude and atmospheric pressure or temperature, as well as to the different building structures/thicknesses whenever the flux measurements are not performed outdoors. From a modern physics point of view, the measurement of muon flux at different elevations is a powerful test of special relativity and Lorentz transformations. As an example, with the portable muon detector it is possible to repeat the flux measurement in the nearby small village of Vason (1650 m above sea level, 40 min by car or 1.5 h by bus from Trento) obtaining $\phi_h = (141 \pm 1)$ m^{-2} s^{-1} that is just a bit higher value despite the relatively large elevation difference. Knowing that the muon lifetime is □ = 2.2□s we argue that the time it takes for the muons to descend from Vason elevation to Trento elevation (T = 4.8□s in our lab. frame) must be shrunk in the muon rest frame by a factor □ = (T/□)/ln(ϕ_h/ϕ_0) ~ 10. This demonstrates that muons are arriving at the ground with a relativistic velocity of ~99% of the speed of light. Another interesting measurement relies on the ability of this muon detector to measure the energy deposited by the muon crossing the scintillator slab. The left panel of Figure 4 shows the correlation of event amplitudes measured by the left side SiPM Ch1 and right side SiPM Ch2. The energy deposited by a charged particle crossing a small material thickness is described by the Landau distribution: for relativistic muons crossing 1cm of plastic we expect an energy deposited of 1.75 MeV (Zyla et al. 2020), which allows an energy calibration of the measured ADC counts. In the right panel of figure 4, the distribution of the average of the two ADC channels is shown. The red curve is a fit performed by using the Landau distribution with an additional exponential contribution. For signal amplitudes below

the Landau peak, the electronic noise is the dominant contribution, whereas the long right tail is due to different factors like the Landau distribution, the existence of some inclined muons in the cosmic ray flux and the limited energy resolution due to a low surface of SiPM readout.

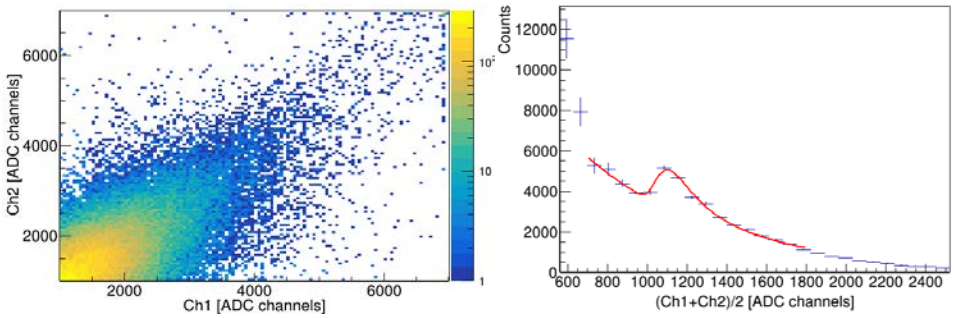

Figure 4. Left) Correlation of signal amplitudes. Right) Measured average amplitude distribution.

Another interesting measurement regards the statistics. The distribution of time differences for consecutive events can be plotted and compared with the exponential distribution that is expected considering a memoryless Poisson process (fig. 5 left panel). The fit of the experimental time difference distribution using an exponential function provides the rate of $R = (0.817 \pm 0.004)$ Hz.

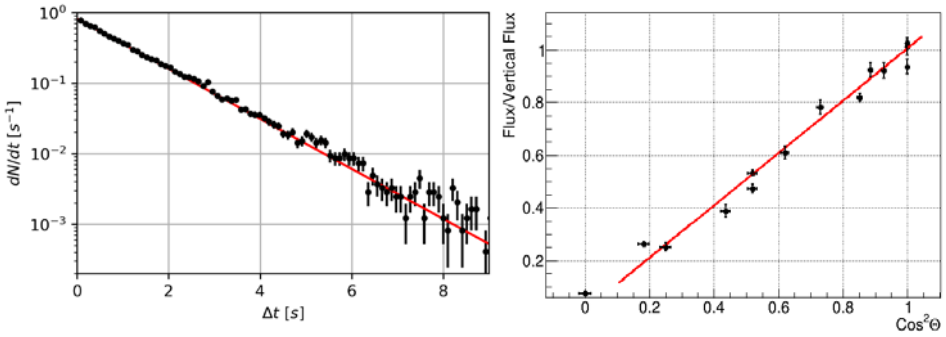

Figure 5. Left) Distribution of time difference for consecutive events. Right) Measured muon angular distribution.

Finally, it is possible to use two different scintillators in a telescopic configuration and perform many flux measurements changing the telescope zenith angle Θ. In the right panel of figure 5, the angular distribution of the muon flux is shown. The expected $\cos^2\Theta$ behaviour is measured indeed, which demonstrates that atmospheric muons travel mostly vertically due to their being produced as secondary particles by primary cosmic rays that hit the top of the atmosphere.

7. Conclusions

In this report, we summarize how a low-cost portable muon detector can be built by exploiting the digital electronics incorporated within an FPGA development board. This is a powerful educational tool and we suggest building it with the students in a course of "Laboratory of Advanced Electronics" and to use it for many measurements in high-level courses or also to communicate modern physics to a vast audience during public events like the yearly "International Cosmic Day". Some examples of possible measurements involving muon detection are shown, in particular, simply counting the number of muons detected in a time interval, i.e. the muon rate, it is possible to test the time dilation effect of special relativity and to measure the muon angular distribution proving that muons come from the sky.

References

Abbrescia, M. et al. (2018). "*Search for long distance correlations between extensive air showers detected by the EEE network"*. The European Physical Journal Plus, 133, 1-13. doi:10.1140/epjp/i2018-11898-x

Aramo, C., Ambrosio, M., Candela, A., & Mastroserio, M. (2017). *"Go to the astroparticle physics school with the Toledo Metro Station Totem-Telescope for cosmic rays"*. Proceedings of Science (EPS-HEP2017) 549. doi:10.22323/1.314.0549

Bocci, V., Chiodi, G., Nuccitelli, M., Iacoangeli, F., & Recchia, L. (2017). *"A low cost network of spectrometer radiation detectors based on the ArduSiPM a compact transportable Software/Hardware Data Acquisition system with Arduino DUE"*. Proceedings of ANIMMA2015 conference doi:10.1109/ANIMMA.2015.7465621

He, X., et al. (2019). *"Hybrid Portable Low-cost and Modular Cosmic Ray Muon and Neutron Detector"*. Proceedings of Science (ICRC2019) 078. doi:10.22323/1.358.0078

Hutten, M., et al. (2017). *"The International Cosmic Day – An Outreach Event for Astroparticle Physics"*. Proceedings of Science (ICRC2017) 405.

Zyla, P.A., et al. (2020). *"Review of Particle Physics"*. (Particle Data Book) Progr. Theor. Exp. Phys., 083C01. doi:10.1093/ptep/ptaa104

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14564

Enhancing student engagement in reflecting on professional skills development using digital tools for data collection and distribution

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Abstract

Tutors at NHL Stenden University in Leeuwarden, the Netherlands were challenged to enhance student participation in reflecting on professional skills development e.g collaborating. Using the living labs method, researchers set up research together with tutors and students. The living labs process consists of iterative design and evaluation cycles, involves endusers in all phases, and has evaluations carried out in real-life settings. In four iterations, we found that digital tools for collecting, merging and distributing data enhances student participation. Google Workspace for Education and Autocrat was used in this paper, a similar tool is Microsoft Office and Power Automate. Privacy of student data turned out to be one of the critical key elements and needs further discussion.

Keywords: *Student engagement; Google Workspace; Living lab; professional skills, Autocrat.*

1. Introduction

Students are easily distracted nowadays, since there are many temptations inside and outside of the classroom. The most common distractions for students who struggle with focus and concentration are their smartphones, intensive social media use, family and friends and their thoughts and worries (Schmidt, 2020). One's attention is diverted from the task or thought at hand and turned to another unrelated thought or activity. Students are multitasking while doing schoolwork, which has a detrimental effect on student learning and performance.

At NHL Stenden University in Leeuwarden, the Netherlands, tutors were challenged to get students engaged in reflecting on the development of their professional skills. In the first class in a series of eight classes during a semester, students formulate their professional goals for the semester on paper. After eight weeks, students reflect on their skills development. It turned out that some of the students lost their piece of paper. Others did a poor job in the reflections. Moreover, students who were well prepared were demotivated in talking to badly prepared peers about personal development.

The challenge was: how to engage students in reflecting on the development of their professional skills?

2. Design Based Education

The educational concept of NHL Stenden is Design Based Education (DBE). NHL Stenden University of Applied Sciences in Leeuwarden offers higher professional education programs which prepare students for their future profession. Students who complete the programs are awarded an associate, bachelor or master's degree.

This research was done in the Personal Development Program of the Bachelor Communication, using the professional skills collaborating as an example. Outcomes can be transfered to other educations and accompanying professional skills, e.g. bachelors degree in nursing (skill: communicating professionally with patients and their family) or a bachelors degree in teaching (skill: maintaining order in the classroom).

Design Based Education implies that students work on real-life issues. Collaborating with industry is inspiring and motivating for all stakeholders. Students differ from each other in terms of their qualities, experiences and cultural background. By working together on practical issues, they make use of these differences and learn from each other. With DBE, NHL Stenden University creates a learning environment in which students develop as a person and a professional. Lecturers are professionally competent and pay attention to a student's learning process. They coach students and give frequently feedback. Students, lecturers and the professional field form a learning community and learn from each other.

Working on real life issues, students use the six design thinking stages: empathize (research your users needs), define (state your users' needs and problems), ideate (challenge assumptions and create ideas), prototype (start to create solutions) test (try your solutions out) and implement. The design process is an iterative process, the practice of refining and improving a product or process through multiple iterations.

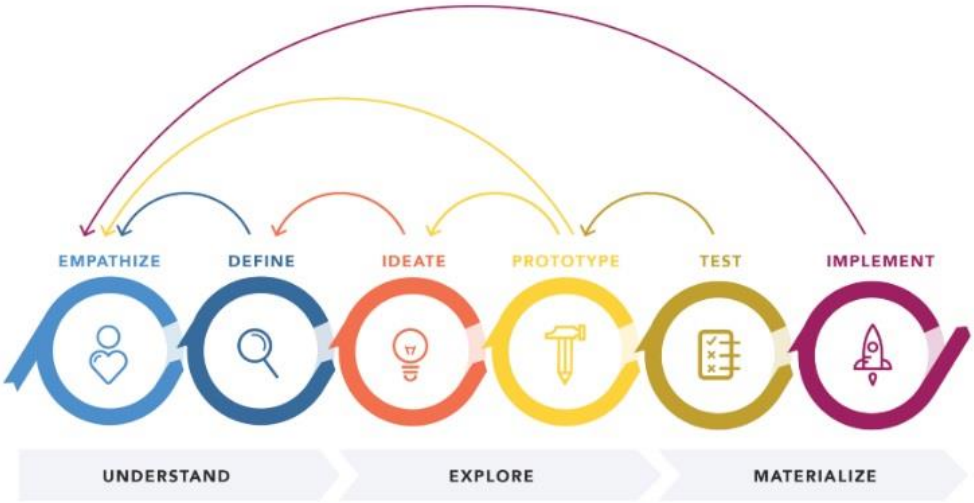

Figure 1. The six stages of Design Based Education

We followed the stages of DBE. It is attractive for tutors to practice what they preach.

3. Living lab method

We use the living labs design method for our research. The living lab design and evaluation approach refer to the methodological principles involved in the development process of new products/services. This process consists of iterative design and evaluation cycles, involves end users in all phases and has evaluations carried out in real-life settings with minimal obtrusiveness caused by measurement (Feurstein et al., 2008). Tutors work closely together with students and researchers on longitudinal knowledge media studies.

Action research in higher education is defined as a *critical collaborative enquiry by reflective practitioners who are accountable in making the results of their enquiry public, self-evaluative in their practice, and engaged in problem-solving and continuing professional development* (Zuber-Skerritt, 1992).

The major justification for the use of action-research is that (a) teachers have to plan the use and effects of each of their ICT-based projects, (b) during a project they have to collect data about its use and effects, (c) after the project they have to reflect on this by analyzing their

data, and (d), by doing so, they bridge their daily educational work with broad academic theory (Venkatesh et al., 2003).

4. The challenge to enhance student engagement

The challenge was to engage students in reflecting on the development of professional skills that are needed to become a communications officer. Seventeen Communication courses at universities in the Netherlands established nationwide six qualifications, seven professional skills and the body of knowledge that a student needs to obtain to graduate. In this paper, we use the skill collaborating as an example.

Table 1. Qualifications and professional skills of a communications officer.

Six qualifications:	***Seven professional skills:***
Context & strategy	Collaborating
Target group & behaviour	Innovative power
Concept & creation	Examining power
Planning & organization	Reflective capabilities
Persuasion and commitment	Emphatic capabilities
Connection & facilitation	Ethical beliefs
	Agility

Students work in small, interdisciplinary groups on assignments from external clients, e.g write a corporate communications plan (qualification: context and strategy). By working together to reach this goal, students need professional skills (skill: collaborating). Finally, the body of knowledge describes declarative or procedural knowledge about all aspects of the profession and the (scientific) domain.

At the beginning of each semester, students reflect on one of the professional skills during the Personal Development Program (PDP). They start with a baseline measurement in the first week, a discussion in small groups in the second week and close with a reflection on the obtained progress in the last week. The baseline measurement of the professional skill Collaborating consists of seven questions. Before each question, students rate themselves on a Likert scale (1-5) and substantiate their rating. We also ask students to write down two personal learning goals on this semesters skill, in our example: collaborating.

Table 2. professional skills rated from 1 to 5 and learning goals

rate	*Professional skill: collaborating*	*My personal learning goals for the professional skill: collaborating*
1-5	I show interest in other group members.	By the end of this semester, I want to listen without prejudice to my group members and to react openly and constructively to their input.
1-5	I make work agreements with group members and keep them.	
1-5	I listen to others and are open to their input.	
1-5	I take responsibility for process and product and you also speak others to it.	By the end of this semester, I want to mention three good points of each member and one point that could be improved and keep the relationship on a good level.
1-5	I contribute effectively to dealing with differences of opinion and solving problems within the group.	
1-5	I ensure a clear division of tasks.	

5. Connecting digital tools with an educational assignment

In the first stages of DBE, we did research on the usability of using digital tools for data collection and distribution. We used Google Workspace for Education and Autocrat, which is a document merge tool that takes data from a spreadsheet and merge it into a document via a template and send it to designated recepients. Microsoft Office and Power Automate offers the same functionality. We found valuable research on the use of Google Workspace, but no research was found on the use of Autocrat.

Google Forms is often used to gather, analyse and interpret information from various stakeholders (e.g. tutors, students, future employers). Teaching at Bangalore University in India, researchers found that Google Forms provides a good way to enhance collaborative stakeholder engagement in a wide country (Sandhya et al., 1970).

Google Forms can be used for daily course evaluation; as evaluations often come at the end of a course, they are summative in nature: they measure what has occurred (Gehringer, 2010). It would be better to get (formative) feedback during the course instead of at the end. Google Forms provide a flexible tool, to perform frequent evaluations, whereas Google sheets is helpful for flexible, detailed and fast analysis.

Google Forms can be used to increase active learning and as an instrument of formative assessment (Djenno et al., 2015). Google Forms provides an easy and inexpensive way to incorporate both active learning and assessment in library instruction sessions.

Tutorials on Youtube show some examples of tutors using Autocrat to gather data from students (e.g. name, date and course taken) and merge it into a certificate which is automatically sent to the student after passing a course (Johnson, J. 2021) or to merge test results into school reports and send it to students as a pdf (The EdTech Spot, 2020).

6. Four iterations to develop the new learning goal process

In the next phase of our research, we performed the DBE stages ideate, prototype and test. The living lab method gave us the opportunity to test in the real life setting of NHL Stenden university, using evaluation cycles with end-users (tutors and students). We performed these DBE stages four times, as we used test results to improve the prototype and to test again.

The **first** iteration was that students wrote the rating, their explanation and their two learning goals on a piece of paper, which they kept for themselves during the semester. It turned out that students lost their pieces of paper and that others poorly reflected on those, due to the fact that they did not take the assignment serious. A minor change was to hand in the paper to their PDP-tutor, but this turned out te become a time-consuming activity for the tutor: collecting, registering and handing back the papers, warning students that had forgotten the assignment and trying to hand back the assignments to students who were absent that week.

Figure 2. Collect data in Google Forms, displayed in Google Sheets.

The **second** iteration was to create a Google Form to collect the reflections of students. creating a Google Form is easy and costs little time. Once the Google Forms-questionnaire is created, it can be used multiple times. The data from Google Forms comes automatically in a Google Sheet, which can be read by the tutor. The link to the Google Forms was sent to students using the Learning Management System of NHL Stenden University.

Tutors were stunned by the amount of effort and the in-depth analyses the students had written, reflecting on their personal professional skills. The average student worked for about 45 minutes on the questionnaire. Most of the tutors had the students fill in the Google Forms-questionnaire in class, but in times of COVID-19, students did the work at home. We learned that our students also often shared personal remarks, therefore the tutors decided to add a disclaimer: *This questionnaire will only be used by your mentor and will not be further distributed. The information will be deleted at the end of the academic year.* The disclaimer is important. The information is private and must remain private.

The Google Forms questionnaire had disadvantages. The data in Google Forms is almost unreadable. Tutors were not able to use it during group discussions. In addition, students did not receive a copy of their answers, so they could not reflect on their learning goals.

Figure 3. Collect data in Google Forms and via a process mailed to student and tutor.

In the **third** iteration we collect data using Google Forms, which is automatically put in Google Sheets. Using the tool Autocrat, we merge data in a Google Docs-text document, convert it to a PDF document and automatically mail a copy to the student and his tutor. This iteration turned out to be the best as students work focused on their professional skills and actively participate in the group discussion in the second week. Both the tutor and the student receive copies of their questionnaire, which makes it easier to discuss the answers.

Tutors evaluate the third iteration positively. *Students are stimulated to actively think ahead, therefore consciously shaping the learning process with pleasure* (tutor A). *In the first years, students practice methodically with their professional skills using the questionnaire. After two years, the method is internalized, no forms and questionnaires will be needed* (tutor B).

Students also reacted positively. *I think it is a well-arranged document, you clearly know which parts you will be working on, easy to find, but difficult questions sometimes because you have to substantiate* (student A). *I think it's great that we do that, because then you can see later how much you have grown. You set clear goals for yourself. Later you can see whether you have achieved those goals. If so, it gives a sense of satisfaction. If you didn't make it, you know what to spend more time on* (student B).

In the **fourth** iteration, we discovered that Google Workspace for Education is not part of the application white list of privacy proof systems at NHL Stenden University in the summer of 2021. The Dutch Personal Data Authority (AP) stated that the identified risks relate to fundamental principles that apply to the processing of personal data which falls under the Dutch General Data Protection Regulation (AVG). Due to the lack of clarity about the processing of personal data by Google, this processing is not lawful. Google stated in a response that they are committed to the GDPR and that Google is working on solutions in order to facilitate Dutch Universities to use Google Workspace for Education. This will be different at other universities in other countries. Privacy is important, therefore we monitor the situation. Microsoft Power Automate is on the white list of privacy proof systems.

7. Conclusion

The living lab method is valuable and delivered fine results due to collaboration in a real-life setting. Students and tutors were motivated to adapt to new processes, because they were

involved during the complete process. The six DBE stages with iterations and frequent feedback by tutors and students gave the researchers valuable information to continuously improve the prototype. Google Workspace for Education + Autocrat is a free tool to easily and free of cost collect data, merge data in a new document and distribute it to designated users. Microsoft Office and Power Automate offers the same functionality. Dealing with personal professional skills, privacy is important. Students need to be absolutely sure that their data is safe and will only be used for the right demands.

References

Djenno, M., Insua, G. M., & Pho, A. (2015). From paper to pixels: Using Google Forms for collaboration and assessment. *Library Hi Tech News*, *32*(4), 9–13. https://doi.org/10.1108/LHTN-12-2014-0105

Feurstein, K., Hesmer, A., Hribernik, K., Thoben, K.-D., & Schumacher, J. (2008). *Living Labs – A New Development Strategy* (pp. 1–14).

Gehringer, E. (2010). Daily course evaluation with Google forms. *ASEE Annual Conference and Exposition, Conference Proceedings*.

Johnson, J. (2021). Use Autocrat to Mail Merge from Google Sheets to Docs, Slides, or PDF Files, https://www.youtube.com/watch?v=U1EyOo1_CA4. - Google Zoeken. (n.d.). Retrieved April 13, 2022, from Google Search.

Sandhya, S., Koppad, S. H., Kumar, S. A., Dharani, A., Uma, B. V., & Subramanya, K. N. (1970). Adoption of Google Forms for Enhancing Collaborative Stakeholder Engagement in Higher Education. *Journal of Engineering Education Transformations*, *33*(Special Issue). https://doi.org/10.16920/jeet/2020/v33i0/150161

Schmidt, S. J. (2020). Distracted learning: Big problem and golden opportunity. *Journal of Food Science Education*, *19*(4), 278–291. https://doi.org/10.1111/1541-4329.12206

The EdTech Spot. (2020, July 13). *How To Create School Reports Using Google Sheet Data, Autocrat and Google Doc*. https://www.youtube.com/watch?v=R8HyPRyD_XY

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly*, *27*(3), 425–478. https://doi.org/10.2307/30036540

Zuber-Skerritt, O. (1992). *Action Research in Higher Education: Examples and Reflections*. Kogan Page Limited, 120 Pentonville Road, London N1 9JN England, United Kingdom.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14670

Comparing online and on-campus students' perceptions of the digitalization of higher education institutions

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Abstract

Higher education institutions (HEIs) are facing significant progress in their digitalization. Covid-19 is an external affordance in which digitalization helps to secure social distance. Internal affordances are requirements to enhance the students' learning experience. We analyze students' attitudes toward the digitalization of their HEI based on empirical data from two groups of students within the same study program during the pandemic. Before the pandemic, the first group started on-campus and was forced into online teaching. The second group started online. Our results show that students, to a high degree, perceive harm in their learning success. At the same time, they have trust in the HEI's data handling. Generally, the group, which started online, shows a slightly higher negative perception. The differences between the two groups show a low to medium degree. Our work contributes to clarifying the impact of having to start studies online, which seems to be minor.

Keywords: *Higher education, organization, digitalization, learning, technology, covid-19*

1. Introduction

Even before the pandemic, teaching and learning were transformed by digital instruments at higher education institutions (HEIs) (Castro, 2019). Student assistance, administration procedures, the transfer of knowledge, and assessment have been increasingly digitalized. The digital infrastructure leads to constructive learning approaches, improves access to learning material and communication and collaboration across various interest groups. Digitalization is an increasing trend within education. HEIs have been experiencing difficulties in technology adoption. Due to the different demands of various stakeholders, complex requirements have hindered digitalization in HEIs (Reid, 2014). However, adoption became an imperative due to the Covid-19 pandemic.

The present paper aims to contribute to research on the current issues in digitalization. We aimed to determine the perceptions of the students during Covid-19. Some were forced into online teaching by the beginning, others during their studies. The working hypothesis is that there were differences between the perceptions of these two groups due to the compulsory acceleration of digitalization. Thus, the research question was determined as follows: How differently do students who started their studies on campus before the pandemic perceive the digitalization of their HEI compared to students who began online during the pandemic? Student perceptions were investigated based on the dimensions of trust, learning, and organizational culture.

The theoretical framework of the study is presented in the next section. Then, the research approach is presented, followed by a discussion of the findings. The paper ends with a short conclusion section, the implications, and the limitations of our research.

2. Digitalization of Higher Education Institutions

Educational digital technologies assist the lecturers in the improvement of learning resources and the analysis of learning goals (Vogelsang, Droit, & Liere-Netheler, 2019). Furthermore, digital processes accelerate service support. Digital technologies integrate instruction and administration. Thus, they lead to more transparent and transferrable student outcomes. Also, convergence could lead to more efficient processes. Since HEIs operate in an increasingly competitive environment, efficiency and competitive advantage become imperative (Adler & Harzing, 2017). Ubiquitous digital availability could lead to issues across the faculty and administrative staff (Proserpio & Gioia, 2007).

The employment of digital assets has been quite heterogeneous in higher education. Today, the pandemic forced HEIs to adopt and employ these assets (Mittal, Mantri, Tandon, & Dwivedi, 2021). Thus, we hypothesize a higher negative perception among the students forced into online teaching with digital assets as the starting point of our study.

Often, research has focused on the analysis of learning environments (Lapitan, Tiangco, Sumalinog, Sabarillo, & Diaz, 2021), the effects of students' individual learning achievements (Janson, Söllner, Bitzer, & Leimeister, 2014), or measurement of the success of the systems (Ouajdouni, Chafik, & Boubker, 2021). Besides the drivers and obstacles (Gregory & Lodge, 2015), studies provided recommendations for didactic learning element design (Tejedor, Cervi, Pérez-Escoda, Tusa, & Parola, 2021). Some studies tackled the organizational anchoring and adoption (Porter & Graham, 2016). Even the pandemic could not lead to significant operational responses across the HEIs (Miller, 2021). There is a certain resistance to change in HEIs, which is a factor in issues associated with the organizational digital technology integration (Al-Senaidi, Lin, & Poirot, 2009). The student experiences in digitalization are those of the users. Since they grew up as digital natives (Crittenden, Biel, & Lovely, 2019), they have been particularly critical of the digitalization of HEIs. They will probably be even more critical due to the enforcement during the pandemic. Furthermore, the effects of digitalization will remain with them in their professional careers (Friga, Bettis, & Sullivan, 2003).

3. Research Method and Sample

To measure the constraints associated with the Covid-19 pandemic, we used a questionnaire with 16 different items. The items take areas of potential concern in digitalization into account. Interestingly, the questionnaire was developed before the pandemic to capture students' general perceptions regarding the digitalization of their HEI. The participants rated statements on a Likert scale using a five-point range from "I do not agree at all" (1) to "I strongly agree" (5) (Brink, Packmohr, & Vogelsang, 2020). The pandemic allows measuring differences in students' perceptions in short time frames due to enforced digitalization. Thus, we judge the instrument to be valid for this use.

We collected two data sets during the pandemic within the bachelor's program in Media technology at Malmö University, Sweden. One course was on Digital Marketing (2nd semester) and the other on Introduction to Business (5th semester). The students of the Marketing course started their studies completely online. On the contrary, the students of the Introduction to Business experienced teaching on campus for at least their first and partly their second semester. Thus, the respondents from the two samples stem from different cohorts of students. Nevertheless, the two samples follow the same curriculum. Both courses have a workload of 15 ECTS aiming at a holistic perception of the fields taught. Thus, we collect a broad range of perceptions of different digitally conducted course elements. Class activities range from online lectures over digitally conducted workshops to office hours. Assignments within courses range from project work both individually and in groups to classical exams and working with case studies. Students' learning should lead to holistic evaluation and validation abilities. Currently, HEIs' digitalization of teaching is provoked

through an external effect. Before, administrative processes in Sweden were converted into contactless and digital services using personal tax numbers.

From the sample on Marketing, we received 83 completed questionnaires. From the sample on Introduction to Business, we received 73 completed questionnaires. Comparing both samples offers the chance to examine the change in students' perceptions between having a campus experience and having no campus experience. Thus, we assumed that the two samples' differences in response behavior should be observable based on the contrasting baseline conditions. However, it was uncertain whether there was an effect at all. To assess potential differences between the samples, we first analyzed the quantitative data. Then, we checked the normal distribution using the Shapiro-Wilk test and conducted a Mann-Whitney U test due to a missing normal distribution of the data. The Mann-Whitney U test compares the medians of two samples and indicates if there are significant divergences. Also, the degree of the differences can be calculated as an effect size (Pallant, 2005).

4. Results and Discussion

The following table 1 shows the results from the sample in which the students started online and in which the students started on campus. During both time points of the data collections, the students were taught online. To understand the impact of having to start a study program online or on campus, we compare both samples' statements' means ($\bar{x}$) and standard deviations (s). We calculate the differences ($\Delta\ \bar{x}$) between the mean results of these two samples to make the differences visible.

Regarding the characteristic of changed learning, the online sample shows a higher fear of harm in its learning success and a lower standard deviation, indicating a more homogenous perception within the sample. A non-advantageous digital learning platform triggers the online sample slightly higher than the on-campus sample. Still, the perception is towards the non-agreeing side of the scale. Both samples emphasize a rather high and similar degree of classical methods of teaching conducted digitally. Thus, the students do not perceive a clear digital progression within the teaching by their HEI. The perception of the non-availability of resources is higher within the online sample. Generally, in other characteristics, the deltas are rather small. Within the characteristic strategy, the perception of the online sample is more inclined to agree less with the university's efforts. Both samples show a high perception of trust for adequate data handling and do not expect a negative effect on their usage of online resources because of more increased transparency.

We analyzed whether the observed differences in means between the two samples were statistically significant (sig.) by applying the Mann-Whitney U test (MWU) (Pallant, 2005). We also calculated the effect size (r) to determine the magnitude of the differences. The effect

strength is a measure that indicates the overlap of two samples. A high value implies a low overlap of the samples and vice versa (Fritz, Morris, & Richler, 2012).

Table 1. Mean Values, Standard Deviation, and MWU test.

Charac-teristic	Statements in keywords	Started online		Started on campus		Δ x̄	MWU test	
		x̄	s	x̄	S		Sig.	r
Changed Learning	Harms learning success	3.66	1.05	2.71	1.30	0.95	0.00	-0.37
	No advantages of the digital learning platform	2.73	0.91	2.48	0.94	0.25	0.15	-0.11
	Same methods for teaching & services	3.78	0.87	3.84	0.83	-0.06	0.70	-0.03
Changed Services	Services offered digitally	3.72	1.00	3.84	1.04	-0.12	0.44	-0.06
	Processes digitized	3.63	0.90	3.68	0.96	-0.05	0.83	-0.01
Cultural Change	Same learning culture	2.80	1.07	2.93	1.19	-0.13	0.40	-0.06
	Constant learning to transform digitally	3.39	0.87	3.58	0.92	-0.19	0.01	-0.13
	New ideas in teaching	3.75	1.08	3.97	0.96	-0.22	0.22	-0.10
Digital Resources	Position for digitalization	3.20	0.97	3.30	0.86	-0.1	0.60	-0.04
	No resources for the digital learning platform	3.07	1.18	2.62	1.15	0.45	0.01	-0.20
Digital Strategy	HEI moves forward	3.65	0.88	3.99	0.97	-0.34	0.01	-0.21
	Management supports	3.65	0.82	3.78	0.86	-0.13	0.22	-0.10
	HEI has vision / strategy	2.92	0.98	3.24	0.88	-0.32	0.02	-0.19
Trust	Control of data storage	2.61	0.99	2.88	1.22	-0.27	0.21	-0.10
	Trust in data handling	4.12	1.04	4.26	0.90	-0.14	0.50	-0.05
	No effect of transparency on platform usage	4.20	0.92	4.15	1.08	0.05	0.96	-0.01

Source: Cf. (Brink et al., 2020) for exact wordings of the items

Results in table 1 show a moderate difference in the perceived harm to learning success, which is significant. Other low-moderate significant differences concern the non-availability of resources and the aspects concerning the strategy of the HEI. To examine whether further factors cause differences, we tested the influence of other variables on the response behavior.

The variables were age and final grade. We tested by using Spearman's rank correlation coefficient (Ratner, 2009). Furthermore, we tested for differences in gender by using the Mann-Whitney U test (Pallant, 2005). However, we did not observe any significant effects of the aforementioned factors on the response behavior.

Comparing both samples clearly shows a negative trend in the characteristic changed learning. Students who started online believe that the change harms their learning success, with the highest delta of 0.95. Also, they perceive the digital learning platform as slightly less advantageous. Previous studies comparing pre- and intra-covid data conclude that online learning harms learning success according to students' perceptions (Packmohr & Brink, 2021). With this study, we can broaden the perspective, as even students, who did not experience the change in the same way as the students who have started their education on campus, perceive stronger harm to their learning success. On the contrary, other studies prove better student performance during the pandemic (Gonzalez et al., 2020). Education in this study program focuses on problem-based learning. Students have assignments with rather low contact hours. Often, these assignments are conducted in groups. Thus, it seems important for learning success to find the right peers (Nerantzi, 2020). Having started on campus allows students to find the right peers better and form working groups. Regarding other characteristics, this pattern is prevalent. The students who started online-only are inclined toward a more negative perception. In general, we expected a greater difference in the samples, as the experiences and study durations of the samples are rather different, and a pandemic is a complex experience. Not all students are equally affected (Aucejo, French, Ugalde Araya, & Zafar, 2020).

5. Conclusions and Limitations

Our study investigates students' perception of the digitalization of their HEIs. To research differences in perception, we surveyed two batches of students in the same program of Media technology studies. Both batches started with different conditions (completely online and entirely on campus) but faced an online education at the time point of the intra-pandemic data collections. The batches are at various stages of their education. Although the university conducted online teaching, state regulations were formulated as recommendations and barely enforced.

The results show a slightly more negative perception of the students who started online on different aspects of their HEI's digitalization. By testing the correlation of other variables without significance, we can exclude the effect of gender, age, and study results. Especially, the non-significance effects of the study results indicate that students might overestimate their harm in learning success. The Mann-Whitney U test shows low to moderate effects, which means a relatively high overlap between the two samples. This overlap limits the

generalizability of our study. The homogeneity between the two samples might be too high, as they study the same program. The students who started on campus are more advanced in their studies but have taken the same courses as those who began online only. Thus, future data collections could survey a group of students from another program as a comparison. Future statistical data analyses could apply ordered probit regression to stay within the ordinal Likert scale (Della Lucia, Minim, Silva, Minim, & Cipriano, 2013).

Sweden abolished all restrictions by the beginning of February 2022, and the programs will gradually go back to campus. It will be interesting to follow up with the students who do not have an on-campus experience. This gives the chance to observe possible changes within their perceptions.

References

Adler, N. J., & Harzing, A.-W. (2017). When Knowledge Wins: Transcending the Sense and Nonsense of Academic Rankings. Academy of Management Learning & Education, 8, 72–95.

Al-Senaidi, S., Lin, L., & Poirot, J. (2009). Barriers to adopting technology for teaching and learning in Oman. Computers & Education, 53, 575–590.

Aucejo, E. M., French, J., Ugalde Araya, M. P., & Zafar, B. (2020). The impact of COVID-19 on student experiences and expectations: Evidence from a survey. Journal of Public Economics, 191, 104271.

Brink, H., Packmohr, S., & Vogelsang, K. (2020). The digitalization of universities from a students' perspective. 6th International Conference on Higher Education Advances (HEAd'20), 967–974.

Castro, R. (2019). Blended learning in higher education: Trends and capabilities. Education and Information Technologies, 24, 2523–2546.

Crittenden, W. F., Biel, I. K., & Lovely, W. A. (2019). Embracing Digitalization: Student Learning and New Technologies. Journal of Marketing Education, 41, 5–14.

Della Lucia, S. M., Minim, V. P. R., Silva, C. H. O., Minim, L. A., & Cipriano, P. D. A. (2013). Ordered probit regression analysis of the effect of brand name on beer acceptance by consumers. Food Science and Technology, 33, 586–591.

Friga, P. N., Bettis, R. A., & Sullivan, R. S. (2003). Changes in Graduate Management Education and New Business School Strategies for the 21st Century. Academy of Management Learning & Education, 2, 233–249.

Fritz, C. O., Morris, P. E., & Richler, J. J. (2012). Effect size estimates: Current use, calculations, and interpretation. Journal of Experimental Psychology: General, 141, 2–18.

Gonzalez, T., de la Rubia, M. A., Hincz, K. P., Comas-Lopez, M., Subirats, L., Fort, S., & Sacha, G. M. (2020). Influence of COVID-19 confinement on students' performance in higher education. PLOS ONE, 15, e0239490.

Gregory, M. S.-J., & Lodge, J. M. (2015). Academic workload: The silent barrier to the implementation of technology-enhanced learning strategies in higher education. Distance Education, 36, 210–230.

Janson, A., Söllner, M., Bitzer, P., & Leimeister, J. M. (2014). Examining the effect of different measurements of learning success in technology-mediated learning research. 35th International Conference on Information Systems (ICIS), 1–10.

Lapitan, L. DS., Tiangco, C. E., Sumalinog, D. A. G., Sabarillo, N. S., & Diaz, J. M. (2021). An effective blended online teaching and learning strategy during the COVID-19 pandemic. Education for Chemical Engineers, 35, 116–131.

Miller, M. T. (2021). Do learning organizations learn? Higher education institutions and pandemic response strategies. The Learning Organization, ahead-of-print. https://doi.org/10.1108/TLO-09-2020-0159

Mittal, A., Mantri, A., Tandon, U., & Dwivedi, Y. K. (2021). A unified perspective on the adoption of online teaching in higher education during the COVID-19 pandemic. Information Discovery and Delivery, 49. https://doi.org/10.1108/IDD-09-2020-0114

Nerantzi, C. (2020). The Use of Peer Instruction and Flipped Learning to Support Flexible Blended Learning During and After the COVID-19 Pandemic. International Journal of Management and Applied Research, 7, 184–195.

Ouajdouni, A., Chafik, K., & Boubker, O. (2021). Measuring e-learning systems success: Data from students of higher education institutions in Morocco. Data in Brief, 35, 106807.

Packmohr, S., & Brink, H. (2021). Comparing Pre- and Intra-Covid-19 students' perception of the digitalization of higher education institutions. 7th International Conference on Higher Education Advances (HEAd'21). Presented at the Seventh International Conference on Higher Education Advances.

Pallant, J. (2005). SPSS survival manual: A step by step guide to data analysis using SPSS for Windows (version 12) (2nd ed). Maidenhead, Berkshire. U.K. ; New York, NY: Open University Press.

Porter, W. W., & Graham, C. R. (2016). Institutional drivers and barriers to faculty adoption of blended learning in higher education: Drivers and barriers to blended learning adoption. British Journal of Educational Technology, 47, 748–762.

Proserpio, L., & Gioia, D. A. (2007). Teaching the Virtual Generation. Academy of Management Learning & Education, 6, 69–80.

Ratner, B. (2009). The correlation coefficient: Its values range between +1/−1, or do they? Journal of Targeting, Measurement and Analysis for Marketing, 17, 139–142.

Reid, P. (2014). Categories for barriers to adoption of instructional technologies. Education and Information Technologies, 19, 383–407.

Tejedor, S., Cervi, L., Pérez-Escoda, A., Tusa, F., & Parola, A. (2021). Higher Education Response in the Time of Coronavirus: Perceptions of Teachers and Students, and Open Innovation. Journal of Open Innovation: Technology, Market, and Complexity, 7, 43.

Vogelsang, K., Droit, A., & Liere-Netheler, K. (2019). Designing a Flipped Classroom Course–a Process Model. Proceedings of the 14th International Conference on Wirtschaftsinformatik, 345–359.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14427

EXITrun – A Lecture as a Virtual Educational Escape Game

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Abstract

Using gamification approaches in Higher Education is an appropriate way to increase student's engagement especially during the time of the COVID-19 pandemic. Escape Games which could be either used as physical experience of a group in a room, or - more virtually - as several puzzles that need to be solved with the target to solve one overarching mystery, are well known tools that can be used in an educational environment as well.

However, despite of existing frameworks and manifold examples it remains difficult to set up a Virtual Educational Escape Game (VEEG) with the proven positive effect on successful learning. This study presents some factors that support successful learning when using a VEEG and compares cost-benefit-ratios for manually versus automatically run VEEGs.

Keywords: *Virtual Educational Escape Games; Game Based Learning; Gamification; Escape Rooms; Educational Games.*

1. Introduction

COVID 19 changed life at schools and universities all over the world. Not just students have been impacted by COVID as they had to learn in a different way, but also teachers, because they had to switch their lectures mostly to a completely digital format. Within weeks teachers had to restructure lessons, get familiar with the use of new learning platforms, or record their subject matter to videos. However, many well-known motivational measures, that work well in a physical world, could not be transferred to a digital environment. Therefore, every tool or instrument that creates a certain motivation at students to actively take part in a virtual lecture, or to engage with learning content was highly welcome.

Virtual Educational Escape Games (VEEG), which are puzzles build into lectures offering a reward when the puzzles are solved, promise to be helpful tools that create an additional learning experience. If these puzzles contain topics of the lecture which encourage the student to engage with the subject matter, VEEGs can have a threefold effect. Firstly, VEEGs may motivate students to stick to the subject matter, secondly, they may increase having fun while learning, and thirdly, they may create a team spirit when puzzles are solved in a team. Both are very helpful effects in virtual teaching situations, and they may make VEEGs a good option to increase student's learning success.

2. Related work

Escape Games (or *Escape the Room Games*) originally derived from text based or online adventure games. The main task of these Games is to find an exit of a certain location (Veldkamp et al., 2020). Beside text or online versions *Live Escape Games* (also called *Escape Rooms*) have emerged, where a group of persons is locked in a physical room and tries to find the exit by solving puzzles in a certain time (Nicholson, 2015). Between 2013 and 2015, physical Escape Rooms emerged globally and became increasingly popular around 2016. Nowadays you find more than 50.000 of these Escape Rooms in more than 88 countries around the globe (Oveit, 2022; IED, 2022a), 2.250 of these rooms are counted in U.S. alone (Room Escape Artist, 2022). In 2016, first *Escape Games* were released in the form of board or card games, or as online versions of Escape Rooms, mostly known as *Exit Games* or *Unlock Games*. Their popularity increased significantly, especially during the Corona crisis (IED, 2022b).

Of course, these kinds of Escape Games can be used for educational purpose as well, because they provide a good opportunity to combine exhaustive learning with having fun by solving puzzles. There is a large number of papers describing a successful use of physical Educational Escape Rooms in higher education in a variety of subject matters (e.g., Järveläinen & Paavilainen-Mäntymäki, 2018; Williams, 2018; López-Pernas et al., 2019; Veldkamp et al., 2020). Most of these papers give creative examples of Escape Room setups, gain insights to

the perception of these rooms to the students and provide conclusions to the learning outcome. There are also many studies on the general topic of Game Based Learning (GBL) which comprises all kinds of games that can be used for educational purpose. Indeed, several meta-reviews reveal improved knowledge acquisition, content mastery and motivation as main general effects of educational games (Jabbar & Felicia, 2015; Connolly et al. 2012).

However, it remains unclear how and to what extent virtual versions of Educational Escape Games contribute to the learning success and which factors drive the learning process. For this reason, this study deals with the questions (1) what are factors for successful learning with a VEEG, and (2) how do these factors contribute to the learning success (see Figure 1) Furthermore, the study also focuses on an economic aspect as it (3) compares the effort of conducting a VEEG with students manually with the effort of an automated version.

Figure 1. Research focus

3. Design concept of the Virtual Educational Escape Room

Shortly after the outbreak of the COVID-19 pandemic, we developed two different VEEGs with the general goal to motivate students and to increase interest and participation in the subjects IT Service Management and Business Information Systems. In the first term, a completely manual VEEG was used which caused high facilitation effort. In the second term, a web-based, automated version of this VEEG has been inserted, in which most of the processes were automated, and the facilitation effort was reduced accordingly.

Both VEEGs were designed according to design-frameworks (Clarke et al., 2017) and design proposals (Breakout EDU, 2022) with a special focus on the design of puzzles. On the one hand, puzzles were designed to increase the duration of engagement with the subject matter, on the other hand, they should strengthen getting to know each other as well as cooperation among students. By solving the respective VEEG, students get an access code that revealed one of the questions of the final exam.

The manual VEEG was designed as a multi-path-based Escape Game (Veldkamp et al., 2020) with six parallel paths for each student, with alternating individual and group puzzles (Figure 2, left). The automated VEEG had a strongly sequential structure (Figure 2, right), with only one group puzzle, shortly before the final “escape” puzzle with the exam question as solution.

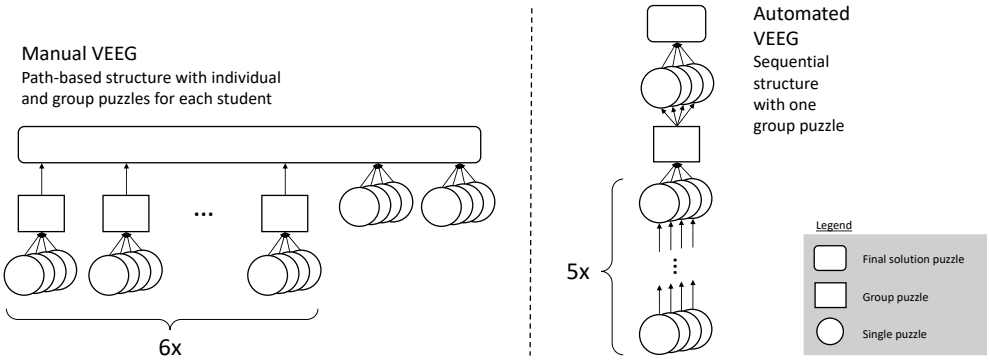

Figure 2. Structure and puzzle paths of the manual and the automated VEEG

For technical reasons only a limited number of group puzzles could be implemented in the automated VEEG, and it was also not possible to support a high number of parallel puzzle paths. Therefore, the manual and the automated version of the VEEG differed regarding its structure even if the design of the puzzles was similar. Furthermore, the automated VEEG needed to have a stronger story, and we decided to introduce the "Hacker Kane", who has stolen the exam exercises of the lecture and hid one exercise behind a code that could be solved with the puzzles.

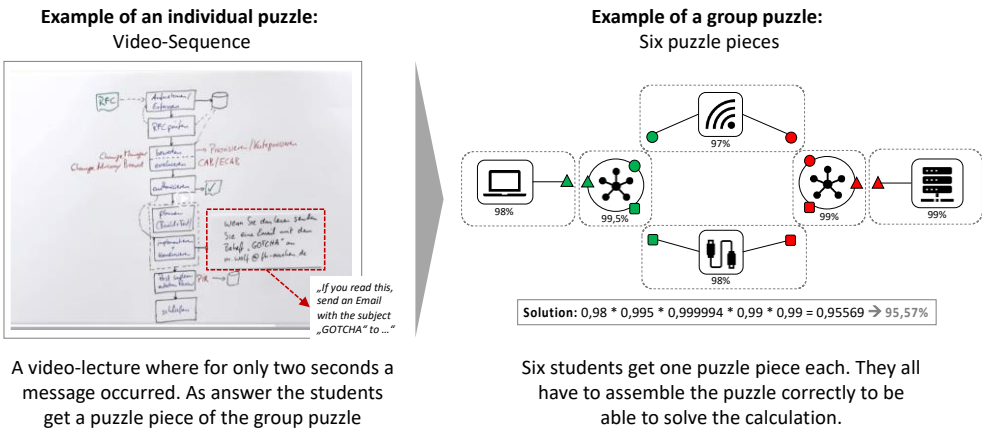

Figure 3. Examples of an individual puzzle and a group puzzle.

Individual puzzles usually consisted of "strange things" that appeared in videos (Figure 3, left) or on slides (e.g., colored letters or symbols in the slides, specific results in the exercises, etc.). Many times, the puzzles were spread over the whole video or slide-set. In one case, for example, spoken letters appeared from time to time in the audio track of a video. All these

letters built a question to the content of the lecture that needed to be answered. In this way, students had to watch the whole video to solve the puzzle.

After solving an individual puzzle, the students received an answer which was either a part of a new puzzle which only could be solved in a group (Figure 3, right), or an entry to the next individual puzzle. When solving all puzzles, the students received the key to the "exit door" of the VEEG. With this key they could open a webpage that contained one original exercise of the exam.

Both VEEGs were tested with different groups of students. The first, manual VEEG was used with students at the end of their second study year at the elective lecture IT Service Management. In total, 54 students took part in the lecture of which 34 participated in the VEEG. The second, automated VEEG was used with first-year students in the introductory lecture of Business Information Systems. 76 students took part in this lecture and 46 of them started to play the VEEG. None of the students took part in both lectures that any recognition effects could be excluded. Both VEEGs started round about in the middle of the term and ended at the last lecture. At the manual VEEG a Pre-Post-Test was conducted, the first one briefly after the release of the first puzzle, and the second one two weeks after the last lecture. For organizational reasons a Pre-Post-Test could be conducted only at the manual VEEG. Therefore, the survey of the automated VEEG focused on usability and design issues of the VEEG-tool as well as on the effort of its usage.

4. Results and Discussion

As mentioned in chapter 2 several effects on the learning success by using a VEEG were tested in scope of the first, manual VEEG. 22 students (out of 54 – ratio 41%) took part in the Pre-Test, and 14 students (out of 39 who participated in the VEEG – ratio 36%) in the Post-Test. As shown in table 1 clear increases can be ascertained at the "Time spent for Subject Matter" as well as at "Sympathy to the teacher". Neither an increase, nor a clear decrease occurs at the "Interest in" the subject matter. Regarding "Importance of Subject Matter" no clear result could be found. The students have been asked to rank the importance of their subject matters in the term and the results before the VEEG were lower than after the VEEG. On the other hand, the survivorship bias may have been significantly in this case and, therefore, the results should be interpreted only qualitatively. This finding strengthens the assumption that (1) successful learning is strongly dependent on the VEEG itself and (2) it is very difficult to combine a subject matter with the game story. However, a slight increase can be detected at "subjective learning success" even if this value was not calculated based on objective results and might be biased. Furthermore, the usage of a VEEG seems to prevent un-motivation. There was a slight increase in motivation of students, but this can be attributed

to the effect of student's perseverance. Figure 4 summarizes the results according to the research focus.

14 students (out of 46 who started the VEEG – ratio 30%) took part in the survey of the second, automated VEEG. Even if the results have not been raised in scope of a Pre-Post-Test and therefore are subjective, they match the results of the first survey. Accordingly, no increase was detected regarding the "Interest to" and "Importance of" the subject matter. However, a strong correlation (cov = 0,78) was found regarding the number of puzzles solved and the increase of interest in the subject matter. This means, the more student liked the subject the more successful they took part in the VEEG. For this reason, it may not be sensible to use a VEEG with a group with low interest to the subject matter as it will not result in a more successful learning.

Table 1. Results of the manual VEEG survey (Pre/Post).

	Pre-VEEG	**Post-VEEG**	**increase**
Number of questionnaire-participants	22	14	
Time spent for Subject Matter (h)	6,16	8,22	**33%**
Interest in Subject Matter (scale 1-7)	2,27	2,01	-11%
Importance of Subject Matter (scale 1-7)	2,36	2,14	-9%
Motivation (scale 1-7)	-	4,56	-
Unmotivation (scale 1-7)	-	**1,87**	-
Sympathy to teacher (%)	31%	64%	**106%**
Subjective learning success (scale 1-7)	*3,68*	*4,25*	***15%***

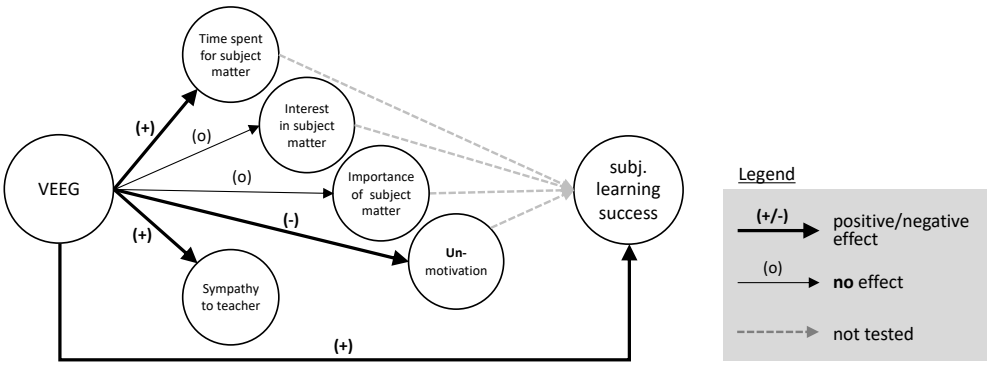

Figure 4. Research results according to the research focus.

Finally, the total effort of the development and conduction of both VEEGs was analyzed. Even if the lecturer's effort to run the VEEG was – as expected – significant lower at the automated VEEG (22%), it took 15 times longer to develop the web-tool for the automated VEEG then the manually built Excel-sheets, that were necessary for the manual VEEG (Figure 5, left). This means, VEEG-automation may only be worthwhile if it is foreseeable that the VEEG will be used frequently and for a high number of students. However, regarding automation of VEEGS it should also be considered, that automation results in a lower teacher-student interaction (Figure 5, right). This may cause a higher dropout rate which reduces the probability that students intensively engage with the subject matter.

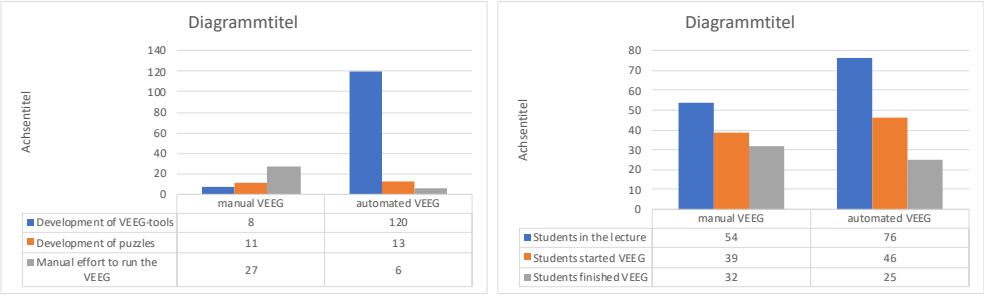

Figure 5. Spent effort for manual and automated VEEGs and its finisher ratio.

5. Conclusion

The use of Virtual Educational Escape Games (VEEGs) in lectures, especially in digital or remote lectures, is an appropriate tool to keep students engaged and to build up a relationship not just functionally but also personally. However, the necessary amount of time that need to be spent for preparing and conducting a VEEG should not be underestimated. Even if automation tools are used that dramatically decrease the time required, the time that need to spend for creating puzzles is still significant. Furthermore, automation of VEEGs seems to counteract or neutralize some of the positive effects of manual VEEGs. Therefore, automated VEEGs should be developed and used carefully and only if aspired positive effects cannot be achieved in another way.

References

Breakout EDU. (2022). Retrieved Jan. 22nd, 2022 from http://www.breakoutedu.com/.

Clarke, S. J., Peel, D. J., Arnab, S., Morini, L., Keegan, H., Wood, O. (2017). EscapED: A Framework for Creating Educational Escape Rooms and Interactive Games to For Higher/Further Education. *International Journal of Serious Games*. 4(3), pp. 73-86. doi: 10.17083/ijsg.v4i3.180

Connolly, M. T., Boyle, A. Z., MacAuthor, E., Hainey, T., Boyle, M. J. (2012). A systematic literature review of empirical evidence on computer games and serious games. *Computers & Education.* 59, pp. 661–686. doi: 10.1016/j.compedu.2012.03.004.

IED – Institute of Entrepreneurship Development (2022a). *Escape Rooms history.* Retrieved Jan. 17th, 2022 from https://ied.eu/project-updates/escape-rooms-history/

IED – Institute of Entrepreneurship Development (2022b). *Escape Rooms trends.* Retrieved Jan. 17th, 2022 from https://ied.eu/project-updates/escape-rooms-trends/

Jabbar, A. I., Felicia, P. (2015). Gameplay engagement and learning in game-based learning: A systematic review. *Review of Educational Research*. 85(4), pp. 740–779. doi: 10.3102/0034654315577210

Järveläinen, J., Paavilainen-Mäntymäki, E. (2019). Escape room as game-based learning process: Causation - effectuation perspective. *Proceedings of the 52nd Hawaii International Conference on System Sciences*. Vol. 6, pp. 1466–1475. doi: 10.24251/ hicss.2019.178

López-Pernas, S., Gordillo, A., Barra, E., Quemada, J. (2019). Examining the Use of an Educational Escape Room for Teaching Programming in a Higher Education Setting. *IEEE Access*, vol. 7, pp. 31723-31737. doi: 10.1109/ACCESS.2019.2902976.

Marin, D., Vidal, I., Pardo, M. I. (2020). Escape room in education: a bibliometric study. *6th International Conference on Higher Education Advances (HEAd'20)*, pp. 25-33. doi: 10.4995/HEAd20.2020.10960

Nicholson, S. (2015). *Peeking behind the locked door: A survey of escape room facilities.* White Paper, 1-35. Retrieved Jan. 6th, 2022 from http://scottnicholson.com/pubs/erfacwhite.pdf

Oveit (2022). *Stats and Figures on Escape Rooms.* Retrieved Jan. 18th, 2022 from https://oveit.com/blog/2017/12/05/infographic-stats-figures-escape-rooms/

Room Escape Artists (2022) *6 Year US Escape Room Industry Report (August 2020).* Retrieved Jan. 18th, 2022 from https://roomescapeartist.com/2020/08/24/escape-room-industry-report-2020/

Veldkamp, A., van de Grint, L., Knippels, M.-C., van Joolingen, W. R. (2020). Escape education: A systematic review on escape rooms in education. *Educational Research Review*. Vol. 31. doi: 10.1016/j.edurev.2020.100364.

Williams, P. (2018). Using escape room-like puzzles to teach undergraduate students effective and ef cient group process skills. *IEEE Integrated STEM Education Conference (ISEC)*. pp. 254-257. doi: 10.1109/ISECon.2018.8340495

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14487

Using Augmented Reality to improve understanding of the Carbon cycle

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Abstract

We designed an activity to improve students' knowledge and understanding of the Carbon cycle, which is typically a difficult concept. We wanted users to understand the main Carbon repositories and how the element circulates, as well as how human activity is impacting it. Originally designed for an advanced biogeochemistry course on paper, it was later redesigned using augmented reality (AR) to reach a wider audience and increase accessibility to both specialized and nonspecialized audiences. The reason for using augmented reality (AR) coupled to inquiry-based learning was to motivate students to complete the activity independently and make it more appealing to a wider audience. The Carbon cycle was divided into 7 stations that will be placed throughout the university campus, and which can be accessed by anybody using an android smartphone. They can choose to complete the whole cycle and answer a questionnaire, or just browse freely. We expect that the activity will improve understanding of the Carbon cycle in a didactic, playful and non-threatening way, and motivate users to learn autonomously. We also expect it to improve long-term retention.

Keywords: *Augmented reality; Carbon cycle; Active learning; carbon repositories; flows of carbon.*

1. Introduction

Since its first use in 1992, Augmented Reality (AR) has gained popularity in educational processes due to its recognized efficacy for teaching and learning (Chen et al., 2012; Ibáñez & Delgado-Kloos 2018; Wang et al., 2018; Garzón et al., 2020). AR uses virtual objects or information overlaid on natural physical environments in a meaningful way that can improve the learning experience (Chen et al., 2012 and references therein). While originally the relatively high cost did not allow for wide dissemination, the advent of mobile devices made it possible for AR to become widespread (Garzón at el., 2019). This increased accessibility and affordability of AR has made it possible to design activities that reach a wider audience.

By layering virtual information over the real physical world, AR provides an exciting array of enhanced learning and engagement educational possibilities (e.g. Wang et al., 2018). In fact, AR has been linked to increased concept understanding, long term concept retention and motivation (Chen et al., 2012; Ibáñez & Delgado-Kloos 2018; Wang et al., 2018; Garzón et al., 2020). While the use of AR seems to have a medium-high impact on learning gains, when coupled with the right pedagogical approach, a higher impact can be achieved. Typically, Inquiry-based learning (IBL) is used in AR applications for natural sciences (Garzon et al., 2020). IBL is an active pedagogical approach where students learn by doing, and allows them to construct knowledge independently as well as improve retention (Edelson et al., 1999).

The Carbon cycle describes the process in which carbon atoms continually travel between the atmosphere, hydrosphere, biosphere and geosphere (e.g. Killops and Killops 2005). Carbon is the foundation of all life on Earth, required to form complex molecules like proteins and DNA. The carbon cycle is also key to understanding the climate system and its imbalance, which makes it very pertinent not only in academia but for the society at large. While it is often challenging to comprehend the carbon cycle form and function as well as how we fit into it, we expect that AR will facilitate this knowledge integration.

As it has been argued that people learn more deeply from words and pictures, we expect this activity will become a great asset for the university community that will have access to clear and didactic information on the carbon cycle (e.g. Mayer, 2005). Furthermore, we added short supporting texts that provide enough information to navigate the carbon cycle and to complete the questions designed to guide users to a deeper knowledge, if they so wish.

While originally designed for advanced geoscience students to improve their understanding of the subject, we saw early on in the development that it provided a great opportunity to engage other members of the university community in the activity, regardless of their educational background. We expect that the use of AR in the exploration of the Carbon cycle will motivate individuals to engage with the activity without feeling it is too complicated or out of reach.

2. Methods

2.1. Activity design

The carbon cycle is key for life on earth; however, the cycle is complex, and thus we used a simplified carbon cycle to design the activity (e.g. Killops and Killops 2005; Fig. 1). The activity has 2 main objectives:

a. Increase understanding of the Carbon cycle

a.1. Understand the reservoirs and fluxes.

a.2. Comprehend the notion of imbalance of the system and human interference.

b- Motivate a wider audience to learn about the Carbon cycle and how we fit into it.

To achieve the objectives, the carbon cycle was divided into 7 stations corresponding to 1) Atmosphere, 2) Soil, 3) Surface ocean, 4) Land biota, 5) Deep ocean, 6) Ocean biota, and 7) Lithosphere. In each station we have a process, reservoir and flux tap that will show the most relevant process in augmented reality as well as a supporting text box with additional information (Figs. 1-3).

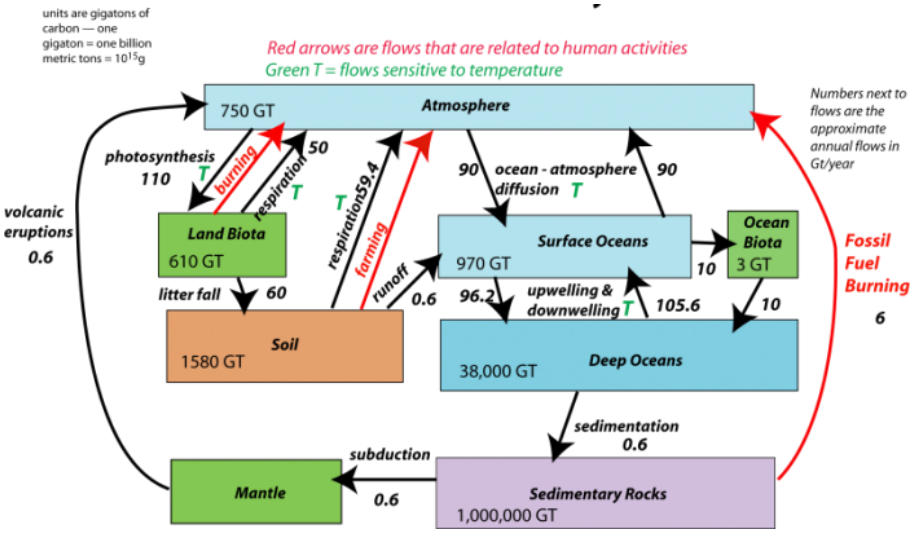

Figure 1. The global carbon cycle used to design the activity. The different reservoirs for carbon and the exchanges between reservoirs in gigatons (GT) per year are shown. The imbalances are indicated with red arrows (figure reproduced from: David Bice © Penn State University is licensed under CC BY-NC-SA 4.0).

2.2. Augmented reality environment design

The Vuforia Engine is the most widely-used software development kit for mobile devices that enables the creation of augmented reality applications. The Vuforia Engine was used for the AR development using the free version programming library (https://library.vuforia.com/). This allows users to freely select the image they want to use as a marker, and the objects (images, sounds, videos, 3D models) that will be displayed when the device's camera recognizes the mark (see Fig. 2 for example of the marker used).

The 3D models were made from scratch by two design students using the Blender application (https://www.blender.org/). The 3D models and animations were optimized so that the application works smoothly. The use of AR allows the models to be viewed from different angles and positions, as long as the activator is visible to the device. To interact with the buttons and switch between Process, Reservoir, and Flow, the touch screen of the mobile devices must be used (Fig. 2).

2.3. Application design

To develop the augmented reality application, the Unity video game engine was used (https://unity.com/). Unity is the world's leading platform for developing virtual and augmented reality experiences. A video game engine allows you to assemble all the components that a video game has, such as programming, graphic design and 3D models. It also allows you to wrap your app for Android phones 5.0 and up using the APK format.

To install the app in the phone you need the following link:

https://drive.google.com/file/d/17uNaCRkskThrT5zAFQwqu_-mz4mOEXqw/view?usp=sharing

Once installed you can scan the marker of each station and access the information (Fig. 2).

Figure 2. Images of a) Icon of the app and opening screen with the 3 tap for process, reservoir and flux designed with https://unity.com/; *b) example of the markers for Station 1: Atmosphere (*https://library.vuforia.com/).

3. Designed activity and expected learning outcomes

With this AR activity we are addressing intrinsic motivation, as we are targeting the audience's propensity to learn by providing interesting, relevant and enjoyable information (Ryan & Deci, 2000). We are made of Carbon; we breath, eat and have built our civilizations and economies on it, and so a working knowledge of the Carbon cycle is crucial for anybody that wishes to understand our planet (Killops and Killops 2005). As the AR has animations it is easier to see the flow and extent of the carbon circulation between the reservoirs. The inclusion of explicative panels supports the animations and gives extra information to go beyond the simpler processes proving a deeper understanding.

Since the Carbon cycle is a multilayer, complex concept, to make the activity easier and more didactic we parcelled the cycle into 7 stations that represent the main reservoirs of the cycle (Fig. 3). In each reservoir users can access the size, processes and fluxes away from the reservoir by switching between the buttons (Fig. 2). We wanted to show the flow of Carbon from each reservoir: for example, we show the fluxes from the atmosphere to the ocean and land reservoirs (Fig. 3a). It was also key to explain the impact of the human activity on atmospheric CO_2 concentrations and thus enhanced greenhouse effect (Fig. 3b). From the original activity we identified that it is crucial for learners to be included in the Carbon cycle to increase motivation and comprehension. For this reason, one station deals with land biota showing photosynthesis (Fig. 3c) as well as respiration and organic matter flux to the soil. Of course, a little less known is how the oceans also incorporate carbon through photosynthesis, mostly surpassing the capacity of land biota to do so. Moreover, the oceans are great regulators of the cycle, with 90 GT of carbon entering surface waters by simple diffusion and then being incorporated through the bicarbonate chemical reaction in the oceans (Fig. 3d). Although often disregarded, soils are one of the main carbon reservoirs (Fig. 3e). Surface and deep oceans act as separate boxes in our model (Fig. 1) and we can see that the carbon will flow from the surface to the atmosphere, biosphere and deep ocean (Fig. 3f).

The university community can navigate one or all the stations, but only by completing the circuit can they obtain all the necessary information to answer the activity questionnaire:

a. Complete the blank carbon cycle with the arrows both back (natural) and red (anthropogenic) carbon fluxes (Answer is in Fig. 1).

b. Answer the following questions:

   b.1. Indicate the reservoir size in GT (1015g) and put the reservoir sizes in order from the biggest to smallest.

   b. 2. Where do you fit into the carbon cycle?

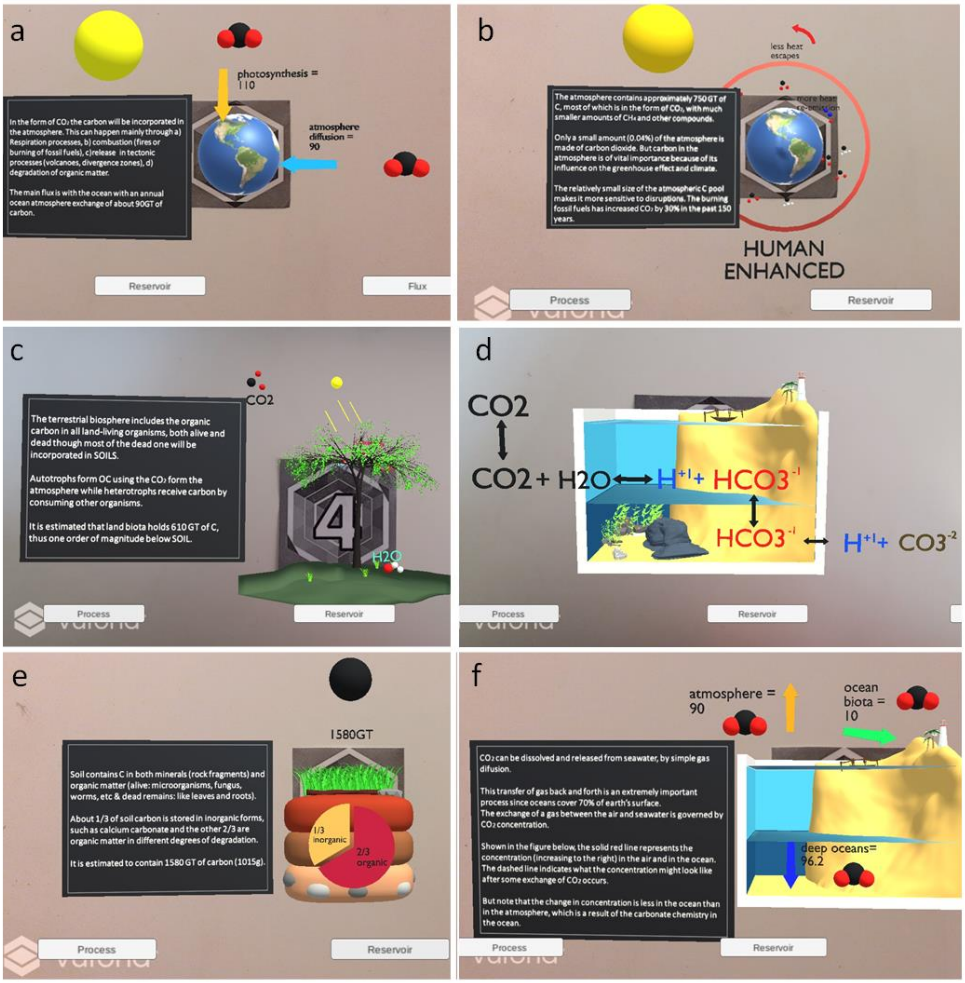

Figure 3. Screen shots of the AR activity corresponding to a) fluxes of Carbon from the atmosphere to the oceans and continents, b) impacts of humans on atmosphere CO_2 concentrations, and thus climate, c) process of photosynthesis by land biota, d) process of Carbon capture by the oceans, e) soil Carbon reservoir and f) fluxes of Carbon from surface oceans to the atmosphere, ocean biota and deep oceans.

The activity is framed within the IBL active approach, where students have to construct knowledge alone or in groups, increasing motivation and retention (Edelson et al., 1999; Garzon et al., 2020). Students have to go through all the stations to find out the necessary information to fill in the blank cycle and answer the questions.

Although the AR activity is designed to be coupled to the IBL approach, even if the users do not complete the activity, we still expect they will be motivated to learn more about the

Carbon cycle. Moreover, we anticipate that the use of AR will motivate non-specialized audiences to complete the activity.

4. Impact of the activity

We expect that the activity will not only reach (geo)science students but engage a wide audience to learn more and understand the dynamics of the carbon cycle. Often both learners and facilitators are afraid to tackle complex concepts for fear of frustration or lack of understanding. That is why the present AR activity was designed so that anybody could engage with and follow the Carbon cycle, becoming aware of where carbon is stored and how it cycles through the different planetary spheres.

We expect that having to circulate between stations and see what are usually abstract concepts overlaid in natural settings will improve understanding of the basic carbon cycle and related concepts. Psychology specialists in the Dean of Students office, after seeing a presentation of the activity, highlighted the active component of the activity as being motivating and conducive to learning. As AR incorporates the surrounding environment, the user can really visualize how we are part of the carbon cycle. We hope that giving all members of the university community the opportunity to live the carbon cycle as an activity, and see the magnitude of the impact human activity has on it, will result in more people taking an interest in what we can do to reduce or mitigate the impact we are having on our planet.

While a full implementation has not yet been possible due to COVID restrictions, the targeted geoscience students and teachers' group that used it during the testing phase reported it to be clear and engaging. The activity was also presented in a specialised group of professors from various faculties participating in a challenge for the development of digital educational resources, where it received very positive feedback. We hope to be able to provide campus availability within the following months.

The impact of the activity on geoscience students will be tested later on in the semester within the environemental geochemistry course to see the impacts on learning outcomes. This will give us the opportunity to test the coupling of intrinsic and extrinsic motivation (Ryan & Deci, 2000). While there is no way to test the number of users on the campus, those that want to complete the activity will need to contact us for the questionnaire, which will help us keep tabs on the usage of the app. We also plan to design an online survey using QualtricsXM (https://www.qualtrics.com/) where users can report usefulness of the activity in improving their knowledge of the Carbon cycle as well as its influence on motivation and long-term retention.

References

Bice, D. Professor of Geosciences, College of Earth and Mineral Science, The Pennsylvania State University, https://www.e-education.psu.edu/earth103/node/1019.

Chen P., Liu X., Cheng W., Huang R. (2017) A review of using Augmented Reality in Education from 2011 to 2016. In: Popescu E. et al. (eds) Innovations in Smart Learning. Lecture Notes in Educational Technology. Springer, Singapore. https://doi.org/10.1007/978-981-10-2419-1_2

Edelson, D. C., Gordin, D. N., & Pea, R. D. (1999). Addressing the challenges of inquiry-based learning through technology and curriculum design. The Journal of the Learning Sciences, 8(3–4), 391–450.

Garzón, J., Pavón, J., & Baldiris, S. (2019). Systematic review and meta-analysis of augmented reality in educational settings. Virtual Reality, 23(4), 447–459.

Garzón, J., Baldiris, S., Gutiérrez, J., & Pavón, J. (2020). How do pedagogical approaches affect the impact of augmented reality on education? A meta-analysis and research synthesis. Educational Research Review, 31, 100334.

Ibáñez, M. B., & Delgado-Kloos, C. (2018). Augmented reality for STEM learning: A systematic review. Computers & Education, 123, 109-123.

Killops, S., & Killops, V. (2005). Introduction to Organic Geochemistry, 2nd edn (paperback).

Mayer, R. (2005). The Cambridge handbook of multimedia learning. Cambridge: Cambridge university press.

Ryan, R. M., & Deci, E. L. (2000). Intrinsic and extrinsic motivations: Classic definitions and new directions. Contemporary Educational Psychology, 25, 54–67.

Wang, M., Callaghan, V., Bernhardt, J., White, K., & Peña-Rios, A. (2018). Augmented reality in education and training: pedagogical approaches and illustrative case studies. Journal of ambient intelligence and humanized computing, 9(5), 1391-1402.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14565

Anti-Disciplinary Works, Speculative Words. A Teaching Experience of Communication Design Based on Thinkering and Speculation

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Abstract

This paper aims to present and discuss how the teaching of visual identity and experience design in Communication Design education may be developed within a speculative design framework. By adopting this approach, students can experience the ethics of design practice and explore alternative design values, forms, and representations. They become familiar with the idea of design as a problem-seeking and problem-finding practice, and that encourages the development of concepts, scenarios and results without any predetermined function. The development of each project is based on the principle of learning by doing, which consists of thinkering, making mistakes and trying over and over again to improve the results and acquire competencies and skills. By the analysis of selected students' work, tested design process and implications of an anti-disciplinary approach, the paper aims to inquire how such perspective may both highlight the pain points of conservative methods and the benefits of non-regulatory practices.

Keywords: *Communication Design; Speculative Design; Coding; Problem-Seeking; Teaching.*

Editorial Universitat Politècnica de València

1. Introduction

Design, by its very nature, is a discipline situated among scientific knowledge, technical expertise and art. It resembles an interdisciplinary field where people from different backgrounds work together, share their knowledge and design new things preserving their own expertise. However, designers' knowledge and culture are becoming increasingly difficult to fit into any existing academic standard. It is an anti-disciplinary field that requires a new set of values (Ito, 2016) in terms of knowledge, culture and expertise (soft and hard skills). In addition, it is possible to witness a clear switch from the centrality of function to the centrality of meaning (Antonelli, 2011a): this change conveys the idea that design, far from being a mere problem-solving framework, can also be a tool for exploration and questioning.

Over the last eight-nine years, these premises have inspired the teaching method and the assignments of a Communication Design Studio (Bachelor in Communication Design). The students are prompted to work on visual and experience design related to thought-provoking themes, such as human conditions or emotions. 'Death' is the theme that has been analysed and developed during the 2019–2020 course, which is presented in the following pages. Regarding the theme as an opportunity, the task is to design interactive experiential devices (defined as 'Communicative Machines') in a critical and speculative framework.

The students, who work in small teams composed of five or six members, learn to cross disciplinary borders and adopt a critical approach. Trigg's (2003) statement on experimentation is incredibly fitting: a means to find solutions, even in areas that teachers, professionals or students do not master confidently. That's also valid for the 'learning by doing' approach, the method that the students are required to adopt for building prototypes. While developing their projects, students experience something close to the definition of thinkering (Antonelli, 2011b), according to which results can be only obtained through progressive and collective reworks. As a consequence, the discussed didactic approach does not aim to reassure students with fixed notions. Its goal is rather to unsettle them, providing a set of tools by which they can deal with uncertainties and come up with their design outcomes based on the context they're working in.

2. Analogies and interactions between technology and speculative design

The use of code and digital prototyping is encouraged and the integration of the computational and physical world is highly appreciated, although there is no mandatory technology to be used: framing a design problem by choosing "material, medium or method first [...] might limit [...] possible solutions" (Evans, 2009). On the other hand, coding and other digital technologies are languages that designers need to learn and use in a proactive

and consistent way. Undergraduate students usually regard coding as a sector-specific, obscure practice.

Bringing code within their toolkit enables students to learn "procedural literacy" and no longer regard the computer as a mysterious "black box" (Crow, 2008). They regain control of the technology. In the professional context as well, computational design is misunderstood as a technical skill instead of being regarded as a way of thinking. In a teaching context, an approach that does not consider the acquisition of skills and knowledge as separated fragments, but as an evolutionary process, appears to be more effective. The students are encouraged to use programming (Processing, p5.js, Three.js), electronics and embedded programming with the Arduino ecosystem and digital fabrication to start processes and develop applications (Lehni, 2011).

This variety of possible media and tools finds a breeding ground in Speculative Design, which does not exclusively belong to the design area or a fixed method, but is open to various approaches, tools, techniques and instruments as well as other practices and disciplines (Mitrović, 2019). According to Lukens & DiSalvo (2012), "speculative design and technological fluency are cross-disciplinary and integrative". The term "fluency" can here be interpreted as the "ability to translate between domains and view the membranes separating areas of inquiry as porous" (Lukens & DiSalvo, 2012).

3. An anti-disciplinary design process

According to the belief that design is a tool to create ideas – not only things – students are involved in a process that moves from problem-solving to problem-seeking and problem-finding, encouraging the development of concepts, scenarios and results, without any predetermined function, aesthetic or, as mentioned above, boundaries in the use of technology. The process is based on an anti-disciplinary and evolutionary idea of the educational design process, which doesn't rely on a fixed design method. "[...] When designers decide which method to use [...], they also perceive the design problem in a certain way. The method (whether Agile or User-Centred Design or Activity Based Design) blinds the designer to some aspects and it highlights others" (Evans, 2009). The applied methodology can be visualised as a spiral model (Dubberly, 2005), that accurately represents repeating cycles of design moving away from a central starting point (Figure 1). In each of the four main phases, students experience different steps in the design process, as they gradually approach their final project.

Once the general theme is given (e.g. 'death'), each group has to define a specific point of view and a concept to work on: so they have to seek and find a problem to highlight and discuss. They can use human superstructures and organisations as useful subjects to 'represent' their fiction. According to Blauvelt & Davis (1997), a "critical pedagogical

strategy that emphasizes alternative approaches to conventional problem-solving paradigms would include both problem-seeking initiatives and problem-posing inquiries". The second step is to define a communication strategy and how to develop it in a multidimensional and multichannel dimension (touchpoints and selected media), as well as the communicative machine (the interactive installation) main functions, meanings and contents. According to their concept and strategy, they have to think and design a visual identity that can be consistently communicated in two and three-dimensional outputs. By doing so, the students gain confidence in the design of complex systems.

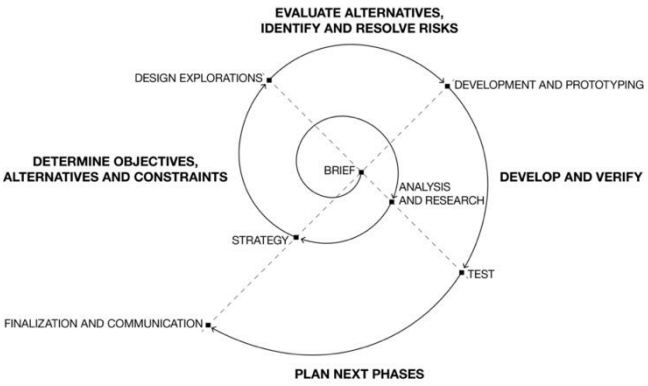

Figure 1. The spiral model of the applied methodology.

Only a few steps are mandatory and deadlines are not given beforehand so that the students learn to move autonomously towards a final result by testing concepts and outputs. The core activity is the prototyping phase, which involves both digital and analog areas. The groups are not strictly organised by distributing students' skills or interests. They are rather encouraged to autonomously acquire the skills they lack – especially for what may concern the areas of digital design, coding and prototyping. They are eventually supported by the teachers to better develop their projects. A crucial element of this "critical pedagogy is the recognition, not the dismissal, of students' social experiences and cultural affiliations, which serve as lenses through which they experience the world and are a reflection of the audiences we attempt to reach" (Blauvelt & Davis, 1997). The main outputs are 'Communication Machines': objects, installations or interactive devices that must be prototyped in order to be verified and tested. Those 'Machines' are intended as "object personas": an extension of the design research and educational process that regards design fiction as an important methodological tool. Design fiction represents a speculative mode of thinking that can disclose new questions and unconventional opportunities (Cila et al., 2015).

4. Speculative Communicative Machines

The experimental projects that are going to be presented aim to "unsettle the present rather than predict the future" (Clark, 2011) and to use design in an active way (Dunne & Raby, 2013). As Peace (2019) asserts "a work of speculative design is often an object […]. While prototyping deals with how an idea could be realized, speculative design asks what if that idea was prevalent in our society? Would we want it?".

Figure 2. Micromort stock exchange monolith (2020).

The first project, named *Micromort* (Figure 2), is a fictional currency connecting nationality and the value of death. The project intends to emphasise the fact that death always has a different social value depending on where it occurred or who has been involved. The critical and political position behind the project is that this value depends on how the western world perceives itself. The speculation is materialised into a 'stock exchange monolith'. Thanks to an algorithm (Hades 2.0) that considers the GDP per capita, the population and the number of violent deaths of each state in the period between 2000 and 2017, *Micromort* calculates the price of every single death worldwide. More than 21.000 real data items have been collected from public databases. The consistency of the Communication Machine design (the monolith), the data visualisation and the user interaction/interface reveal the critical position of the students.

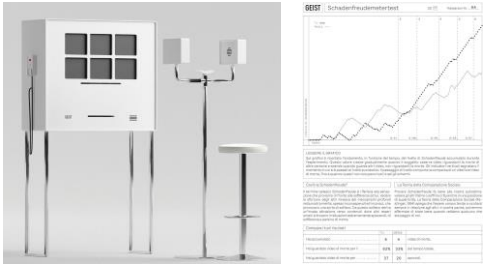

Figure 3. The Schadenfreude test machine and the final output printed (2020).

Geist (Gedankliches Experimentelles Institut für Spezielle Therapien, Experimental Institute of Thought for Special Therapies) (Figure 3) is a fictional scientific research centre that studies unknown aspects of the human mind as the *Schadenfreude*, the pleasure caused by

others' bad luck or death. A fictional test (named *Schadenfreudemetertest*) forces the users to simultaneously watch six videos of real-life events, including deaths and killings. The machine is equipped with an Eye Tracker that follows the movements of the user's gaze, analysing how long people focus on each video. Another essential part is the headrest, equipped with two blinkers with integrated speakers that play the audio and also constrain the users' movements while watching the videos. At the end of the experiment, the Eye Tracker's collected data are processed by customised software that prints a report. The graph represents the trend of the user's *Schadenfreude* level. The whole experience aims to reflect on human morbid curiosity about death, which tends to be emphasised by media and social channels, through fiction with several communicative levels: a consistent visual identity inspired by Dieter Rams' design for Braun, which has been developed both in 2 and 3 dimensions; the accurate selection of videos, a strong contemporary medium, showing well-known events; the final data visualisation.

Figure 4 – The Kaluma jewels (2020).

In the case of *Kaluma - Le forme del lutto* (*The Forms of Mourning*) (Figure 4), the speculation has been developed on three communicative levels: the naming, a collection of three jewels and a promotional campaign. The aim is to address the modern Western habit to hide the pain following a significant loss – such as the death of a loved one – under a social mask of fake serenity. In contemporary metropolitan contexts, there has been a progressive loss of social conventions such as wearing black pins, bands or veils as a communicative act of showing mourning and sharing it with the community. *Kaluma* aims to let the users discuss this condition and give a public display of their mourning. The promotional campaign defines a narrative discourse through photos and videos, by capturing moments of everyday life, during which the deepest and most sincere feelings and pains emerge thanks to the use of the three jewels. Mourning affects everyone, as the images candidly show, connecting young and elderly people.

The last one, *Deposito Cinerario Italiano (Italian Cinerary Depot)* (Figure 5), aims to underline how Italian laws regarding the disposal of the body after its death are limited and influenced by the dominant religious traditions. In Italy, deceased citizens must be placed in cemeteries or established places following strict regulations and standard methods: burial,

inhumation or cremation. There are no other viable solutions: religions other than Catholicism are excluded. For instance, Muslim communities are often forced to repatriate the bodies of loved ones to the country of origin, although they are registered as Italian citizens. This scenario inspired the critical position for *Deposito Cinerario Italiano*, where the user is pushed to act as an agent for a collective burial, where all deceased are equals and indistinct.

Figure 5. Deposito Cinerario Italiano (2020).

5. Conclusions

The four discussed projects interpret the main theme of 'death' starting from diverse points of view, developing different scenarios and using various technologies and media. The speculations and the critical stances are actively translated by using Communication Design. By assuming a Speculative and Critical Design approach, the students could experience the ethics of design practice. They could try to unveil unconventional approaches to the project and explore alternative design values, forms, and representations (Johannessen, 2017; Bardzell & Bardzell, 2013). The anti-disciplinary methodology pushes them to experiment with visual expressions, user experiences and tangible interactions between two and three dimensions, inevitably involving the fourth one: time.

As shown above, they range among many techniques and technologies, from analog to digital ones. A natural consequence of this didactic approach is that each design has to be theoretically discussed and physically tested by making prototypes. It is our firm belief that this way of working and designing should be encouraged, especially in educational contexts, to enable a more consistent and appropriate use of digital tools and to encourage students to adopt a critical approach to design practices.

References

Antonelli, P. (2011[a]). Talk to me. In Hall, E. (Ed.), *Talk to me. Design and communication between people and objects* (pp. 6-16). New York: Museum of Modern Art.

Antonelli, P. (2011[b]) States of Design 03: Thinkering. *Domus*. Retrieved February 10, 2022, from http://www.domusweb.it/it/design/2011/07/04/states-of-design-03-thinkering.html.

Bardzell, J., & Bardzell, S. (2013). What is critical about critical design?. *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 3297-3306). ACM.

Blauvelt, A., & Davis, M. (1997). Building bridges: a research agenda for education and practice. In Beirut, M., Drenttel, W., Heller, S., Holland, DK (Eds.). *Looking Closer 2* (pp. 77-81). New York: Allworth Press.

Cila, N., Giaccardi, E., Tynan-O'Mahony, F., Speed, C., and Caldwell, M. (2015). Thing-Centered Narratives: A study of object personas. *3rd Seminar Research Network for Design Anthropology*. Aarhus: The Research Network for Design Anthropology.

Clark, S. R. L. (2011). *Philosophical Futures*. Frankfurt am Main: Peter Lang.

Crow, D. (2008). Magic box: craft and the computer. *Eye, 70* (18). Retrieved February 10, 2022, from http://www.eyemagazine.com/feature/article/magic-box-craft-and-the-computer.

Dubberly, H. (2005). *How do you design? A compendium of models*. San Francisco: Dubberly Design Office. Retrieved February 5, 2022, from http://www.dubberly.com/wp-content/uploads/2008/06/ddo_designprocess.pdf.

Dunne, A., & Raby, F. (2013). *Speculative everything. Design, fiction, and social dreaming*. Cambridge (MA): MIT Press.

Evans, W. (2009). *Designing ideation: don't be a tool. How tools define our creative output*. Retrieved February 10, 2020, from http://johnnyholland.org/2009/03/designing-ideation-dont-be-a-tool.

Ito, J. (2016). Design and Science. Can design advance science, and can science advance design?. *Journal of Design and Science, 1*. Retrieved February 10, 2022, from https://doi.org/10.21428/f4c68887.

Johannessen, L. K. (2017). The young designer's guide to speculative and critical design. Retrieved February 5, 2022, from https://www.ntnu.edu/documents/139799/1279149990/16+TPD4505.leon.johannessen.pdf/1c9221a2-2f1b-42fe-ba1f-24bb681be0cd.

Lehni, J. (2011). Teaching in the spaces between code and design. *Eye, 81* (20). Retrieved February 10, 2022, from http://www.eyemagazine.com/feature/article/teaching-in-the-spaces-between-code-and-design.

Lukens, J., & DiSalvo, C. (2012). Speculative Design and Technological Fluency. *International Journal of Learning and Media, 3* (4). Cambridge, MA: Massachusetts Institute of Technology.

Mitrovič, I. (2019). *New Reflections on Speculativity*. Retrieved February 10, 2022, from https://speculativeedu.eu/new-reflections-on-speculativity.

Peace, E. (2019). *Speculative design for the real world. How speculative design methods can drive innovation*. Retrieved February 5, 2022, from https://uxdesign.cc/speculative-design-for-the-real-world-551130b22827.

Triggs, T. (2003). *The typographic experiment: radical innovation in contemporary type design*. London: Thames & Hudson.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14617

A Jewelry-Tech Experience: Teaching and Learning Model for Academic Training

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Abstract

The paper aims to describe an innovative teaching and learning process in jewelry-tech design. First of all, the paper analyzes the contemporary and multidisciplinary context, underlining the growing presence of a close connection between digital technologies and the world of accessory design, particularly jewelry. The need to define learning models that aim to integrate different skills to train new professional figures successfully is outlined in this context. Secondly, the paper presents and examines the case study "Living Jewellery" held at the School of Design of the Politecnico di Milano, an international workshop conducted in academic training in collaboration with the Italian jewelry company Roberto Coin. The results obtained during this experience are presented and underline effective methodologies and critical issues in conducting the workshop.

Keywords: *Jewelry design; Fashion-tech; Learning models; Digital Technologies.*

1. Jewelry: from Physical to Digital

The world of jewelry is witnessing a progressive thinning of the boundaries between physical and digital (Cappellieri, 2022), hand-made and machine-made, traditional jewelry, and jewelry with integrated technology. The digital push that the pandemic period has given to the fashion field, including digital fashion shows, platforms for augmented reality, and virtual try-on (Business of Fashion, 2021), continues to advance, introducing digital stores, purchases in cryptocurrencies, and NFTs. The fashion giants are preparing to activate increasingly substantial investments in the metaverse (Business of Fashion, 2022) by replicating actions such as the Gucci Garden immersive event on Roblox and the Bulgari Colors application by Bulgari that allows you to immerse users in the brand's online exhibition. Fashion brands begin to dedicate internal work teams to develop digital experiences and products following this progressive dematerialization. The role of academic training thus becomes central to satisfying the market demand for increasingly multidisciplinary and interdisciplinary skills. As reported in the report "Education for Fashion-Tech: Interdisciplinary Curriculum for Fashion in the Digital Era," there is an ever-increasing need to train professionals with heterogeneous skills ranging between different sectors and disciplines (Colombi & Tenuta, 2020) and that are configured as mediators between creativity and the scientific method (Tenuta & Testa, 2018). This becomes more and more relevant in the contemporary context, in which the dematerialization is ever-increasing, and the value of the object is not given only by its materiality but by the set of experiences that it can give to the end-user. The disciplines involved in the design of an artifact integrated with digital technologies range from those relating to the field of design, engineering, user experience**,** and business. As hybrid figures whose boundaries are increasingly dissolved (Bremner & Rodgers, 2013), designers are required to know how to juggle these disciplinary spaces, communicate in heterogeneous working groups, and understand how to interpret existing technologies, giving them value.

2. Applied Research: Living Jewellery Workshop Case Study

To verify an efficient teaching and learning model for the application of digital technologies in the world of jewelry, the workshop “Living Jewellery” was designed to emphasize strengths and opportunities in academic teaching. Therefore, the workshp was organized at the School of Design of the Politecnico di Milano within the Accessory Design Studio, part of the international Master’s degree program in Design for the Fashion System. Furthermore, to make the experience more in line with market demand and to provide an accurate design scenario, the workshop was integrated with the collaboration of an Italian fine jewelry company, Roberto Coin.

2.1. Workshop's Aims

The workshop's objectives covered both subject-specific (technical) and soft skills. Regarding technical skills, the aims were: to practically verify the application of digital technologies in a project of a smart jewel for a well-established company in the Italian goldsmith sector; to test the quality of the work according to the proposed model and verify strengths and opportunities; to verify the modalities of transposition of the physical behavior of the jewel to its digital twin; to emphasize the future opportunities for teaching and learning in the field of jewelry design that the introduction of digital technologies can offer. About the soft skills, the aims were: to verify the quality of teamwork thanks to the definition of different creative profiles; to monitor and improve the soft skills of the learners such as team working, organization, and communication.

2.2. Teaching and Learning Model

The workshop was structured starting from a specific brief, designed in agreement with the company: design a capsule collection of "living" jewelry according to the stylistic principles of the company. The word "living" refers here to interactive pieces of jewelry "coming to life" thanks to the integration of technology. The project envisaged the creation of a collection of jewels and the design of their behavior: these items were meant to become means of interaction between the user and the context, between different users, between the user and the body, or between the user and other objects. The actors involved were: one company, Roberto Coin; three professors from the Politecnico di Milanoo with specific skills in jewelry design and the technologies to be integrated; thirty-three students divided into six groups, three groups with five members, and three groups of six members; one scientific committee of professors for the final evaluation of the projects developed. After the definition of the brief, the working groups were formed. Professors chose group members based on the results of the Adobe MyCreativeType online test, given to students to be taken before the start of the workshop. The test proposes multiple-choice questions that lead to the definition of eight different types of creative personality: The Artist, The Thinker, The Adventurer, The Maker, The Visionary, The Innovator, The Dreamer, The Producer. The formation of the groups was managed to have a homogeneous balance of creative personalities within the single group, to favor heterogeneity. The six groups were defined and communicated to students on the first day of the activity. The workshop took place over a month, from November 17th to December 22nd, 2021, for nine days, including the launch of the brief and the final delivery. The calendar (figure 1) was structured with: lectures regarding the company brand DNA, in-depth information about brief and technologies, practical exercises aimed at understanding opportunities provided by digital technologies, and reviews of different project phases. The calendar was previously shared with the students to allow the autonomous management of the time available and define specific time intervals for each group.


CALENDAR

17 november
10:00 - 14:00: Company presentation, // Brief launch and guidelines for the project, Prof.
15:00 – 19:00: Hands on technology, Prof.
18 november
09:30 - 11:00: Lecture, Prof.
11:15 - 13:15: Review: brand analysis, target ideas, inspiration/moodboard ideas, Prof.
24 november
11:30 -
25 november
09:30 - 13:30: Team review (brand analysis, product identity, target analysis, moodboard) and individual review (concept), Prof.
1 december
10:00 - 19:00: Review: concept development, Proff.
2 december
09:30 - 11:00: Lecture, Prof.
11:15 - 13:15: Lecture Comftech, Prof.
8 december
HOLIDAY!
9 december
09:30 - 11:00: Lecture,
11:15 - 13:15: Review (concept development),
15 december
10:00 - 19:00: Review: prototype and final presentation, Proff.
16 december
09:30 - 11:00: Lecture, Prof.
11:15 - 13:15: Review, Prof.
22 december
10:00 - 14:00: Final review, Proff.
15:00 - 19:00: FINAL DELIVERY

Figure 1. Course calendar and organization including lectures, exercises, and reviews. Source: Politecnico di Milano, Living Jewellery workshop calendar (2021).

Specific outcomes were defined and shared with the learners on the first day of the workshop and were divided into two parts: a team delivery and an individual delivery. The team delivery was focused on a content co-creation process and included: 1) brand analysis and product identity; 2) target analysis and lifestyle; 3) mood board and color palette; 4) capsule collection and name of the capsule collection. The individual delivery included: 1) concept board and sketches; 2) technical drawings and 3D renderings; 3) storyboard and/or technology usability; 4) advertising and/or shooting campaign; 5) prototype. Finally, the evaluation criteria for the work carried out were defined and communicated both for the teamwork and the individual part: understanding and visualization of the principle of brand identity; observation, analysis, and visualization of the target; visualization of the lifestyle; visualization of the mood board consistent with the brief; the capacity to work in a team; consistency with the theme; consistency with brand identity; innovation in concept (original in idea, inspiration, design, and aesthetics); visual impact (harmonious and desirable); creative and design autonomy; professional attitude (e.g., punctuality, precision, resourcefulness). Quantitative and qualitative methods were adopted to test the model and the effectiveness of the work. Quantitative methods were favored by questionnaires submitted to students during and at the end of the course. Qualitative methods consisted of observing and evaluating the work carried out by a joint scientific committee of professors at the end of the activity.

2.3.. Results

The quantitative results, as previously mentioned, were obtained thanks to self-assessment and course evaluation questionnaires submitted to learners.

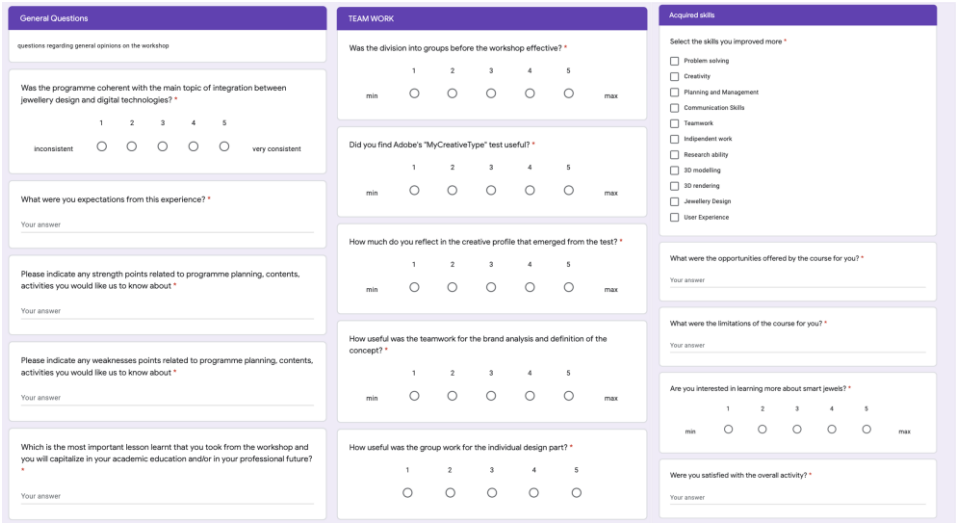

Figure 2. The final questionnaire submitted to students on the last day of workshop.

In particular, during the performance of the group activity, three self-assessment questionnaires were submitted (at the beginning, in the middle, and at the end of the course) to highlight critical issues within groups and intervene if there were any incompatibility. The majority of the questionnaires of the six groups were positive: 90% of the results assigned a maximum score of 5 points to each member and found no problems in carrying out the activities. Furthermore, 80% of learners defined the division into working groups as useful both for brand analysis and the definition of the concept as well as for the individual development of the project. Moreover, 75% found the use of Adobe's creative test compelling and truthful. The most developed skills were jewelry design, teamwork, problem-solving, 3D modeling, and user experience. Regarding the qualitative analysis, the workshop produced six different collection concepts of smart jewels for the company Roberto Coin, for a total of 33 individual items, delivered with a physical prototype. Each presentation included brand analysis, target analysis, lifestyle definition, the co-created concept for the collection, and an individual part related to the jewelry design. The evaluating commission highlighted how the teamwork favored the discussion for the design of collections consistent with the brief. The initial analysis of the company's stylistic codes and the choice of references that groups were asked to follow were helpful in the definition of uniform and consistent aesthetic characteristics to be applied to the jewelry items. The same choice was applied to the use of technology: the dynamic behavior of the jewel was designed based on a common concept

and obtained through the application of different technologies. In particular, the integration between jewelry and digital technologies was declined in different ways. The concepts that emerged concerned the following topics: the reaction of the distance-dependent object with a particular user; the interaction between the jewel and the body (in detail, the user's state of mind detected by tracking sensors of vital parameters); the interaction with a digital twin through an augmented reality application as the interface of the jewel itself; the visual response of movement to stimuli coming from the user's body; the relationship between different users through the transformation of the jewel following an external output. The prototypes presented were not technologically functional; however, the technological behavior was described through a storyboard and the creation, in some cases, of two static prototypes that showed the state of the item before and after the activation. In particular, attention was paid to the app's design connected to the jewel, the interface, and the user experience. Below, in figures 3 and 4 two collection examples are reported.

Figure 3. "Blooming Gold" collection for Roberto Coin. The collection consists of two bracelets, a brooch, and two rings. Once activated, the technology gives life to the jewel that changes through movement or vibration. Politecnico di Milano, final delivery (2021).

Figure 4. "Inside Out" collection for Roberto Coin. The collection consists of a necklace, a bracelet, an earring, and two rings. In addition to giving life to the jewel, the technology allows you to connect the jewel itself to an augmented reality application through which to monitor and view the effects of the interaction between object and user. Source: Politecnico di Milano, final delivery (2021).

As observers, we also noticed that the individual design phase was autonomously and automatically supported by internal group communication, exchange of ideas, and advice between team members. Internal feedback allowed the projects' active evolution and improvement.

2.4. Strengths, Limits, and Opportunities

The questionnaires and observations conducted by the scientific committee of the professors along the workshop's duration revealed strengths and opportunities. Practical exercises on technology and the visualization of the components contained within commonly used devices contributed to understanding objects' functioning. In particular, the teaching model with practical experiments on technology made learners understand their role as designers, underlining their ability to connect existing technologies and elements to produce innovation: designers are mediators between different skills, producing new languages by mixing known elements. Equally influential was the division into work teams obtained thanks to the students' creative skills profiling: they actively collaborated for the group and their individual goals. Thanks to this division, learners could develop soft skills such as interpersonal communication, organization of work, and exchange of ideas. A further strength was the company's presence as a design constraint that gave the brief consistency with the current market's demands, demonstrating interest in wearable technologies. The used design methodology proved to make up for the lack of working prototypes in an effective way. The creation of two different prototypes showing the evolution of items and the presentation of a storyboard visually telling the activation of the technology were essential for conveying the project concept. The workshop also highlighted future opportunities for young designers. Even if, as previously stated, the storyboard was a valuable tool for understanding the behavior of items, students found a practical limit in visualizing it. The brief request to effectively show the behavior of the pieces of jewelry became a stimulus for students to expand their knowledge of 3D rendering and animation software, approaching different skills previously little explored. Furthermore, the limited time available and the significant workload allowed the students to improve their organization, both as a group and individually.

3. Conclusion

The strengths and opportunities of the "Living Jewellery" workshop highlighted the importance of implementing collaborations between different skills and experts in academic training. In the case study presented, the coexistence of different sectors, such as design, engineering, and business, allowed learners to integrate multidisciplinary skills and deal with heterogeneous limits. The company's presence was essential to carry out a project with actual market limits, especially avoiding integrating technology with results that were too avant-

garde and hardly achievable. Comparing the company's needs and respecting stylistic criteria was fundamental to making students face actual working mechanisms. Furthermore, the composition of complementary groups from the point of view of creativity proved to be a valuable and effective tool for building balanced and heterogeneous teams and promoting interpersonal communication between group members. The exchange of information and peer evaluation became helpful tools for personal and professional growth and promoted better design outputs. The evaluation of each learner's work through peer evaluation was necessary for constant and constructive monitoring of the activity and stimulating self-analysis and self-regulation within groups. The workshop also underlined the importance of structuring learning models for designing physical and virtual worlds. Indeed, young designers, increasingly inserted into the digital context, used embedded technology to connect physical objects to virtuality. In particular, knowing how to transfer the brand's identity into a digital dimension without losing the stylistic features of recognizability of the company becomes central in the training of jewelry designers. The overall workshop experience is positive: the need for more significant heterogeneity and interdisciplinarity of the skills involved in the design process of smart jewelry is constantly growing. The opportunities found in the visualization of jewelry's behavior, in 3D renderings, and the integration of technology show how the coexistence of disciplines can contribute to the implementation of the final project. In particular, it becomes clear that product design skills should be integrated with those competencies related to the user's experience. Therefore, the digital experience project coherently linked to the physical product becomes considerable interesting in contemporary. The world we live in sees the boundaries between the real and the virtual (Maldonado, 1994) increasingly thin, and designers are committed to creating for both dimensions. The case study presented fits into the broader context of the digital shift and underlined the importance of continuing the discourse on the impact digital technologies have had on the interaction between objects and users. The solid symbolic, communicative, functional, and aesthetic value that fashion and jewellery have had in their interaction with the body (Cappellieri, 2014; Barthes, 2006; Polhemus, 2005) is further fragmented with digital transformation (Tenuta, 2020; Testa, 2019; Koulidou, 2018; Moller & Kettley, 2017; Ugur, 2013; Seymour, 2008). Current evolutions of body equipment such as objects with embedded technology, digital filters, virtual objects worn by avatars, and NFTs open the space for new design possibilities around their static or dynamic relationship with the body (Testa, 2019). This leads to the formation of new languages and symbols, which focus not only on the aesthetics and form of the product but rather on its behaviour and relationship with the user experiencing it. Digitalization and virtualisation also impact the spaces in which interaction takes place: “humanity is now living in a hybrid existence between the virtual and the actual world and consequently all our cultural activities will be transformed, evolving into new kinds of expressions and existences.” (Santos et al., 2020). While in the past interaction with body equipment took place in the physical sphere of human experience,

today, with the advent of the digital, physical boundaries are being broken down to explore hybrid territories between the virtual and real worlds. The case study explored the discourse around the real and digital to define the spaces of interaction between body equipment and user and inform methodology, considering how "design of experiences is now the 'central and explicit' object of design" (Atkinson, 2019).

References

Atkinson, D. (2019). *Digital Touch Experiences: Educating the Designers*. In: EduCHI 2019, 4th May 2019, Glasgow, UK.

Barthes, B. (2006). *Il senso della moda. Forme e significati dell'abbigliamento*. Torino, Italy: Einaudi.

Bremner, C., & Rodgers, P. (2013). *Design without discipline*, Massachusetts Institute of Technology. *DesignIssue,* 29(3), 4-13. DOI: 10.1162/DESI_a_00217.

Business of Fashion. (2020). *The State of Fashion 2020. Coronavirus Update*. McKinsey & Company.

Business of Fashion. (2022). *The State of Fashion 2022*. McKinsey & Company.

Cappellieri, A., Del Curto, B., Tenuta, L. (2014). *Around the future. New materials and new technologies for jewellery*. Venezia: Marsilio.

Cappellieri, A., Rossato, B., Tenuta, L., & Testa, S. (2022). *Digital Filters. A new way to E-wear jewellery*. *IHIET 2021, LNNS 319*, 837-843. DOI: https://doi.org/10.1007/978-3-030-85540-6_106.

Colombi, C., & Tenuta, L. (2020) *Education for fashion-tech. Design and technology for future fashion creatives.* Nielsen Book. ISBN 978-1-906908-64-5.

Koulidou, N. (2018). *Why Should Jewellers Care about the Digital?,* Journal of Jewellery Research, Vol 1.

Maldonado, T. (1994). *Reale e Virtuale*. Feltrinelli Editore.

Moller, T. & Kettley, S. (2017). *Wearable health technology design: A humanist accessory approach*, International Journal of Design, vol. 11, no. 3.

My Creative Type website includes a test to explore the personal creative attitude (https://mycreativetype.com/the-creative-types/).

Polhemus, T. (2005). *The ornamented ape*. In V. Durschei & B. L. Neri-Belkaïd (Eds.) Access to accessory (pp. 28-31). Geneva, Switzerland: Haute Ecole d'Arts Appliqués.

Santos, L. R., Montagna, G., Pereira Neto, M. J. (2020). *The Virtualization of the Fashion Product*, AHFE 2020: Advances in Industrial Design.

Seymour, S. (2008). *Fashionable Technology. The Intersection of Design, Fashion, Science, and Technology*. Vienna: Springerwiennewyork.

Tenuta, L. (2020). *La Moda nell'Era Digitale. Nuovi Prodotti, Nuovi Processi e Nuovi Servizi / New Products, New Processes and New Services*. Aracne.

Tenuta, L., & Testa, S. (2018). Scientific Method and Creative Process for Wearable Technologies from invention to innovation. *Area: Arts and Interdisciplinary Research*. (1) 35-46. DOI:https://doi.org/10.2218/airea.2763.

Testa, S. (2019). *FashionTech. Body Equipment, Digital Technologies and Interaction*. Universitas Studiorum, Mantua, Italy.

Ugur, S. (2013). *Wearing Embodied Emotions. A practice Based Design Research on Wearable Technology*, Springer.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14863

Using Active Learning to Teach Critical and Contextual Studies: One Teaching Plan, Two Experiments, Three Videos

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Abstract

Since the 1970s, art and design education at UK universities has existed as a divided practice; on the one hand applying experiential learning in the studio and on the other hand using passive learning methods in the lecture theatre. As a result, art and design students are in their vast majority reluctant about modules that may require them to think, read and write critically during their academic studies. This article describes, evaluates and analyses two individual active learning experiments designed to determine if it is possible to teach CCS modules in a manner that encourages student participation. The results reveal that opting for active learning methods improved academic achievement, encouraged cooperation, and enforced an inclusive classroom. Furthermore, and contrary to wider perception, the article demonstrates that active learning methods can be equally beneficial for small-size as well as large-size groups.

Keywords: *Active learning; design pedagogy; reflective practice.*

1. Introduction

In the 1970s, the Coldstream reports argued for changes in higher education that would 'improve the status of artists and designers' (Borg, 2012, p. 4); namely the implementation of contextual and critical studies (CCS) modules to art and design HE courses. Since then, art and design education at university level has been 'almost uniquely divided against itself' (Frayling, 2004, p. 40), often because CCS is taught in a traditional manner that tends to 'reinforce students' role as passive learners' (Ebert-May et al., 1997, p. 601). Subsequently, the requirements of academic study, which are quite different from those of experiential learning, create a certain anxiety to art and design students, many of whom may already struggle with dyslexia or other learning disorders and mental health conditions. In addition to the above, pedagogical studies show that art and design students often resist writing (Borg, 2012, p. 5).

Applying Graham Gibbs' (1988) reflective cycle framework, this article expands on two active learning experiments: one activity involving a small group of six graphic design students (Level 4), and another activity involving a large group of thirty-four graphic design students (Level 4). The findings reveal that teaching CCS is most effective when the instructor follows an active learning approach, which has been found to improve academic achievement and encourage an inclusive environment for all students (Weller, 2019; Baepler and Walker, 2014; Smith and Cardaciotto, 2011; Parker et al., 2005; Haggis and Puget, 2002; Thomas, 2002; Bamber and Tett, 2001). Furthermore, the following sections demonstrate that an active learning approach can be beneficial for small-size as well as large-size classes, when planned appropriately, whilst alternative forms of delivering content help students learn effectively, especially those who identify as visual learners (Falchikov, 2006 (1995); Stefani, 1994; Berk, 2009).

2. Description

CCS modules offer students the opportunity to engage with existing literature on design and other related disciplines, in order to better understand design practice within a wider socio-cultural context. Thus, students are typically expected to read academic texts during their scheduled sessions with their teacher, or independently. In this case, the topic of interest was the difference between art and design practice. However, instead of reading about and then discussing the topic in the classroom, the two experiments examined in this paper utilized two video-recorded presentations by distinguished design historian Alice Rawsthorn at Domus Academy in Milan, Italy (Domus Academy, 2015a; 2015b). In both cases, the purpose of this activity was to watch the videos, answer the questions that were listed in the A3 prints provided, and then use this infromation to develop a discussion around art and design.

Table 1. Teaching Plan

Duration	Activity Description	Assessment Method
5 mins	/ The teacher welcomes students and offers instructions of the day's session // The teacher asks students to form groups of 2-4 people	/ The teacher answers any questions to make sure they understand the activity
15 mins	/ Students watch video 1 on the screen // Students identify and write down their answers to the list of questions provided	/ The teacher moves around the classroom monitoring each group of students, quietly offering support if needed, without distracting other groups
5 mins	/ Students deliberate with peers // Students finalise their answers	/ The teacher moves around the classroom monitoring individual groups, quietly offering support if needed, without distracting other groups
15 mins	/ Students watch video 2 on the screen // Students identify and write down their answers to the list of questions provided	/ The teacher moves around the classroom monitoring individual groups, quietly offering support if needed, without distracting other groups
5 mins	/ Students deliberate with peers // Students finalise their answers	/ The teacher moves around the classroom monitoring individual groups, quietly offering support if needed, without distracting other groups
15 mins	/ She teacher goes through each question on the list prompting students to offer their answers // If students missed any answers during the videos, the teacher encourages them to figure them out through dialogue /// The teacher offers a summary of the key theoretical points learned	/ The teacher answers any student questions to make sure students understood the lessons learned / The teacher offers a list of additional resources for further study to students

3. Feelings

3.1. Session 1 (small-size group)

On the day of the session students were presented with the day's teaching aims and objectives. The reaction to the fact that they were asked to actively participate during the lesson was met with reluctance, however, they were excited to find out that they will be watching two videos, instead of reading academic journal articles, to answer the questions presented to them. This student group was typically quieter than others, yet, when it came to

asking questions about the activity itself and what they were required to do, they were very specific with their queries and appeared keen to do their best with the activity presented to them.

3.2. Session 2 (large-size group)

On the day of the session students were presented with the day's teaching aims and objectives. The reaction to the fact that they were asked to actively participate during the lesson was met with enthusiasm and curiosity. They were excited to find out that they will be watching two videos, instead of reading academic journal articles, to answer the questions presented to them. Given its large scale, this student group consisted of a wide variety of students, so typically the most confident students would be those asking questions about the activity in front of the whole group. Yet, all students paid the appropriate attention to the instructions provided, preparing with their own smaller groups for the activity. The majority of students seemed enthusiastic about the idea of having to work collaboratively.

4. Evaluation

Following both sessions, students were asked to complete a short online survey to capture their opinion on what had just taken place. In general, the responses revealed the activity was beneficial to both groups. It helped students understand the key differences between art and design, exposing them to a number of interesting contemporary design practice examples. One student commented that the set list of questions helped them focus on the information presented by the speaker in the video, trying to sustain their concentration on the task at hand. Another student noted that listening to the design historian talk about design history and practice in a manner that was easily understandable, in contrast to the formal language used in written academic articles, has allowed them to engage better. Another student, who discolved they were dyslexic, noted that they preferred the use of videos because reading academic articles was usually a struggle for them.

5. Analysis

5.1. Session I

Smith and Cardaciotto (2011, p. 58) reveal that active learning may 'be like broccoli', meaning that 'although it is good for students intellectually, their overall impression of it may not be completely positive'. However, Alliger et al. (2006 [1997]) found that when students express a dislike about an active learning session, this typically affects their performance of the required task, rather than their learning. Both opinions are certainly true in this case, given that students did not write down all the answers to the questions provided, although the task was admittedly fairly simple and easy. Yet, their learning was impactful enough to inspire

some of the students to write about the subject presented during the session for their summative assignment, and others to look into some of the information mentioned during the videos independently. Additionally, the use of videos for delivering content to students in combination with the specific set of questions provided has been found to increase students' memory of this knowledge (Berk, 2009; Smith and Cardaciotto, 2011), which in itself proved to be beneficial.

5.2. Session II

Berk (2009) argues that students can attain at least twenty potential learning outcomes when an appropriate use of videos takes place during a taught session. In this case, the active learning session described above has allowed students to focus their attention, created a sense of anticipation, improved attitudes towards content and learning, inspired and motivated students, and decreased anxiety on a typically perceived as intimidating type of activity (ibid., p. 2). Students were intensely concentrated on what the speaker was talking about during her presentation, enthusiastically anticipating for the answers to the questions they had in front of them to come up. Furthermore, students confessed that they gained a better understanding about design history, and how the critique of contemporary design could be beneficial to them as designers – because not only would offer them inspiration and motivation for their own practice, but also offer them a historical perspective to design practice in general. Additionally, as Michaelsen et al. (2009) have previously argued, working as a team of 2-4 people enabled students most susceptible to poor performance to complete the required task and remain on track during the session.

6. Future Considerations

Taking into account the teacher's own observations and the student feedback provided, a number of considerations could be implemented to further improve the learning outcomes of this type of activity. Specifically, asking students in the large-size group to 'think-pair-share' (instead of just pair and share) would potentially lead to better analytical, argumentention, prioritization, problem solving, and resolution skills, as well as foster short class discussions (Kaddoura, 2013; Green, 2000). Additionally, rearranging the tables to create an arrangement that is less linear, and more spherical could also potentially add to the overall student experience, given that physical space can also improve student learning (Brooks, 2011; Park and Choi, 2014). Furthermore, a similar active learning session could possibly be used with students in other levels (e.g. level 5), utilizing a different set of videos appropriate for that level of study. In this case, students could be invited to generate a written summary of the most important elements presented after each video, instead of having to answer a set of predefined questions. This would allow more autonomy, because they would have to decide how to write and what to include in their summary, and then present their own written text

to the group. Providing a learning experience that 'explicitly addressed the development of students as autonomous persons' would then make this active learning session more advanced (Yorke, 2001), and therefore, more challenging and appropriate.

7. Discussion

The results of the two experiments seemed more or less equal in quality, by the end students fully understood the difference between art and design practice, and gained a better awareness of contemporary design practice. From a practical perspective, the larger group required more assistance from the teacher throughout this planned activity, which made it more challenging to remain faithful to the time slots allocated for each task. Yet, the larger group of students seemed to profit much more throughout the session because they were invited to work in small teams of four people, whereas the students in the smaller group worked in pairs.

Research reveals that students learn better by participating in collaborative groups, their desire to participate is higher, and they consider the classroom environment to be fun and dynamic (Ebert-May et al., 1997; Chickering and Gamson, 1987). In fact, the positive effects of active learning methods have been found to benefit the students that may be characterized as 'low-performing' (Walker et al., 2008), as well as the highly-performing students that may already be well equipped to actively participate in these sessions. Active learning also allows students to measure their own knowledge, positioning themselves within their peer group, and at the same time offers tutors the opportunity to assess the level of knowledge of the group, and of individual students, identifying areas that may need more work (Knight and Wood, 2005; National Research Council, 2000). Creating an environment for small-size or large-size groups of students to actively participate in knowledge formation has been shown to increase the length of time students remember the material discussed, because what they say or do stays with them longer than what they hear (Slamecka and Graf, 1978; Edgar, 1969).

A common concern about active learning is that as learning and teaching method it can only be successful with smaller classes (Auster and Wylie, 2006). Yet, this article revealed that size is not necessarily obstructive to the success of an active learning session, as long as all other factors are firmly in place, such as effective planning, interesting and appropriate content. As long as educators, regardless of discipline, are eager to work hard, capable of providing students with suitable active learning opportunities to practice their critical and analytical skills, and willing to offer constructive feedback to students for their performance (Michael, 2006), then in their vast majority active learning sessions are a success.

8. Conclusion

CCS teaching for art and design courses in higher education can and ought to be dynamic, complex, and well-positioned within contemporary practice. Teachers ought to be making use of learning methods that enhance employability, inclusivity, internationalization, the use of digital technologies, and student engagement (Weller, 2019), whilst instilling an enthusiasm for the study of design. Still, moving from being a passive learner to an active learner depends not only on the teacher, but also the student's willingness to accept shared responsibility for their own educational experience (Billson and Tiberius, 1991). Nonetheless, with the use of active learning techniques that allow us to break down 'the hierarchies that divide teachers and learners in traditional learning spaces', and encourage empathy among students (Baepler and Walker, 2014), we can effect change in the modern classroom. But first, we ought to allow room for compassion, in addition to 'responsive academic and positive behavioral support' (Bilias-Lolis et al., 2017).

References

Alliger, G. M., Tannenbaum, S. I., Bennett, W., Traver, H. and Shortland, A. (2006 [1997]). A meta-analysis of the relations among training criteria. *Personnel Psychology*, 50 (2). 341-358. https://onlinelibrary.wiley.com/doi/10.1111/j.1744-6570.1997.tb00911.x

Auster, E. R., and Wylie, K. K. (2006). Creating active learning in the classroom: a systematic approach. *Journal of Management Education,* 30 (2), 333-353. https://journals.sagepub.com/doi/10.1177/1052562905283346

Baepler, P. & Walker, J. D. (2014). Active learning classrooms and educational alliances: Changing relationships to improve learning. *New Directions for Teaching and Learning*, Spring (137), 27-40. https://onlinelibrary.wiley.com/doi/abs/10.1002/tl.20083

Bamber, J. & Tett, I. (2001). Ensuring integrative learning experiences for non-traditional students in higher education. *Journal of Widening Participation and Lifelong Learning,* 3 (1), 8-16. https://www.ingentaconnect.com/content/openu/jwpll/2001/00000003/00000001/art00003

Berk, R. A. (2009). Multimedia teaching with video clips: TV, movies, YouTube, and mtvU in the college classroom. *International Journal of Technology in Teaching and Learning,* 5 (1), 1-21. https://sicet.org/main/wp-content/uploads/2016/11/ijttl-09-01-1_Berk.pdf

Bilias-Lolis, E., Gelber, N. W., Rispoli, K. M., Bray, M. A., & Maykel, C. (2017). On promoting understanding and equity through compassionate educational practice: toward a new inclusion. *Psychology in the Schools*, 54 (10), 1129-1237. https://onlinelibrary.wiley.com/doi/10.1002/pits.22077

Billson, J. M., and Tiberius, R. G. (1991). Effective social arrangements for teaching and learning. *New Directions for Teaching and Learning*, 45 (Spring), 87-109.

Borg, E. (2012). Writing differently in art and design: Innovative approaches to writing tasks. In C. Hardy, & L. Clughen (Eds.), *Writing in the disciplines building supportive cultures for student writing in UK Higher Education.* Emerald Group Publishing Limited. https://pureportal.coventry.ac.uk/en/publications/writing-differently-in-art-and-design-innovative-approaches-to-wr-2

Brooks, D. C. (2011). Space matters: the impact of formal learning environments on student learning'. *British Journal Of Educational Technology,* 42 (5), 719-726. https://bera-journals.onlinelibrary.wiley.com/doi/10.1111/j.1467-8535.2010.01098.x

Chickering, A. W. & Gamson, Z. F. (1987). Seven principles for good practice in undergraduate education. *American Association for Higher Education Bulletin, March*, 3-10.

Domus Academy (2015a). *Alice Rawsthorn #1 - What is design?* [Video]. YouTube. https://www.youtube.com/watch?v=vIBQEeH14ks&ab_channel=DomusAcademy

Domus Academy (2015b). *Alice Rawsthorn #2 – Is it design or art?* [Video]. YouTube. https://www.youtube.com/watch?v=_DaxhxBx_r0&ab_channel=DomusAcademy

Ebert-May, D., Brewer, C., & Allred, S. (1997). Innovation in large lectures: Teaching for active learning. *BioScience*, 47(9), 601–607. https://doi.org/10.2307/1313166

Edgar, D. (1969) *Audiovisual Methods in Teaching*. New York, NY: Dryden Press.

Falchikov, N. (2006 [1995]). Peer feedback marking: developing peer-assessment. *Innovations In Education and Training International*, 32(2), 175-187. https://www.tandfonline.com/doi/abs/10.1080/1355800950320212

Frayling, C. (2004). To art and through art. In P. Bonaventura, & S. Farthing (Eds.), *A Curriculum for Artists* (pp. 38-41). The University of Oxford.

Gibbs, G. (1988). *Learning by doing*. Oxford, UK: Further Education Unit, Oxford Polytechnic.

Green, T. D. (2000). Responding and sharing: techniques for energizing classroom discussions. *The Clearing House,* 73(6), 331-334. https://www.jstor.org/stable/30189612

Haggis, T., & Pouget, M. (2002). Trying to be motivated: perspectives on learning from younger students accessing higher education. *Teaching in Higher Education,* 7(3), 323–336. https://doi.org/10.1080/13562510220144798a

Kaddoura, M. (2013). Think pair share: a teaching learning strategy to enhance students' critical thinking. *Educational Research Quarterly,* 36 (4), 3-24.

Knight, J. K., and Wood, W. B. (2005), Teaching more by lecturing less. *Cell Biology Education,* 4 (4), 298-310. https://www.lifescied.org/doi/10.1187/05-06-0082

Michael, J. (2006). Where's the evidence that active learning works?. *Advances in Physiology Education,* 30 (4), 159-167. https://journals.physiology.org/doi/full/10.1152/advan.00053.2006

Michaelsen, L. K., and Sweet, M. (2008). The essential elements of team-based learning. *Team-Based Learning: Small Group Learning's Next Big Step: New Directions for Teaching & Learning,* Winter (116), 7-27. https://onlinelibrary.wiley.com/doi/abs/10.1002/tl.330

National Research Council (2000). *How People Learn: Brain, Mind, Experience, And School: Expanded Edition*. Washington, DC: National Academies.

Park, E. L., and Choi, B. K. (2014). Transformation of classroom spaces: traditional versus active learning classroom in colleges. *Higher Education,* 68 (5), 749-771. https://link.springer.com/article/10.1007/s10734-014-9742-0

Parker, S., Naylor, P. & Wannington, P. (2005). Widening participation in higher education: what can we learn from the ideologies and practices of committed practitioners?. *Journal Of Access Policy and Practice*, 2 (2), 140-160.

Slamecha, N. J. & Graf, P. (1978). The generation effect: delineation of a phenomenon. *Journal of Experimental Psychology: Human Learning & Memory,* 4 (6), 592-604. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.931.1284&rep=rep1&type=pdf

Smith, C. V. & Cardaciotto, L. (2011). Is active learning like broccoli? Student perceptions of active learning in large lecture classes. *Journal Of Scholarship of Teaching and Learning*, 11(1), 53-61. https://scholarworks.iu.edu/journals/index.php/josotl/article/view/1808/1805

Stefani, L. A. J. (1994) Peer, self and tutor assessment: Relative reliabilities. *Studies in Higher Education*, 19 (1), 69-75. https://www.tandfonline.com/doi/abs/10.1080/03075079412331382153

Thomas, L. (2002). Student retention in higher education: The role of institutional habitus. *Journal Of Education Policy*, 17(4), 423-442. https://www.tandfonline.com/doi/abs/10.1080/02680930210140257

Walker, J. D., Cotner, S. H., Baepler, P. M., and Decker, M. D. (2008). A delicate balance: integrating active learning into a large lecture course. *CBE Life Sciences Education,* 7 (Winter), 347-430. https://www.lifescied.org/doi/10.1187/cbe.08-02-0004

Weller, S. (2019). *Academic practice: developing as a professional in higher education*. London, UK: SAGE Publications Ltd.

Yorke, M. (2010 [2001]). Formative assessment and its relevance to retention. *Higher Education Research & Development,* 20 (2), 115-126. https://www.tandfonline.com/doi/abs/10.1080/758483462

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14393

Remote design thinking. Dynamics and perspectives of the transformation in the online didactics and project

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Abstract

The non-transitory side effects derived from the spread of COVID-19, which have suddenly silenced and emptied schools and universities while activating new didactic 'forms', lead us to a reflection on the value of the e-learning teaching project in design schools and its possible repositioning towards the discipline.

Taking inspiration from the recent modalities of distance learning, which were experimented during the compulsory lockdown and isolation caused by the spread of the virus, this contribution means to reflect on those online teaching procedures that have been used in the domain of design. These refer to some pedagogic experiences for the diffusion of knowledge developed in Italy since the 60s, on media of communication such as the radio and the television. They could become an operational procedure with the ability to influence the new way of conceiving both the teaching and the idea itself of the design project soon.

Keywords: *remote teaching; IT tools; design project; digital information; visual-learning; speed-painting.*

1. Introduction

The non-transitory side effects derived from the spread of COVID-19, which have suddenly silenced and emptied schools and universities while activating new didactic 'forms', lead us to a reflection on the value of the e-learning teaching project in design schools and its possible repositioning towards the discipline.

The complexity of present times, aggravated by the prolonged condition of emergency due to the pandemic, requires a critical revision and an ongoing update of the design teaching modality in Design schools. This is necessary to face the condition of the cultural, social, and financial crisis, to face problems related to the environmental impact - like the decay and depletion of natural resources -, to the processes of technological changes - new instruments and online platforms -, and to the new generation of 'Millennial' students - who prefer learning in a way that is simultaneously active and highly stimulating -.

Coronavirus has accelerated some processes which have already been underway in recent years in the domain of e-learning didactics. In this field, it has been possible to discover new teaching and learning modalities thanks to the transformation and innovation of the digital world. These modalities were never used before, but they are now able to provide new opportunities for the diffusion of design knowledge. The latest digital mobile devices are combined with the technological evolution of computer platforms and with a generous availability of open access data on the net. They allow the achievement of new potential for a consistent transfer of knowledge and an interdisciplinary transmission of 'liquid' skills and knowledge for the design project.

Taking inspiration from the recent modalities of distance learning, which were experimented during the compulsory lockdown and isolation caused by the spread of the virus, this contribution means to reflect on those online teaching procedures that have been used in the domain of design. These refer to some pedagogic experiences for the diffusion of knowledge developed in Italy since the 60s, on media of communication such as the radio and the television. They could become an operational procedure with the ability to influence the new way of conceiving both the teaching and the idea itself of the design project soon. In the first part, we will retrace those pedagogic experiences that, in the past, have influenced and characterized the e-learning of the design 'Made in Italy'. The second part will be about those modern technological devices that are particularly effective in determining a new modality of distance teaching in the field of design. The conclusions outline some relevant aspects that, from a pedagogic point of view, can become a reference for a future passage of the project knowledge in virtual universities on one hand, and ensuring a new position of the discipline through a new approach to the design of the project on the other.

2. Teaching design and distance learning: from the 60s to the e-learning

Correspondence learning has very ancient origins. Records of early forms of distance learning can be found in England, Germany, and the United States during the 1800s to erase the cultural gap between the different classes. Courses were mainly technical or commercial, they were delivered by private institutions and addressed to those who could access education outside a school context.

This didactic form was widely enhanced by the arrival of radios and televisions. It is enough to think that RAI, the national Italian broadcasting company, transmitted for the first time a program that was entirely dedicated to teaching Italian to illiterates from the 15th November 1960. This way, those who had a TV could learn how to read and write Italian directly from their homes, on their sofas.

The real revolution in the field of distance learning takes place with the appearance of personal computers on the market. This gave life to what is defined as "Multimedia education", which broadened the audience of learners, although the learning, in this phase, is still considered as an individual process, and the didactics is still dispensing and not interactive.

The invention of the Internet gives new stimuli to distance learning through "net training": e-learning turns the asynchronous learning process into synchronous, from unidirectional to multidirectional, promoting the sharing of information and the circular form of the learning processes.

In the field of Italian design, there is great evidence of cases where the teaching based on the "know-how" was transferred from the classrooms to the media, promoting the amplification and the in-depth analysis of the knowledge linked to the design activity.

It is enough to think of the first educational television programs, such as *Lezioni di design* (Design Lessons) in 2001, by Stefano Casciani, Anna Del Gatto, and Maurizio Malabruzzi, hosted by Ugo Gregoretti and broadcasted on Rai Educational in 30 episodes. Each episode was dedicated to an investigation on a particular aspect of design (from history to material culture), it included "impossible" interviews, contributions and interventions of exponents of the Italian design who had the task of illustrating, through personal experiences and anecdotes, the peculiarities of a specific subject.

Another example is the program *Ultrafragola*, a tv-art-magazine dedicated to Design, Art, and Architecture, hosted by Vanni Pasca, on the air since 2005 on Cult, a thematic channel on SKY. Ten episodes that try to retrace or rediscover the Italian creative scene - from its glorious traditions to the latest findings in the contemporary production - as well as wander through the scene of international design.

5 Lezioni di Storia del Design (5 Lessons on the History of Design) by Renato de Fusco in 2015, available on the author's YouTube channel.

Furthermore, the most recent Stefano Pasotti's *Storia del design* and *Storia del Design Italiano* (The History of Design and The History of Italian Design) appeared as YouTube Shorts in a playlist of 26 speeches used by the author to retrace the history of international design.

Corso Arte e Design: Lezioni di Bruno Munari (Art and Design Course: Lessons by Bruno Munari) is a particularly interesting online course (available on the WeSchool platform) made of 13 video lessons edited from one longer lesson that the artist held in Venice in 1992. The peculiar thing regarding this course is the possibility of interacting with WeSchool to request further material for a deeper study in real-time.

When we look beyond our national borders, besides the in-depth theoretical studies related to design, video-podcast focused on technical training are available on the web. Among these, it is worth mentioning the talent show *Philippe Starck: Design for Life.* Under the guidance and supervision of the world-famous architect and designer Philippe Starck, a series of aspiring designers are asked to transform their ideas into concrete products. A real design lab, divided into six episodes. In each episode, the students are guided through the different phases of the creative process: from the idea to the model, from the test on the prototype to the advertising campaign.

On a more technical side, the documentary *How it's made* produced in Canada by Production MAJ Inc came out in 2001 and it has been broadcasted on multiple international tv channels. Divided into 32 seasons, with more than 400 episodes, each video describes a single product, from its conception to the materials, technologies, and packaging.

Finally, the web provides a generous selection of video tutorials, video-podcasts aimed at teaching real lessons related to the use of digital devices for cad drawing, 3D modeling, and engineered products.

3. New instruments for online design teaching

In the condition of uncertainty and instability of the present times, how can we foster the knowledge needed to be trained in the design project, to trigger new forms of teaching and effective instruments that take advantage of the web potential?

In the current phase, the tools for the diffusion of knowledge are not represented by books of critique or architecture magazines and paper design any longer. They are represented by the infinite digital container of bookshelves, podcasts, images, databases of "open access" projects available on the web. In this context, it is crucial to divulge the project's culture and instruments with an effective method, which is rapid, sharp, and unambiguous.

Different from the past, when the academic practice of communicating the knowledge of design through a didactic method required a process of settling and slow-paced learning, today, the use of new computer technologies strengthens the process of online teaching of the project. Without giving up the entireness of the project, this process uses the short times of the web as a methodological instrument to impress a clear, short, immediate, and inclusive message. From a pedagogical point of view, it is decisive that the didactic online communications offer suitable elements and notions to allow the students an autonomous orientation in the complex field of knowledge and the different disciplines related to the project.

Within online design teaching, particularly when talking about remote training, it is necessary to outline new practices of design didactic to stimulate the creativeness and knowledge of the new generation of Millennial students. They prefer active learning, rich in stimuli rather than the "old style" lectures about the project. This was characterized by a "face to face" approach between professors and students and, the creative contents of the project were made clear through the empirical instrument of the initial sketch on a piece of paper. Today, new modalities of digital practices opt for an experimental didactic approach to freehand drawing, based on the use of computer instruments compatible with the tested digital platforms for e-learning such as Zoom, Meet, and Teams.

The online teaching during the pandemic has experimented - besides software to draw lines and geometric shapes - original and dynamic instruments of graphic display, particularly suitable in the initial phase of definition and communication of the project's concept, able to digitalize the creative hand drawing. Thanks to the diffusion of instruments such as graphic tablets and viewers that record the act of drawing, it is possible to teach the design discipline online through 'visual-learning' communicative processes and 'speed-painting' expressive ones. With extreme effectiveness and synthetic ability, these new instruments ensure clarity and personalized content, high definition of graphic lines, technical details, and artistic features, together with creativeness, ease to focus, fast learning, and participation.

In a short time, we went from using a viewer with a camera - which records the hand drawing on paper and projects it on the computer screen -, to the Moleskine's Smart Writing Set - which allows you to handwrite and draw on paper, and transfer notes and sketches in digital format on portable devices -, to the graphic tablet - which digitally records the graphic movement traced on its surface by a specific pen with a magnetic point -, to Faber-Castell mechanical pencil with graphite tip and magnetic support - which transfers the drawing line on a device thanks to a compatible graphic tablet -, to a simple and essential magnetic ring with silicone adaptor that can be applied onto any writing instrument such as pens and crayons - which digitalizes the artistic traits of the hand drawing through a specific graphic tablet -.

These new drawing instruments are a support for sketching the design project, they are more and more technologically performant, they can be personalized and compatible with new computer platforms. They represent a valid didactic support for the e-learning, both in a synchronous and an asynchronous modality, they can revolutionize and update the learning systems of the design project while stimulating the interest, catching the attention, and contrasting the difficulties to focus of the new generations of students.

In the next future, the use of these computer instruments will allow the discipline of design to: make the teaching of the project more efficient, immersive, dynamic, and participative; stimulate creativeness and imagination through learning methods; ease the access and the exchange of the materials available online, from any device and in any moment; transform the static learning of images projected on slideshows into a dynamic approach of knowledge diffusion thanks to the empirical and interactive instrument of the project drawing; simplify the creative concept of the project idea.

4. Future scenarios

4.1. The didactics of the project

In the 'liquid' and uncertain condition of the present times, and the domain of the multiple irreversible processes of technological transformation, in which way will the discipline of design be able to reposition its methodological principles in the teaching of the project? And besides, how will the new forms of teaching and learning bias the creative approach to the project and the resulting product of design?

The answer to these questions will have to be found in the 'new dimension of the project of design', which can be transferred through online hybrid educational processes. These make use of the potential of the new digital technological instruments, exploiting the creative and communicative language of the Social Media community. For the academic world, the challenge of the next years will consist of rethinking the pedagogic offer and the cultural content of the design discipline in a critical perspective, through an educational method that can interact with the new generation of 'Millennials', with a smart, communicative language, a flexible, synthetic and inclusive approach. Overall, it will be necessary to determine a training approach to «[…] *make the students overcome the habit of a passive indoctrination to acquire independence of action and judgment*» (Raiteri, 2014, p.115-116).

The design discipline will reposition its methodological principles regarding the teaching of the project, going beyond those teaching modalities used in real-time and face-to-face lessons. The latter, used to on a slow process of sedimentation over time of the "learning by doing", orienting the research towards the new 'liquid' opportunities of a remote knowledge transfer in the "e-learning by making". Without giving up the completeness of

knowledge, these new modalities of teaching and learning will use the short times of distance learning, both synchronous and asynchronous, as a methodological instrument to imprint an effective, sharp, rapid, and inclusive message. Through the use of digital e-learning platforms, of new communicative instruments of 'visual-learning', and 'speed-painting' expressive ones - sourced from the new support devices for the drawing of the project - the critical awareness of the teacher will s stimulate the student's creativity and a new type of experience in the design 'making'. In the comfortable and immersive environment of the virtual student-sized classroom, it will be possible to reduce the distance between teacher and students, favor a cultural debate and a critical confrontation of knowledge, and create a new collective 'project digital intelligence'.

4.2. Design is a trace

The society in which we are currently living could be defined as a "society of information and knowledge". Here, technology plays a crucial role in cultural enrichment and lifestyle sustainability, being used in the field of training and in those activities such as the planning and production of performing artifacts.

The introduction of the e-learning methodologies and the *Digital integrated didactics* have opened new scenarios for the training of future designers and the development of effective planning methodologies. The possibility to operate in an immersive, multisensorial environment has broadened the abilities and the skills of new draftsmen and provided new multitasking instruments to use in the planning process.

Although in the past a team of experts had to be "face-to-face" to reflect on a problem and solve it, nowadays the web offers several scenarios that multiplied and networked the participants, transformed the principle of verticalization of skills in a circular system, dematerializing the gathering space and dilating the time of aggregation.

Dynamism, interaction, immediateness, and multimodality will be the new paradigms that design will have to acknowledge. Dynamism as a synonym for update, specialization and ongoing in-depth study of knowledge. Interaction as a synonym of convergent and transversal knowledge. Multimodality as a possible interaction through the variety of media channels offered by e-technology.

The design is offered a new opportunity. The atopy of the web dimension matches perfectly with the design, which is atopic by definition. The absence of a real physical context, the presence of interlocutors and experts, the possibility to intervene from a distance in any moment of the planning process, represent a challenge for future designers to give life to sustainable planning methodologies, avoiding the mistakes which are often due to rushed and verticalized choices. We plan more and better, we produce less and what should be.

The design becomes a communicative process, the product loses its material aspect adapting to the conditions of the present times. It becomes an Avatar, a holographic image, chosen to represent the essence and the transcendence of things. It goes from being a sing to a trace, an «*open work of art* [...] *allowing an infinite number of interpretations and shows new meanings every time*» (Umberto Eco 1962). An ecstatic experience or image is decoded by the observer or final user through a process of interaction mediated by their background thanks to the input provided by the designer.

The product is not defined to achieve a specific action anymore, but it is a planning scheme, a concept that can be acquired, interpreted, adapted by the needs of those who use it.

The design product will not be the result of generalist planning any longer, may be set by a team from a particular latent need. Instead, thanks to the connectivity, the knowledge, and the ongoing training allowed by the web and the new technologies of rapid manufacturing (either synchronous or remote), the result will be a complex system, studded with relations in which the final user is the protagonist, as a lynchpin of the planning process that can be given the task to finish and define the ultimate nature of the artifact.

The team defines the trace, the hologram, the opened work of art. The user grafts the seed, the sprouting idea into the trace to produce a unique artifact, just like an haute couture tailor would.

Acknowledgments

In order to recognise independent contributions in publications with multiple authors, it is necessary to clarify that the plan, the abstract, and the contents of the article are the result of a common reflection by the Authors. The individual and independent contribution of prof. Roberto Bianchi is found: in the first part of the chapter 1, titled: "*Introduction*"; in the chapter 3, titled: "*New instruments for online design teaching*"; in the chapter 4, paragraph 4.1, titled: "*The didactics of the project*". The individual and independent contribution of prof. Marco Elia is found: in the second part of the chapter 1, titled: "*Introduction*"; in the chapter 2, titled: "*Teaching design and distance learning: from the 60s to the e-learning*"; in the chapter 4, paragraph 4.2, titled: "*Design is a trace*".

References

Ceccarelli, N. (2020). *Design e didattica a distanza. Le 'lezioni' del lockdown*. Milano, Franco Angeli.

Raiteri, R. (2014), *Progettare progettisti. Un paradigma della formazione contemporanea*, Macerata, Quodlibet.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14423

'Face-to-Face vs. Distance Learning': analysis of the training of musicians during Covid-19

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Abstract

The Covid-19 pandemic has significantly accelerated the introduction and expansion of forms of distance learning around the world. However, there are still some areas of learning that require direct interaction between the teacher and the student – like «face to face». Teaching of music (solo and choral singing, playing musical instruments) requires constant personal control of the teacher during the lesson. The main purpose of this article is to analyze the quality of distance and mixed learning for students of musical specialties at three humanitarian universities of Russia, Kazakhstan and Kyrgyzstan. Students answered to 32 questions of an online questionnaire on the using of various digital technologies in the process of distance learning during the pandemic. The authors come to the conclusion that the most promising is the mixed model of music education, in which digital technologies serve as an additional means for the development of professional skills.

Keywords: *blended learning; music education; digital technologies.*

1. Introduction

Over the past two years (2020-2021), education around the world has seen rapid changes, from the search for the quick solutions amid the constraints of the Covid-19 pandemic to the creation of the new pedagogical models of learning through digital technologies. The most relevant research topics in the field of education are still distance and mixed learning (Victorino et al., 2021) in various subject areas. The problems of music lessons related to the need for individual communication between a teacher and a student "face to face" in a pandemic also remain in the spotlight (Wendt et al., 2021). The lessons in vocals, piano, guitar, etc., when the teacher has to see and hear his student's every sound and every movement, are especially difficult in a remote format. In such conditions, the choice of digital educational tools and technologies is a difficult task, as musicians need high-quality sound and video transmission. Researchers provide many examples of the use of mobile applications for the vocal training (Shi, 2021), which help to change the pedagogical model in accordance with the demands of the quality of the lesson. However, the development of digital technologies in the field of academic vocal pedagogy is still lagging behind (Fan, 2021). As the most acceptable form of distance learning for students of creative specialties, many teachers offer a mixed or hybrid format (Li et al., 2021).

Learning through online resources has become popular – these are social media, which have a large number of educational video courses (Sun, 2021). A new class of young musicians has emerged who give lessons through YouTube channels and who consider themselves experts in musical knowledge (Vizcaíno-Verdú et al., 2021). Teachers and students have significantly advanced their skills in recording digital content for classes, mastered new programs and applications (Gutman et al., 2021).

The development of artificial intelligence technology has gained popularity for training musicians during the Covid-19 pandemic (Yang G. & Yang L., 2020). Massive Open Online Courses (MOOCs) for musicians have also emerged and online messaging services have been used for educational purposes: "They've broken the traditional learning model" (Yang G. & Yang L., 2020). However, the technical problems of audio distortion and Internet data rates are the "cons" of using these digital applications for online learning (Yang G.& Yang L., 2020).

A large study of the work of music schools and conservatories in Spain during the pandemic is presented in the paper of several authors (Calderón-Garrido et al., 2021), who concluded that music theory classes were less affected in the distance learning. And we agree with the authors that the greatest difficulties during online learning are experienced by the musical ensembles (Calderón-Garrido et al., 2021).

In the studies and papers, you can get acquainted with new online resources for learning – SmartMusic, eMusicTheory and Dolmetsch Music Theory and find out the results of testing

them by the students in the choral singing class (Lv & Luo, 2021). An experimental program for online learning to play keyboards and vocals was presented by a group of authors (Zhang et al., 2021) showed good results in activating the memory and creative skills of students.

Today, it is time to take stock of the use of the digital technologies in the training of musicians over the past two years. It is necessary to carry out an analysis – which digital applications and programs were most in demand, convenient, promising for further use. The training of musicians is inevitably moving to a new stage – the combination of the traditional forms of face-to-face lessons in combination with new digital tools for independent work of students in a mixed format.

The main goal of this paper is to analyze data from a survey of students of musical specialties in three higher educational institutions in Russia, Kazakhstan and Kyrgyzstan. It is important to understand the degree of student satisfaction with the distance learning format, especially for individual music lessons. The results of this study are planned to be used in the preparation of international academic mobility programs for music students from the three countries listed above. The choice of optimal digital services will help create favorable conditions for joint learning of music students. The result of the analysis of the online survey should be the answer to the question – is it the mixed form of education that is the most suitable for musicians from different countries.

2. Research methods

A simultaneous survey was conducted in the form of an online questionnaire (GoogleForms) for 107 music students of higher educational institutions of culture and art from three countries. The responses were received from students: 43 from Russia (Kazan State Institute of Culture, KazSIC), 31 from Kyrgyzstan (Kyrgyz State University of Culture and Arts named after B. Beishenalieva), 33 from Kazakhstan (Kyzylorda University named after Korkyt Ata). The main purpose of the survey is to identify students' attitudes towards the total online learning, especially in musical disciplines that require face-to-face communication with the teacher. The second important task is to analyze changes in students' digital competencies, their attitude to digital technologies in education, in their creative and professional activities. The researchers needed to identify a common set of digital educational services; degree of mastery of digital programs and applications for musicians; as well as knowledge of professional terminology in English.

3. Results

The results of the survey showed that students from the three countries gave very similar answers to the main questions. However, some answers were different. Let’s consider

successively the results of an online questionnaire of 32 questions. All the questions were in Russian and had different types: ready-made answers – "yes" / no, multiple choice and open-ended questions.

The 1st group of questions – "general information" (No. 1-4). Full-time students (No. 4**)** in their 3rd and 4th year of undergraduate level (No. 2) were surveyed, 32% of which were male and 68% were female (No. 1). The students were distributed in the following musical specialties: 43% solo singing, 36% instrumental performance, 21% choral singing (No. 3).

The 2nd group of questions – "online learning" (No. 5-12, 14, 27, 28). The analysis of responses to this group of questions showed mixed results across the countries. The results of answers to more important questions are given as a comparison in Table 1.

Q5: What do you think – is it possible to study well with the help of online technologies ("yes / no").

Q6: What do you think – are digital programs and applications necessary for learning ("yes/no").

Q9: Did you understand all the professional advice on playing, singing, conducting, articulation with a teacher in creative disciplines during distance classes, articulation ("yes/no").

Q28: What do you think – is mixed learning (face-to-face and online) the best option in modern conditions ("yes / no").

Table 1. The comparative analysis of important questions of the second group.

	Q5	**Q6**	**Q9**	**Q28**
Russia	no 60,5%	yes 76%	yes 44%	yes 65%
Kyrgyzstan	no 61%	yes 71%	yes 61%	yes 64%
Kazakhstan	yes 63%	yes 67%	yes 78%	yes 72%

The majority of students use Google as their digital cloud platform for distance learning (No. 14).Works pace for Education (84%) and MOODLE-based systems (30%). Most often, the teachers suggested that students use video conferencing services for music lessons (No.10) – ZOOM (94%), Google Meet (27%), Microsoft Teams (3%), Discord (3%), Skype (3%). Students chose ZOOM (70%), Google Meet (19%), Skype (3%), WhatsApp (3%) as the most convenient service for individual music lessons (No. 12). The vast majority of students chose WhatsApp (97%), Telegram (30%), VK (29%), Classroom (3%), Viber (2%), Instagram (2%) as a quick messaging service (No.11). Question No.27: "How affordable are free licenses for digital mobile apps? " – the majority of students answered – "yes, they are

available for free" (64%), "you need to buy a license" (20%), "I use a demo version" (27%). Half of the students answered that they have a sufficient level of English language proficiency to work in digital programs and applications (No.7-8).

The 3rd group of questions – "the digital and multimedia technologies and social media" (No. 13, 15, 26, 29, 30). A very important group of questions for understanding what digital applications students use during distance learning, when some do not have a piano nearby for classes; it is necessary to record the completed tasks well in audio and video format and send it to the teacher. Carrying out creative projects, promoting your own social media accounts also requires many digital and multimedia competencies.

As a result of counting the answers for this group, we found that music mobile applications are in the lead (No. 13) like "Piano" (68%), GarageBand (22%), Absolute ear (15%), Musescore (10%), AudioScore (8%), Smule (6%), NotateMe (5%), PhotoScore (5%), Vocalremover (1%), Metronomebeats (1%), do not use any at all (4%). Among multimedia programs and applications for creating creative works, students chose the following (No. 5): Photoshop (35%), AdobeCreativeCloud (30%), Canva (21%), Movaviclips (12%), SuperSound (7%), InShot (5%), do not use any (4%). To the question No. 26 "How often do you use digital applications for processing video, sound, images to create content on the Internet? ": "often" (46%), "not often" (44%), "I don't use it at all" (10 %). The leadership among students' choice of social media to promote their own musical creativity (No.29-30) distributed as follows: Instagram (69%), FB/Meta (7%), VK (2%), YouTube (10%), TikTok (8%), I don't use any (1 person out of 107), all of the above have an account (1 person).

The 4th group of questions – "the knowledge of digital technologies in the field of culture and musical art" (No. 16-18, 23). The questions of this group are needed in order to understand how widely students know and want to study in more detail the digital technologies of artificial intelligence (AI), virtual (VR) and augmented reality (AR), the creation of digital applications, work in music editors and virtual studios. The results showed that many use applications for education and cultural leisure (No. 16) GoogleArts&Culture (51%), Artefact (25%), VRCardboard (16%), do not use any (13%). Among music editors (No. 17), the most popular were Sibelius (59%), Musescore (30%), Finale (27%). General question No.23 about the availability of the module AI in various digital tools showed that many people know about services with AI, AR, VR from Google (83%).

The 5th group of questions – "the digital competencies of future professional activity" (No. 19-22, 24, 25, 31, 32). As the students themselves will work as music teachers in the future, we needed to identify the level of motivation for independent use and further development of digital educational tools. 80% of the students answered that they have already had professional work experience and know where they will work after graduation (65%). More than half of the students want to use digital programs and applications for musicians in their

professional activities (No. 21). The majority of students answered that they would improve the overall level of digital literacy (86%) and want to learn new digital technologies in the future: AI (54%); AR/VR (35%), the programming (35%).

4. Discussion

Despite some conflicting answers from students from different countries, in general, the results of the online survey showed the following results. In the "online learning" block of questions, students from Kyrgyzstan and Russia answered that they did not want to study remotely only, and this is due to the problem of video conferencing services that do not provide high-quality sound transmission for the level of professional musicians. Additional factors of dissatisfaction with full distance learning are the problems of accessibility of licensed programs and applications, and language restrictions. Also among the survey participants were several students who were negatively opposed to online learning in general, against digital technologies, mobile applications and social media. Perhaps this is how psychological fatigue from the the pandemic restrictions manifests itself.

The block of questions "the digital and multimedia technologies and social media" shows a great interest of students in creative projects for personal promotion in social media. A group of questions on digital technologies in the field of culture and music showed the willingness of students to learn AI, VR, AR and create digital applications. Artificial intelligence in culture and art got students interested more than other technologies.

The majority of students prefer mixed learning as the most preferable for musicians (67% on average). It should be concluded that students from Kazakhstan were more satisfied with the quality of online learning in all groups of questions, since they use the Platonus distance learning system (in integration with the MOODLE platform). The "Platonus" system brings learning closer to the "digital twin" model of the university, and creates comfortable conditions not only for learning, but also for the entire range of services of the educational campus. "Platonus" can become the basis for the future international academic mobility programs music students from the three countries.

5. Conclusions

The pedagogical experience of the authors of the study shows that a total remote mode is possible for many subject areas that do not require constant monitoring "face to face" – these are humanitarian lecture courses. Special musical disciplines, in which individual lessons are conducted, traditionally require full-time classes. The Covid-19 restrictions made us look for convenient digital educational tools for conducting creative lessons online. We conclude that mixed learning in a pandemic may be the best option for teachers and students. Many tasks

can be performed using cloud platforms, mobile applications, but "the live control" of mastering musical skills cannot be replaced by any digital technologies at this stage in the development of technical progress. In the near future, mixed reality technologies and holographic data transmission will become widespread, and then, perhaps, the "teacher's digital twin" will be able to conduct online classes from anywhere in the world.

References

Calderón-Garrido, D., Gustems-Carnicer, J., & Faure-Carvallo, A. (2021). Adaptations in Conservatories and Music Schools in Spain during the COVID-19 Pandemic. *International Journal of Instruction*, 14(4).

Fan, Y. (2021). Application of Computer Technology in Vocal Music Teaching. In *Journal of Physics: Conference Series* (Vol. 1881, No. 2, p. 022050). IOP Publishing.

Gutman, E., Topal, N., Yavgildina, Z., Shalamova, G., & Iskhakova, I. (2021, March). Digital Educational Environment of Professional Training: Modeling and Development. *IV International Scientific and Practical Conference (DEFIN-2021)*, 1-4. doi:10.1145/3487757.3490920

Li, Q., Li, Z., & Han, J. (2021). A hybrid learning pedagogy for surmounting the challenges of the COVID-19 pandemic in the performing arts education. *Education and Information Technologies*, 26(6), 7635-7655

Lv, H. Z., & Luo, J. (2021). Creative approaches in music teaching: Possibilities of Web 2.0 technologies. *Thinking Skills and Creativity*, *40*, 100840.

Shi, Y. (2021). The use of mobile internet platforms and applications in vocal training: synergy of technological and pedagogical solutions. *Interactive Learning Environments*, 1-12.

Sun, W. (2021). New Development of Vocal Music Teaching in the Omnimedia Era.

Victorino, G., Henriques, R., & Bandeira, R. (2021). Teaching Design Thinking in times of COVID-19: an online learning experience. *7th International Conference on Higher Education Advances (HEAd'21),* 263-270. doi: 10.4995/HEAd21.2021.13149

Vizcaíno-Verdú, A., Contreras-Pulido, P., & Guzmán-Franco, M. D. (2021). Youtube musicians and self-perceived multimedia, hypermedia, intertextual and transmedia competencies. *Learning, Media and Technology*, 1-16.

Wendt, L., Du Toit, E., &Naug, H. (2021). 'Face-to-Face vs. Flipped': A Comparative Study on Academic Outcomes and Learning Preferences in First Year Allied Health Students Undertaking Anatomy and Physiology. *7th International Conference on Higher Education Advances (HEAd'21),* 1043-1052. doi: 10.4995/HEAd21.2021.13017

Yang, G., & Yang, L. (2020). Exploration of Vocal Music Teaching Mode from the Perspective of the Age of Artificial Intelligence. *International Journal of Frontiers in Engineering Technology*, 2(1).

Zhang, M., Guo, M., & Xiao, B. (2021). Creative thinking and musical collaboration: Promoting online learning groups for aspiring musicians. *Thinking Skills and Creativity*, 42, 100947.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14466

An Analysis of Conversational Volatility During Telecollaboration Sessions for Second Language Learning

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Abstract
Tandem telecollaboration is a pedagogy used in second language learning where mixed groups of students meet online in videoconferencing sessions to practice their conversational skills in their target language. We have built and deployed a system called L2 Learning to support post-session review and self-reflection on students' participation in such meetings. We automatically compute a metric called Conversational Volatility which quantifies the amount of interaction among participants, indicating how dynamic or flat the conversations were. Our analysis on more than 100 hours of video recordings involving 28 of our students indicates that conversations do not get more dynamic as meetings progress, that there is a wide variety of levels of interaction across students and student groups, and the speaking in French appears to have more animated conversations than speaking in English, though the reasons for that are not clear.

Keywords: *Telecollaboration; Second Language Learning; Conversational Dialogue, Videoconferencing.*

1. Introduction

One of the most important aspects of second language learning, known as L2 learning, involves practicing conversations and dialogue, ideally with native speakers of the target language. This helps to reinforce the learner's confidence in the target language, expands vocabulary and exposes the learner to experiences of the cultural norms and practices of that target language.

In pre-COVID times, practicing conversational second language learning was difficult unless the learner relocated to a country where that language was spoken, which happened often through student exchanges funded by the Erasmus program, or through local meetups and gatherings. The concept of telecollaboration or virtual exchange whereby students would meet with native language speakers of their target language via videoconferencing calls had been used for a long time pre-COVID and its use was has long been a part of virtual exchange pedagogy (O'Rourke and Stickler, 2017). Tandem collaboration involves a reciprocal arrangement whereby the groups paired up for telecollaboration sessions spend half the call duration speaking in one language which would be the target language of one group and the native language of the other, and at the halfway point they would change language and the roles would be reversed.

Now, as a result of restrictions introduced by the pandemic, we have had more than 2 years of experience with Zoom, Microsoft Teams, Webex and other supports for teaching and learning, for social gatherings among friends and family, and for business purposes. As a result we are now more comfortable and familiar with the use of video conferencing in our day-to-day activities, and more open to its use in a variety of contexts.

In this paper we outline how we developed and deployed a software platform to support second language learning via telecollaboration in our University and in partnerships with 7 other Universities in Europe. This covered second language learning of English, French, German, Spanish and Italian. We automatically extracted a variety of metrics from each of the +400 telecollaboration meetings which were then presented to student participants to aid them in self-reflection on their participation in these online meetings.

One of the metrics we presented was conversational volatility, a measure reflecting the dynamic vs. static nature of conversational interactions. This paper presents the results of the conversational volatility metric for 114 telecollaboration meetings for a class of 28 students from our University learning French as a second language, partnered with students from Belgium learning English. Groups of up to 4 students were created and the groups met weekly for videoconferencing sessions for up to 6 weeks in a row. We explore whether there is variety in the level of conversational interactions across different groups as reflected in the conversational volatility metric and whether the dynamicity of the dialogue during the online sessions changed from one week to the next.

2. Background

Telecollaboration in language learning is not a new concept and a history of its development is presented in (Dooly & O'Dowd, 2018). More recently, a bibliometric analysis of 254 research articles in (Barbosa & Ferreira-Lopes, 2021) presented a summary of the field including an exploration into the benefits and drawbacks of different technologies that can support it.

In a recent editorial position paper, Colpaert (2020) took issue with the terminology used to describe this pedagogy and the shift to the use of the term "virtual exchange" but does expand on the many ways in which "telecollaboration affords many more activities than its physical counterparts", thus further strengthening arguments in favour of telecollaboration. What we are interested in here is how technology can be, and has been used, to support the specific needs of telecollaboration.

The bibliometric study presented in (Barbosa & Ferreira-Lopes, 2021) addressed this by looking at the most-used technologies and found that videoconferencing systems like Skype, virtual worlds like Second Life, social media platforms like Facebook, storytelling wikis and blogs, were the main tools used, drawing much of its evidence from (Avgousti, 2018). There are also quite a few software platforms specifically built to offer support for tandem language learning including HelloTalk, Babbel.com, SpeakPlus and others.

However what is common to the specialist platforms, the videoconferencing systems and the other tools used is that they do not support post-session reviews. In particular, there is nothing to specifically support students' self-reflection on their telecollaboration tandem meetings, which is what we address in this paper.

3. The L2 Learning System

The L2 Learning system (Dey-Plissonneau et al, 2021a) is built on top of Zoom and uses the Zoom audio transcripts which are an encoding of Zoom's timed speech recognition. Students hold their Zoom meetings typically in groups of 3 or 4 with half the meeting being in English and half in the second language. After each meeting with students when Zoom has completed its processing and speech transcription, students share the link to their video recording and upload the transcript file (in VTT format) to the L2 Learning system. From this we generate a visualisation of the telecollaboration meeting as shown in Figure 1.

The visualisation shown in Figure 1 which is not one from the student telecollaborations, shows a meeting between 3 participants. The features include a hotlinked timeline as a series of vertical bars in blue, red and yellow showing who spoke when and for how long as well as the overall % participation for each participant. A chord graph on the right of the screen indicates the cumulative sequence of who followed who in the conversation. A metric we

call conversation volatility, described in the next section, is also shown for the overall and for each half of the meeting as a bar chart on the bottom left. The conversation flow chord graph is useful to illustrate when a subset of participants dominate the Zoom call by having their own conversations among themselves and 1 or more of the remainder are left out of the dialogue. This can happen for any of several reasons, including when a participant is not comfortable speaking the language of the conversation at that point in the Zoom call. The colour coded utterances on the timeline are hotlinked so clicking on any of them starts video playback shown in the middle of the screen with the headshots as a gallery view of the 3 participants in this case (with faces blurred).

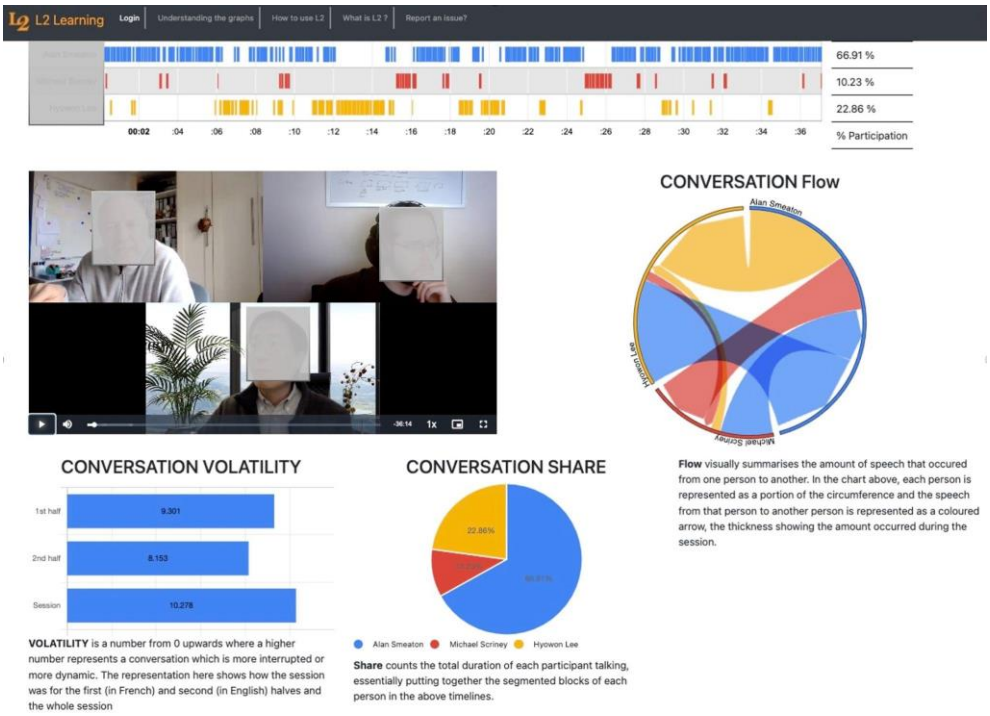

Figure 1: Screengrab from L2 Learning System

We have been using the L2 Learning system for three full semesters in collaborations between 2 English-speaking Universities and Universities speaking French, Spanish, German and Italian (Dey-Plissonneau et al, 2021b). For this paper we focus on data gathered from 28 students in an English-speaking country taking a 1-semester French language course at intermediate level in Autumn 2021. These students were grouped with 36 students in a French-speaking University in Belgium who were learning English and a total of 114 Zoom tandem telecollaboration meetings of average duration 58 minutes were recorded and analysed.

4. Conversational Volatility

When analysing a telecollaboration meeting in an automatic and scalable way, features like total speaking time are useful but what we would really like to identify is the amount of interaction or turn-taking during the Zoom meeting by the meeting as a whole as well as by each participant. To address this we introduced conversation volatility as a metric. As shown in (Guydish and Fox Tree, 2021) while the characteristics of good conversations are complex, and even more so with new online communication technologies, the rationale is that the more that participants engage in a conversation, the better the experience will be for all. Thus an online conversation with lots of interaction and interruption from multiple participants will have a higher volatility measure and result in a more enjoyable experience for all participants than a conversation which is a flat series of monologues with low conversational volatility.

Historical volatility (Hong and Lee, 2017), (Somarajan et al., 2019) is a statistical measure which is widely used in applications in economics and finance. It is used by analysts and stock traders as part of the creation of financial investing strategies. Historical volatility is formally defined as the degree of variation of values of some continuous time series over time, usually measured by the standard deviation of daily changes in stock prices.

If we apply the historical volatility metric to turn taking for a telecollaboration meeting, that will indicate whether the dialogue was truly interactive and composed of shorter and longer utterances mixed such as when people interrupt each other, or whether it consisted of long monologues with likely tedious turn-taking. Conversational volatility can attribute scores to the dialogue as a whole or to individual participants. Here we compute conversational volatility for the first and the second halves independently as well as for the whole meeting. This would indicate whether there was more interaction in the French or English speaking parts of the meetings.

5. Results

A total of 114 telecollaboration Zoom meetings involving the 28 students from our University form the data for analysis of conversational volatility in this paper. The average Zoom meeting length was just under 58 minutes with little variation either side of that, so students were consistent in keeping to the one hour recommended meeting duration. Students were asked to spend the first half of the meeting in French and at about the mid-way point to switch to English. When we manually annotated the turnover point for the 114 meetings we found that on average this point was within 3 minutes 44 seconds of the actual midway point of the recorded meeting. There were 2 of 114 meetings that spent much longer in one language before changing and when we remove those the changeover point dropped to within 3 minutes of the actual midpoint. This means that when calculating conversational volatility for the French and English parts of telecollaboration meetings we can use the half-way point

to determine the point of language changeover without much error. Our annotation found that 93 of the 106 meetings started in French followed by English and 13 had the opposite so we would need some form of language identification if we are to completely automate the calculation of conversational volatility, though for the analysis presented here we use the manual annotation of which half was in French and which was in English.

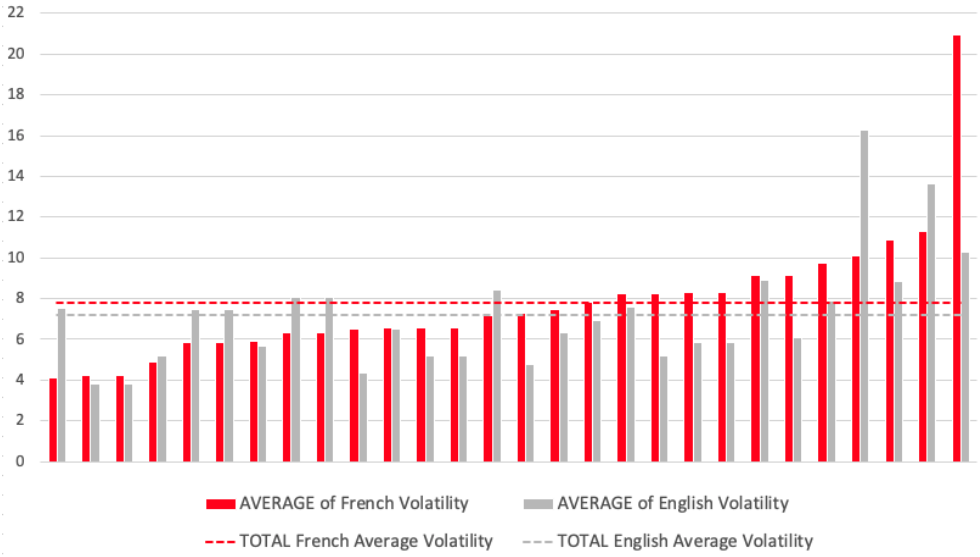

Figure 2: Average conversation volatility per group speaking each language (groups ordered by increasing volatility for French sessions)

Figure 2 shows the average conversation volatility measures for each of 28 students for the English-speaking and French-speaking halves of their meetings. There is a small spread of average values though with some extreme values, both very dynamic and very static. Of the 28 students in groups, 19 had higher volatility for French than for English parts and 9 had higher volatility for English and the average for French (7.8) was greater than for English (7.2). Given that it is the same sets of students in a group speaking English and French, does this difference in languages indicate that speaking in French is more dynamic than in English? We do not yet have enough evidence for this and it is a topic for further investigation.

We then looked at how the volatility measure changes for 19 of the 28 students as they progress from one meeting to the next for the French-speaking parts of their meetings and this is shown in Figure 3. We chose these 19 students as they had missed fewer than their peers so had greater contiguity. The x-axis labels indicate the numbers of students who had 1 meeting (19 students), 2 meetings (19 students) and so on up to 6 meetings (3 students). The dotted red line shows the average volatility measure for first, second, etc. meetings.

Figure 3 reinforces what we saw in Figure 2, that there is a spread of values for almost all students with some extremes. Almost all students they have ups and downs throughout their meeting progressions, with little flatlining on the graph. We also note that there is no overall increase in conversational volatility as meetings progress from first to last and this is shown in the averaged value per meeting (dotted red line) as well as in entries for individual students.

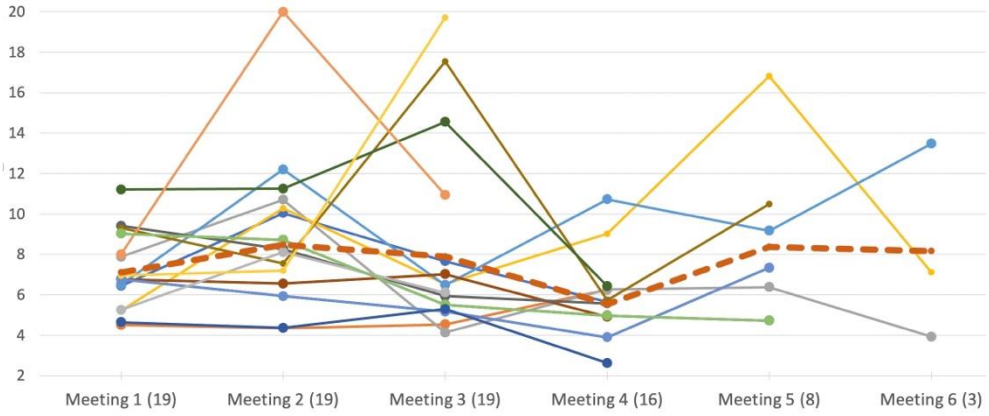

Figure 3: Conversational volatility per group for French-speaking parts of online meetings

Finally, we calculated conversational volatility measures for individual student participation in meetings. The values for volatility for individuals are less than those for whole groups because of smaller numbers of utterances. For 87 meetings involving these 19 students with 68 hours of video recordings and transcriptions, almost half had higher volatility for their French speaking contributions and half had higher volatility for their native English speaking contributions but the French parts did have higher volatility levels on average.

6. Conclusions

In this paper we report on the levels of conversational interaction which took place as part of tandem telecollaboration for 28 students learning French as a second language, partnering with French-speaking students learning English and using the L2 Learning system. We introduced a measure of conversational dynamics called conversational volatility which quantifies the amount of interaction among participants at group and individual levels.

Our analysis shows that levels of conversational dynamics does not increase as students progress through their weekly tandem telecollaboration sessions and that video conversations in French seem to have more interaction and turn taking than in English. We found variety in the levels of interaction for different students with some more animated and interactive than others. Finally we observed variety in the levels of interaction for students across their own meetings. The reasons for these observations are all topics for future investigation.

Acknowledgements

This publication has emanated from research supported by Science Foundation Ireland (SFI) under Grant Number SFI/12/RC/2289_P2 (Insight SFI Research Centre for Data Analytics), co-funded by the European Regional Development Fund.

References

Avgousti, M.I. (2018) Intercultural communicative competence and online exchanges: a systematic review, *Computer Assisted Language Learning*, 31:8, 819-853, doi: 10.1080/09588221.2018.1455713

Barbosa M.W. & Ferreira-Lopes, L. (2021) Emerging trends in telecollaboration and virtual exchange: a bibliometric study, *Educational Review*, doi: 10.1080/00131911.2021.1907314

Colpaert, J. (2020) Editorial position paper: how virtual is your research?, *Computer Assisted Language Learning*, 33:7, 653-664, doi: 10.1080/09588221.2020.1824059

Dey-Plissonneau, A., Lee, H., Pradier, V., Scriney, M. & Smeaton, A.F. (2021a). The L2L system for second language learning using visualised Zoom calls among students. *European Conference on Technology Enhanced Learning* (pp. 409-413). Springer, Cham. doi: 10.1007/978-3-030-86436-1_45

Dey-Plissonneau, A., Lee, H., Scriney, M., Smeaton, A.F., Pradier, V. & Riaz, H. (2021b). Facilitating reflection in teletandem through automatically generated conversation metrics and playback video. *CALL and professionalisation: short papers from EUROCALL 2021*, 88. doi: 10.14705/rpnet.2021.54.1314

Dooly, M., & O'Dowd, R. (2018). Telecollaboration in the foreign language classroom: A review of its origins and its application to language teaching practice. *M. Dooly and R. O'Dowd (Eds.)*, 11-34

Guydish, A.J, Fox Tree, J.E. (2021). Good conversations: Grounding, convergence, and richness. *New Ideas in Psychology*, 63, doi: 10.1016/j.newideapsych.2021.100877.

Hong, Y., & Lee, Y. J. (2017). A general approach to testing volatility models in time series. *Journal of Management Science and Engineering*, *2*(1), 1-33. doi: 10.3724/SP.J.1383.201001

O'Dowd, R. (2021) Virtual exchange: moving forward into the next decade, *Computer Assisted Language Learning*, 34:3, 209-224, doi: 10.1080/09588221.2021.1902201

O'Rourke, B. and Stickler, U. (2017). "Synchronous communication technologies for language learning: Promise and challenges in research and pedagogy". *Language Learning in Higher Education*, 7(1), 1-20. doi: 10.1515/cercles-2017-0009

Somarajan, S., Shankar, M., Sharma, T., & Jeyanthi, R. (2019). Modelling and analysis of volatility in time series data. In *Soft Computing and Signal Processing* (pp. 609-618). Springer, Singapore. doi: 10.1007/978-981-13-3393-4_62

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14677

'Realia & Replica': In-class Museums and Emotional Archives

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Abstract

The teaching project 'Realia & Replica' promotes learning in the History, Culture, and Heritage courses offered by the Universidad de Valladolid to English Studies undergratuates. It furthers their understanding and appreciation of the histories and societies of the English-speaking cultures, their links with Spain and their cultural heritage. It comprises four interrelated seminars that culminate in an internship at the university's libraries and historical archive. In the seminars, the classroom becomes a museum, where students work with real historical artifacts and facsimile reproductions; as interns, they receive instruction in special collections description and management. Apart from yielding excellent academic results, the project has built a teaching collection and provided assistance in cataloguing the university's library and archival holdings. It fosters the students' professionalisation alongside their social, ethical, and cultural awareness development, inspired by practice at Rare Book School at the University of Virginia, the materiality of learning, and affect studies.

Keywords: *In-class museums; materiality; affect; History; libraries; archives.*

1. Introduction: The Materiality of Education and Emotional Archives

In the teaching of the Humanities, experience has long shown the didactic deficiency of resources that lack material support. That fault was traditionally palliated by planning field-trips to museums, libraries, and archives, which mostly proved insufficient in terms of pedagogical gain, inasmuch as interaction with the material there exhibited was almost invariably, yet understandably, impossible. The multitude of onsite and online workshops, lessons, themed collections that such institutions have been preparing since the turn of the century is excellent, but those delivered onsite still want a direct link with the classroom and those published online often present discontinuity with the particular course syllabuses. Nonwithstanding, it is very much thanks to their effort that the materiality of the objects of study and of the learning environment are now recognised to have a fundamental bearing in the learning process, no matter how generously the digital world is contributing to education. Sørensen (2009) has explained this with respect to the learning media, while the recent turn to affect in teaching has incorporated the human body and corporeality to the teaching learning equation (Dernikos, *et al*., 2020). In the field of History, the work that the students do with archival material (e.g. correspondence, diaries, photographs), printed matter (e.g. propaganda tracts, travel books, war declarations) and objects (e.g. coins, rare books, tapes) involves emotional work *per se* (Barclay, 2018): the texts or images contained in them often deal with people's lives and ideals and usually concern conflict and discord. It is only natural that the students produce affective responses to them, to perhaps either love or reject what they have just read or listened to. And yet, what matters here is how those affective responses (and the surge of future memory and desire they afford, according to Tyng *et al*., 2017) are heightened by the physicality of their media, when students are given a chance to handle them. Since 1983, Rare Book School (RBS) at the University of Virginia has been serving as a worldwide reference in "teaching with stuff" (Belanger & Heritage 2019). Their method of teaching the history of written, printed, and digital materials with real historical sources in the classroom has spread internationally and to most areas of historical expertise, in such a way that today, the Humanities department that is not building up a teaching collection of artifacts and liasing with special collections repositories is clearly falling behind in its educational standards. The present project is inspired by their hands-on teaching method.

2. The 'Realia & Replica' Project: Courses, Participants, and Aims

The teaching project 'Realia & Replica: In-class museums for students of History, Culture, and Heritage' (R&R) was first set up in 2017 at the Universidad de Valladolid (UVA) and has been continuously active since then. It is comprised of four interrelated practical seminars corresponding to the courses in History, Culture, and Heritage offered to undergraduate students of English Studies (*Grado en Estudios Ingleses*, EEII) at the School of Philosophy and Arts (*Facultad de Filosofía y Letras*, FyL).

In their first year at UVA, the students of English are required to take two core courses in the histories of the Anglophone countries and the societies that have been shaped by them: *Cultura y sociedad de las Islas Británicas*, followed by *Cultura y sociedad norteamericanas*, one semester each. *Relaciones histórico-culturales* is required in their second year. It marks out the historical and cultural milestones in the history that Spain has shared with the English-speaking nations. In their third year, they can opt for *Patrimonio* to learn about the principles and practices of heritage management and be introduced to British and American art and cultural heritage. Here is the average enrollment data over the past four academic years:

Table 1. Course units and average matriculation figures (2017-2021).

Year/S.	Course unit	Type	ETCS	Matric.
1Y/1S	*Cultura y sociedad de las Islas Británicas*	Core	6	52
1Y/2S	*Cultura y sociedad norteamericanas*	Core	6	53
2Y/2S	*Relaciones histórico-culturales España-mundo anglosajón*	OB	6	32
3Y/2S	*Patrimonio artístico-cultural del ámbito anglosajón*	OP	6	37

Source: SIGMA, Sistema Integrado de Gestión de Matrícula, UVA. Prepared by the author.

Using the only official evidence available (*La UVA en cifras*, 2017), the students participating in the R&R seminars may be described as female in their majority (62,7%) and residing in Valladolid or nearby provinces (over 80%). With an average grade of 6.9 obtained in their entrance examinations, most of them have earned similar general final results: Good (36,5%) and Pass (36,8%). Their social background is middle- or working-class. The project is administrated and imparted by five academics from the departments of English Studies and History of Art and the two directors of the UVA Faculty Library (*Biblioteca de Filosofía y Letras, UVA*) and Historical Archive (*Archivo Histórico de la UVA*, AUHVA). Two students aid in the management of the teaching collection and class administration as course assistants.

Grounded on the theories and practices presented in the introduction, R&R works with the hypothesis that teaching with artifacts in the classroom, in an awareness of the role that materiality and affect have in the process, enhances the students' long-term learning. It aims to provide students with: a) an understanding of the history and culture of English-speaking countries and the dynamics of their relations with Spain; b) a grounding knowledge of the tools of historical and documentary analysis; c) an appreciation of cultural assets and the institutions that manage them. Building a departmental teaching archive and promoting the connection between the academic and heritage centers of the university are two further aims, which, like those above, derive from the set of activities programmed: lectures, questionnaires, seminars, poster exhibitions, and internships.

3. Activities, Methods, and Materials

At the UVA, the delivery of contents of any one of these undergraduate courses (6 ECTS) is often structured around ten core thematic units, which added to introductory and final debate sessions (plus the hours taken up by official holidays) span over a total fourteen weeks.

3.1. Lectures and 'The Odd One Out'

A week's plan starts with two 50-minute interactive lectures. In them, contents are delivered in 10-minute periods, preceded and followed by an introduction and a wrap-up, and intervalled by brief question and discussion time. Their focus is to provide exposure to the basic informative content and present further recommended reading on the subject. To aid the students with retention of facts and critical discrimination between similar phenomena, R&R has designed a particular form of Moodle questionnaire named "The Odd One Out." For each of the twelve questions posed, one of the four answers proposed will be "the odd one out": either three of them will be true and one will be false, or three of them will be false and one true. To answer them, the students may need to go back to their notes and suggested readings, but the point is precisely that, by reviewing content, the key facts and threads of discussion are clarified and retained (Roediger & Karpicke, 2006). They are encouraged to take the test as many times as necessary and once they feel they are ready, use the virtual forum to explain the reason why any three of them are true or false among the rest. The tutor's feedback will be available to the benefit of all students.

3.2. The R&R Seminars: Emotion and Materiality

After the lectures, the group of students is divided into two to attend one weekly seminar each. For nearly two hours, the classroom becomes an interactive museum (Gidcumb, 2015). Each seminar consists of 3/5 activities of about 10/20 minutes followed by the students' explanations and the tutor's feedback. The students work individually or in informal groups of 3 to 4 members and around either real historical-documentary material (*Realia*) or facsimile reproductions (*Replica*). Following instructions by the tutor, they fill in a worksheet which includes definition tasks (concepts, situations, problems), data extraction and organisation (timelines, family trees, tables, maps) and interpretation (summaries, deductions, hypotheses) (table 2). Like the lectures, the seminar begins with an introduction and ends with a wrap-up session and the submission of the completed worksheets.

During the two first-year *Cultura y sociedad* courses (1Y/1S&2S), in the seminars "The tools of the historian" (I) and (II), the students work with digital reproductions and printed replicas from the National Archives, UK (e.g. from "Gift from a King," through "English Reformation, 1527–90," reaching to "Victorian Health Reform") and the US National Archives (e.g. the US Declaration of Independence, Jefferson's correspondence, Nixon's tapes). They are used to introduce them to the study of primary sources, how to identify,

describe, analyse, and interpret them and their surrogates, presenting basic notions of paleography in the first semester and of editorial practice in the second.

In the seminar "Historical contact through Realia & Replica," in *Relaciones* (2Y/2S), they explore the dynastic alliances, explorations, conflicts, travels, literary and artistic exchanges, that have linked the histories of Spain and the English-speaking nations, through original and facsimile sources like Armada pamphlets, 18th-century picaresque books, newspapers of the Spanish-American War, or ELT material from the US-Spain cooperation agreements of the 1960s (table 2). The students advance in their analytical skills (with more complex exercises on paleography and primary source description) and improve their interpretative and critical ability by reading and evaluating research on the documents and sources under scrutiny.

Table 2. Seminar Resources and Materials.

Source	Aim	Items
Instructor	Defining, analysing and interpretating	Worksheets: concepts, situations, problems; timelines, geneaological trees, tables; hypotheses, summaries
Instructor	Preliminary reading	Reading guidelines: e.g. Hariot's *Report* (1588), Paine's *Common Sense* (1776), *US Office Statistical Atlas* (1898), Brown v. Board of Education (1954)
Dep. teaching coll. (Curating)	Exhibiting and handling documents	book cradles, snakes, loupes, spotlights, gloves
Departmental teaching collection (Facsimiles)	Source identification, description and interpretation	e.g. UVA Matriculation Books, 1588-1800, AUVA LIB 33-58; US Constitution, LOC; Yndice de las obras inglesas, c.1805, BHSC MS 506; English pamphlets of the Spanish Civil War (1936-1937)
Departmental teaching collection (Donations)	Source identification, description and interpretation	Donations from the Ford Foundation and the British Council (1960s). Including: vinyl records (33 ½ RPM, 12", 7"), magnetic tapes, phonetics lab handbooks, slides and posters

Source: Prepared by the author.

"Principles of bibliographical and archival description," in *Patrimonio* (3Y/2S), teaches the students how to technically identify, analyse, and describe the materiality of documentary heritage (creator, hand, format, collation, provenance), through contact with originals (historical paper, exemplars of folios, quartos, octavos, duodecimos, and archival items).

As explained earlier, each of these four seminars is conceived as an interactive in-class museum, where a number of textual and non-textual artifacts relating to the week's lecture contents are displayed in the classroom (fig. 1). Some of them are replicas; others, realia. In

all cases, the students are allowed to touch and handle, following the required protocols. Here is where emotion plays its role. Seeing how most students get excited, engaging emotionally with historical testimonies appears to be the natural reaction. Even if it is not always to like them, the corporeality of those artifacts brings a sense of nearness of the past. With the hands-on interaction, they "teach fast," as Belanger would put it (2019), and the emotion they produce induces learning with memory and desire, as Tyng *et al.* have explained (2017).

Figure 1. Materials from the R&R teaching archive. Source: Photographs by R&R team (2020).

Outside the classroom, divided into formal groups of 3 or 4, the students work on a teamwork project. They must research one specific case study around one primary source relating one of the course units, design an academic poster around their findings, and present it orally in an end-of-term debate session. In two group tutorials, they report on their reading and draft poster and receive suggestions and corrections, before the final posters are printed out and displayed in a joint physical exhibition at the Faculty, for the public to visit.

3.3. Internships, Engaged Learning, and Service-Learning

During their final year of studies, some students choose to put their knowledge and skills to practice as interns. R&R offers placement posts in the UVA FyL Library and the AHUVA, to work with their historical collections. They are taught the principles and basic practices of special collections description and management by the professionals at their care. In return, the students assist them in their cataloguing of historical and rare material and several have written their final dissertations around their collections and helped the author of this article prepare their online exhibition in her Omeka site: *Spanish Connections*, under a CC Licence.

4. Results

It is fair to say that R&R is marked with success. The last academic year (2020-21) is a good example. Its results reflect very closely those of previous years and their steady improvement.

4.1. The Students' Grades

Of a total 24 students of *Relaciones*, more than 75% of those that sat the first call (72.31%) passed the course. The majority of them (66%) obtained grades *Notable* (Good) and *Sobresaliente* (Excellent), markedly improving the performance of past groups. Apart from

being naturally talented, this group's general participation in "The Odd One Out" tests boosted their content retention and clarification of concepts. Their satisfaction was high.

4.2. Their Evaluation of the Teaching Perfomance

It was also the case of the 35 students of *Patrimonio* evaluating the project. Like those of *Cultura* and *Relaciones*, the graded the project "Excellent."

Table 3. Patrimonio: Teaching performance evaluation (2020-2021).

Course	Planning	Materials	Methods	Motivation	Assessment
Patrimonio (R&R)	100	100	100	100	100
Degree (EEII)	87,8	93,5	89,4	92,3	86
School (FyL)	88,2	93,2	87,6	90,4	85,8
UVA	80	86,8	86,3	85	83,5

Source: SIGMA, Sistema Integrado de Gestión de Matrícula, UVA. Prepared by the author.

It is gratifying to see that maximum levels of satisfaction were reached very generally. In all sections, the instructors obtained an average 11.3 points above those teaching the other courses in the Degree and the UVA. A median of 4.5 or 5 was always obtained, with the maximum of 5 being awarded to course planning, materials used, learning benefits in class, and interest aroused by the subject.

4.3. An Assessment Questionnaire on R&R

The final anonymous Moodle questionnaire submitted by 16 of the 24 students of *Relaciones* corroborated those results. It offered additional data on specific student preferences for certain activities and materials. The majority opted for those that included realia, like the Ford Foundation and British Council donations; however, favourite activities and materials also included facsimiles (e.g. newspapers from the Spanish-American War or the UVA manuscript inventory of 18th-century English books). The poster project was considered rewarding, unlike "The Odd One Out" questionnaires, which, albeit rewarding, was found to be too demanding by 27% of the participants.

4.4. Serving the community

Our undergraduate students are by no means the only beneficiaries of R&R. Its teaching archive has been put to use with the matriculates of the UVA Humanities International Semester and in the workshop "Shakespeare and the material book," which was designed as part of the UVA Research and Excellence Baccalaurate. We are proud also that one of our R&R students sits at the Board of the UVA General Library to represent her fellow students.

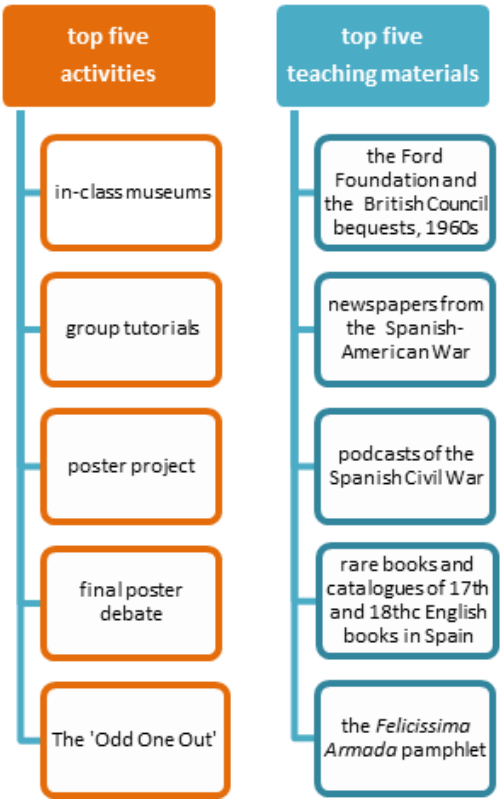

Figure 2. The students' top 5 activities & learning materials. Source: R&R Report (2021).

5. Conclusion

This project has now been tested out for four academic years. Although there are aspects that need to improve, its principal goals regarding student learning in History, Culture, and Heritage have been well reached, our teaching archive grows, while our links to the UVA repositories strengthen. We are certain that our methodological preference for the materiality of learning and affect has created a uniquely emotional learning environment for the students, spanning across their undergraduate years, where they are able to articulate knowledge, think creatively, and develop a social and cultural awareness, capable of opening up for them new career prospects in the field that the majority would never have considered before.

Acknowledgements

This project is funded by the Vicerrectorado de Innovación Docente y Transformación Digital of the UVA (2017-). My warm thanks to all those involved in carrying it out.

References

Barclay, K. (2018). Falling in Love with the Dead: Emotional Archives. *Rethinking History: The Journal of Theory and Practice*, 22(4), 459–473.

Belanger, T., & Heritage, B. (2019). Teaching with Stuff: Building Bibliographical Collections at Rare Book School *Bibliography Among the Disciplines*. Soundcloud: https://soundcloud.com/rarebookschool/bxd-short-3/.

Dernikos, B., *et al*. (2020). *Mapping the Affective Turn in Education: Theory, Research, and Pedagogies*. Routledge.

Gidcumb, B. (2015). Creating Classroom Museum Exhibits. *Building the Future of Education: Museums and the Learning Ecosystem*. American Alliance of Museums.

Roediger, H. L. III, & Karpicke, J. D. (2006). Test-Enhanced Learning: Taking Memory Tests Improves Long-Term Retention. *Psychological Science*, 17(3), 249–255.

Sørensen, E. (2009). *The Materiality of Learning: Technology and Knowledge in Educational Practice*. Cambridge University Press.

Tyng, C. M., *et al*. (2017). The Influences of Emotion on Learning and Memory. *Front Psychology*, 8.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14681

French-Spanish service learning as a pedagogical tool:an overview of the MIGPRO Project

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Abstract

The MIGPRO project aims to inspire and engage university students in a silent reality the world currently faces: migration. Through a collaboration between an NGO (Red Cross – Castellón) and students from the Translation and Interpreting degree (Universitat Jaume I, Castellón, Spain), the main goal will be to use the service learning pedagogical strategy. To do so, we will refer to the learn it, link it process (Oakley and Sejnowski, 2021), whereby students make connections and link theory with practice. Specifically, glossaries and Spanish didactic tools are offered to the Red Cross - Castellón. Learning resources are co-created based on refugees' needs. As a consequence, the acquisition of language and culture mediation strategies are targeted. Furthermore, connections between students' reactions and their (non-)existent migration background is established. Plans for a long-term project—seeking to enroll all generations of students with French as a second language—are devised.

Keywords: *Teaching tools; co-creation; language education; service learning.*

1. Introduction

At a time when migration is an everyday reality that requires our attention, we provide an enriching activity for students from the Translation and Interpreting degree with French as a Second Language (FSL) at the Universitat Jaume I. We are pioneering a MIGrant PROject (MIGPRO) in which students experience authentic assessment (Brown, 2015) and performance assessment (Fernández, 2010). Our ultimate goal is to help students acquire the skills required in the subject in which we are developing the project—with the pedagogical strategy of service learning being prominent. We also resort to other research-pedagogical tools, such as surveys administered at the end of the learning experience. Twenty-eight students in their 20s are taking part in this project, which is not an "extracurricular activity" (Eccles et al., 2003), where they face tasks that emulate difficulties found in an authentic professional context. The project was not initially contemplated in the course syllabus, but given the inherent benefits from this project, we decided to do it as a course activity where students later decide if they want to donate the materials to the Red Cross. However, even if they do not donate the materials created, they would still benefit from the service learning. The project is scheduled to last four months, in which students create materials for Spanish learners in an environment monitored by the lecturer.

2. Brief description of the project

As part of MIGPRO, we worked with the 28 students (in their 20s) enrolled in Translation C (French) -A1 (Spanish) (I) (code: TI0936) during the 2021–2022 academic year. In this subject, students are exposed to an upper-intermediate level of French that is used both for communication and language mediation.

Essentially, MIGPRO facilitates the provision of a learning service by Translation and Interpreting undergraduates to the Red Cross. This learning service aims to assist with French-speaking migrants acquiring basic Spanish.

MIGPRO consists of the following stages:

1. Initial survey (see below).
2. Learning about MIGPRO.
3. Analyzing the profile of (18–21-year-old) migrants.
4. Choosing a topic and working methodology.
5. Reflecting on proactive intervention.
6. Sharing proactive intervention.
7. Refining results with common feedback.

After introducing the students to the reality of migration and explaining the purpose and stages of MIGPRO, the project starts with an initial survey (conducted in Qualtrics)—a key

element on their learning path. Students sign an informed consent to express explicit agreement with the sharing of their answers (and subsequent materials) with the Red Cross. With this survey, we gather essential information to reflect upon results in MIGPRO-II.

SURVEY

1. Where are you from?
2. Do you have any migrant background?
3. Do you have friends who were born in a different country?

4. Do you think your level of French is good enough for the course you are currently in?
5. Do you speak or practice French outside the classroom? How do you practice it?
6. Do you think practicing French outside the classroom is needed?
7. Do you think the French language needs more space in the degree program to improve your linguistic skills? If wanted, you can specify which aspects should be included.

8. As a Translation and Interpreting student, do you think it is important to know the reality of migration? Why?
9. As a Translation and Interpreting student, do you think this experience could help you get to know new working prospects?
10. What kind of activities would you perform in this project to improve your translator and interpreter competences?

Figure 1. Survey to be undertaken before starting the project.

Students are provided with introductory information about the project and are trained in the basic skills to achieve maximum success. For instance, the underpinnings of glossary building and lesson planning are provided here. Students must understand what they want the migrants to achieve (i.e., goals) and how they will make this possible (i.e., content and methodology). Therefore, students have to reflect on this before designing the glossaries or learning materials, as we see in the following schema:

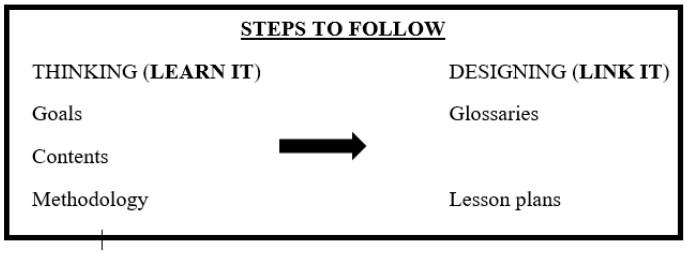

Figure 2. Structure for designing glossaries and lesson plans.

Since the materials are meant for migrants, students are asked to include the final design of their glossary or lesson plan (i.e., we assess how they link their learning). The goals and methodology will not be assessed due to the fact that students are designing a lesson plan for the first time.

As part of these initial stages, students are given anonymized data about 18–21 year-old migrants, with whom they will subsequently work. It is crucial to highlight that the students

and migrants are of similar ages to enhance empathy and learning. Students are then given the option of creating a glossary with the terms that migrants view as important for their integration in society. Alternatively, they can plan a learning lesson that works with language and cultural aspects of considerable difficulty. Final reflection-feedback activities close the project.

Notice that all these stages are performed individually and in pairs (Cano et al., 2020) in the classroom under the lecturer's constant supervision (and subsequent feedback).

As can be seen, MIGPRO reinforces the abilities targeted by TI9036:

Competences and learning outcomes

Generic and specific competences

CE01 - Command of translation techniques and strategies
CE05 - Command of the second foreign language and its culture for translating and interpreting
CE07 - Command of computer tools applied to translation/interpreting
CG01 - Analysis and synthesis skills
CG02 - Problem-solving
CG06 - Autonomy
CG07 - Decision-making

Learning outcomes

Assimilating the factors to be considered in decision making
Consolidating the use of electronic resources for documentation
Consolidating and extending skills in the use of basic reference works and other documentation resources
Developing problem-solving skills
Increasing theoretical knowledge with regard to the language combination in question
Ability to apply different strategies to reading comprehension and the identification of translation problems
Ability to apply the theoretical knowledge acquired in language B subjects
Ability to apply appropriate translation techniques and strategies
Ability to apply autonomous work methods
Ability to identify and understand how the different text types work in languages C and A, as well as their incidence on translation

Figure 3. Competences and learning outcomes expected from the course syllabus of the subject TI0936 – Translation C-A1 (French-Spanish) (I) (Universitat Jaume I, 2022).

Nevertheless, MIGPRO adds what we consider to be a fundamental (and missing from the previous list) competence for our 21st century classroom: empathy with world realities. It is imperative (or so we think) that students develop an awareness of the importance of their proactive role in society. Thus, MIGPRO establishes connections between undergraduates and migrants living in Castellón (Spain). We firmly believe this is a potential way to encourage students to learn and react to society, in which they have rights and duties. Furthermore, MIGPRO aims to create synergies between the Degree of Translation and Interpreting and the Red Cross. It is high time the university abandons its academic cocoon.

3. MIGPRO's underlying aims and planning

The most immediate goal of this project is to improve students' abilities in French and in French-Spanish translation using the pedagogical strategy of service learning. The project ultimately seeks to make students aware of the reality of migrants who come to Spain with no resources for job hunting, and to react as a consequence of this learning. A key result would be for students in future academic years to follow suit and participate, so both migrants and students benefit from the experience in the long run. The research questions (RQs) we put forward are:

1. Is there any improvement in participants' competences (including empathy) with the service learning strategy?
2. Do students experience any improvement in their French and Spanish language competences?
3. Which learning task and materials are chosen by students when proposed to do so?
4. Do they veer toward glossary creation or syllabus creation?
5. Is there any difference in materials created by participants with (or without) a migrant background?

To answer the RQs, we compared the answers given in the initial survey as well as the resulting glossaries and didactic tools created by the students. Due to most data in the materials created being qualitative, we will quantify the number of glossaries or lesson plans made, but a rubric is to be designed and introduced in MIGPRO-II to analyze the contents found in each glossary and lesson plan proposal and its connection with the initial survey. To do this, we will code the chosen topics and the surveys numerically so as to link the results with their background.

4. MIGPRO theoretical platform

As students are learning, neurons are linking and strengthening. We refer to this process as *learn it, link it* (Oakley and Sejnowski, 2021: 3). In other words, lecturers aim to get students to learn something and make connections afterwards to put the acquired knowledge into practice. Being exposed to and working with sample problems can be invaluable in allowing students to begin to form mental templates that enable them to understand and solve a wide range of issues (Chen et al., 2015). With this in mind, we consider service learning to be the most suitable strategy. We understand this term as this "reciprocal learning" (Sigmon, 1979) where providers and recipients of services benefit from the activities (Furco, 1996: 2).

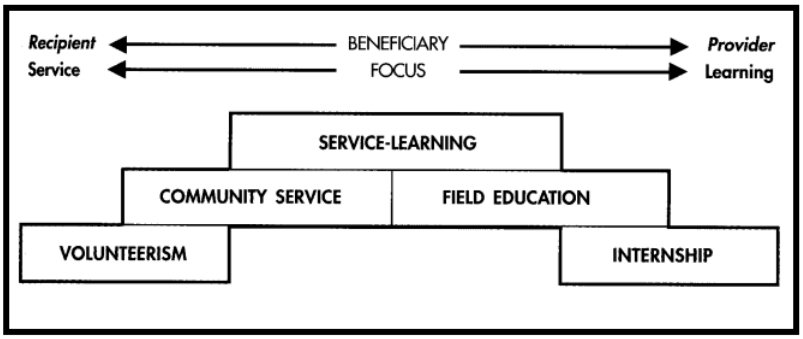

Figure 4. Distinctions among service programs (Furco, 1996: 2)

We believe that turning students into providers and content creators is a particularly good idea. This allows them to absorb initial knowledge (the *learn it* phase), and enables them to create materials and reflect upon associated competences (the *link it* phase).

We favor teaching all students the same content knowledge and skills but using different approaches to meet individual needs. In this respect, we agree with Oakley and Sejnowski when they argue that "different learners need different approaches to succeed" (2021: 21). Oakley and Sejnowski (2021:16) state there are (at least) two types of learners:

1) "race-car (i.e., fast thinkers) learners": students who are quick in their answers and fast in their learning connections, and
2) "hiker (i.e., slower) brains": students who benefit more from a flexible way of thinking.

To cater to these two types of learners in MIGPRO after giving students preliminary information, they are encouraged to choose the kind of proactive task they find most suitable to liaise with Red Cross migrants. On one hand, they can put together a glossary with the most basic Spanish terminology still needed and the French equivalent. Conversely, they can devise a lesson to aid migrants in acquiring the abilities they need. Both glossaries and lessons will be grouped in units to unify the Spanish contents presented in the learning materials.

It seems to us that the task of glossary building is most suitable for race-car learners because they are faster in the linking process.

It is logical therefore that the lesson planning task is most suitable for hiker learners because organization and a slower thinking process would result in a good presentation of the contents to be learned.

By offering students two options to pursue the *learn-it-and-link-it* circle, we believe we contribute to optimizing conditions for the acquisition and reinforcement of competences. Motivation and peer-to-peer work—which are undoubtedly decisive in the learning

process—are also maximized. As MIGPRO is student-centered, students practice problem-solving, decision-making, and autonomy in addition to the lecturer monitoring the whole process.

5. Future evaluation

Seeing the evolution (before, during and after) of students' attitudes and results in the classroom will be helpful. We completed the latter with the data obtained from the aforementioned survey. Since the project emphasizes skills, we will focus on them, focusing on our newly added empathy competence. Since MIGPRO is envisaged for the long run, we expect to carry out a future longitudinal evaluation. The impact of the project will be evaluated in MIGPRO-II.

5.1. Future expansion

An increased scope of the project is planned. Subsequently, we aim to hold an event where students can teach and present the main contents to refugees from the Red Cross. This event may include talks or lessons, and will be a valuable opportunity to empower both students and refugees.

6. Conclusion

We have developed an engaging project in which we are willing to have increased participation whereby students become providers. This project is built upon the *learn-it-and-link-it* theoretical platform with a view to boosting empathy, a newly added competence that we consider crucial in the 21st century. The expected benefits from this project are:

- Connecting students with the reality of migration and encouraging a proactive attitude vis-a-vis individual and social realities.
- Encouraging students to choose their learning path according to their learning (race-car/hiker) profile to enhance their French to Spanish translation competences and their FSL knowledge.
- Providing an exciting and innovative opportunity for students to be exposed to authentic learning.

Further conclusions (based on the student surveys and their lesson plans and glossaries) are outlined in the future MIGPRO-II. We also plan to extend this project into an annual program where more students could get involved and more migrants may join to contribute to learning.

References

Brown, S. (2015). La evaluación auténtica: el uso de la evaluación para ayudar a los estudiantes a aprender. *RELIEVE*, *21*(2). doi: http://dx.doi.org/10.7203/relieve.21.2.7674

Cano García, E., Pons Seguí, L., & Lluch Molins, L. (2020). *Feedback en educación superior*. Retrieved from: http://diposit.ub.edu/dspace/bitstream/2445/158466/1/Guia_feedback_Educacio_Superior_Cano_Pons_Lluch.pdf

Chen, O., et al. (2015). "The worked example effect, the generation effect, and element interactivity". *Journal of Educational Psychology Review* 107(3). pp. 689–704.

Eccles, J. S., Barber, B. L., Stone, M., & Hunt, J. (2003). Extracurricular activities and adolescent development. *Journal of social issues*, 59(4), 865-889. doi: 10.1046/j.0022-4537.2003.00095.x

Fernández, A. (2010): La evaluación orientada al aprendizaje en un modelo de formación por competencias en la educación universitaria. *Revista de docencia universitaria, 8*(1). Retrieved from: http://dialnet.unirioja.es/descarga/articulo/3996629.pdf

Furco, A. (1996). *Service-learning: A balanced approach to experiential education*. Washington, DC: Corporation for National Service.

Oakley, B., & Sejnowski, T. J. (2021). *Uncommon sense teaching: Practical insights in brain science to help students learn*. London: Penguin.

Sigmon, R. (1979). Service-learning: Three principles. *Synergist, 8*(1), pp. 9–11.

Universitat Jaume I (2021). *TI0936 – Translation C-A1 (French-Spanish) (I*) (Course syllabus). Retrieved from: https://e-ujier.uji.es/pls/www/gri_www.euji22883_html?p_curso_aca=2021&p_asignatura_id=TI0936&p_idioma=en&p_titulacion=207

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14588

Some practical insights on teaching FL to visually impaired students

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Abstract

This paper aims at discussing pedagogical practices within the area of inclusive and accessible language education, with a particular focus on visual impairment. Accessible education cuts across all aspects of education: physical and technological infrastructures, instructional modes, teaching strategies, learning materials, and assessment. The success in creating an inclusive learning environment depends on teacher training and professional development. After a brief clarification of the notion of accessibility in educational settings, the paper offers practical recommendations which address any instructor who is committed to planning and teaching an accessible foreign language course for visually impaired students within a mainstream university setting.

Keywords: *Inclusive education; accessibility; visual impairment; foreign language education; foreign language teachers.*

1. Introduction

The actual implementation of inclusive practices in university teaching programs still represents an emerging phenomenon. In most cases, the success in creating an inclusive learning environment depends on the problem-solving skills and creativity of the single instructor, rather than on a conscious and shared strategy. One of the main problems lies in the lack of training, experience, as well as adequate methodology that can be employed for teaching students with special educational needs. In this paper I would like to provide practical insights and guidance concerning inclusive language education in higher learning institutions on the basis of my personal experience of teaching Russian as a foreign language (FL) to a group of Italian native learners, among whom some were visually impaired (VI). The experience was gained in the context of the project "Towards accessible and inclusive teaching practices in Russian FL. An experimental study" that was developed by the Department of Foreign Languages and Literatures of the University of Verona in 2019-2021.

2. "Accessibility" in education: what does this actually mean?

Generally speaking, accessible education may be defined as the process of designing and delivering courses to encounter the comprehensive needs of people from different background and with different capabilities, cognitive characteristics, learning times and styles, and motivations. Concretely, this implies that every moment of the learning process must be accessible by each learner *with equal ease*. Given this assumption, when designing a course that aims to be inclusive, we must bear in mind that accessibility should be articulated at three levels: physical accessibility, technological accessibility and learning content accessibility. *Physical accessibility* pertains to those courses that are held (entirely or partially) in-person and consists in the actual access of students to the educational spaces, implying the removal of any environmental barrier, and the ensuring of a student-friendly spatial setting. *Technological accessibility* relates to any course that is delivered (entirely or partially) in e-learning mode and benefits from the use of one or more technological platforms (Moodle, Zoom, etc.). Technological accessibility may be pursued by meeting the "Web Content Accessibility Guidelines" standards (WCAG 2.0) elaborated by the W3C (see W3C 2008). Web accessibility depends on both accessible Web browsers and accessible content, which leads us to the concept of *learning content accessibility*. It concerns either in-person or e-learning courses and consists of designing contents in a way that is accessible to every learner. This level of accessibility encompasses both instructional materials and strategies.

3. Teaching an accessible FL course to VI students

When planning a course, any instructor is required to make a series of choices that involve its design and delivery mode, instructional strategies and materials, as well as assessment

methods. In the following sections a set of recommendations is provided to support teachers in undertaking such choices in order to make their FL courses accessible to an audience that include VI students.

3.1. What to do prior to classes: how to 'prepare to be inclusive'

An instructor who is committed to the delivery of an accessible FL course needs to get prepared to work in an inclusive setting by carrying out the following actions.

Developing knowledge on visual impairment. It is essential that the instructor gets aware of what visually impairment is so that s/he can be ready to respond to the diverse needs of his/her students. Here I shall limit myself in saying that 'visual impairment' is used as an umbrella term to refer to both low vision and blindness. When it comes to education, we must bear in mind that, while blind students cannot use their vision at all, the partially sighted are able to use their residual vision in the learning process aided by special equipment. It is equally important to gain knowledge on assistive technology for VI individuals in order to understand how VI students access print and digital information and produce written communications. The most frequently used assistive technology tools are the followings: screen readers, Braille readers, Braille bars, magnifying glasses, electronic magnifiers.

Choosing the most inclusive delivery mode. Conventionally, we can distinguish three different ways a class may be delivered: *in-person* (face-to-face (f2f) classroom instruction which may enjoy a limited use of technology); *online* (the so called e-learning, a computer enhanced learning); *blended* (a combination of f2f instruction with online instruction). When designing a course that aims to be accessible to VI learners, the choice of the instructional mode is a crucial one. We must consider that the traditional in-person mode can cause problems to the visually impaired, since it puts at risk the possibility for them to attend classes on a regular basis: mobility is a critical aspect for VI individuals. Given this, the online and blended modes are certainly a better option when planning an accessible FL course, for they ensure a more flexible form of training. The benefits of the e-learning mode in terms of inclusiveness for VI students have been discussed by a consistent number of authors (among others, see Kharade & Peese 2012, Leporini & Buzzi 2007). E-learning may be understood in a broad sense as "the delivery of a learning […] program by electronic means covering a wide set of applications and processes, such as web-based learning, computer-based learning, virtual classrooms and digital collaboration" (Kharade & Peese 2012, 440). It should be noted that with the outbreak of the COVID pandemic the notions of e-learning and blended format have ended up being interchangeable, since, as Hartle (2020) underlines, "f2f is no longer considered simply to be a physical classroom alone but may also refer to f2f by remote teaching with video conferencing tools, where the blend becomes rather one of synchronous and asynchronous activity" (175). Based on my experience, I recommend delivering your inclusive language course remotely in blended mode, alternating between synchronous (f2f

live classes) and asynchronous learning (videos, quizzes, and various forms of assignments to carry out digitally). Another option is adopting the blended mode in its traditional sense, which means combining in-presence lessons (which should be recorded) and online work.

Collecting information from your students. Prior to classes it is essential for any instructor to organize an individual meeting with his/her future VI students in order to identify their needs and requirements. For example, before my course of Russian FL started, I scheduled an online meeting with each VI learner, during which I asked questions pertaining their visual difficulties, the tools and equipment they use to read and write, as well as the way they work with digital and/or printed (in the case of partially sighted) materials. If you are going to use any technological platform, as in my case, it is important to find out if your VI students are familiar to it, and if not to provide them with technical instructions. If your language course is addressed to beginners, ask your students whether they had any experience in FL training: do they know any foreign language? Where and when did they learn it? Did they have a positive experience? If their answer is no, ask them to explain what went wrong. If your students are not beginners, ask them about their previous learning experience in the target language. What was difficult for them to learn? In general, encourage students to provide any information that may help you in improving the effectiveness of your teaching. If your course, or part of it, will take place in a physical classroom, it is best to meet you students in person, give them a tour of the classroom, discuss the seating and the kind of light exposure they need in order to create an accessible setting.

Predicting difficulties in language learning. It is essential to detect *in advance* any possible problem that VI students may encounter when approaching the target language, especially if you are working with beginner learners. For example, with regard to Russian language, one of the main critical issues is represented by the Cyrillic alphabet. In my case, being the course held remotely, such criticality was doubled: how can you teach VI students the graphic asset of Russian letters without relying on tactile materials? And thus, how can you teach and train them to write in Russian via videoconference? (check out next section to see how I responded to such tasks). The identification of educational challenges prior to classes, will help us to figure out a whole set of techniques and materials to overcome future difficulties.

3.2. What to do during classes: how to 'perform inclusion'

The presence of VI students in the classroom challenges us to creatively use and develop a whole set of inclusive teaching strategies and materials in FL education.

Instructional strategies. Inclusive education involves a shift from teacher-centeredness to student-centeredness. Applying a student-centred learning means to value learners' diversity by encouraging each learner to actively contribute to the construction of knowledge. It is well established that "the communicative and collaborative approaches in language teaching offer valuable opportunities for inclusive learning" (Smith 2018). As instructors, structure your

course following a communication-oriented model that involves a high degree of interaction (both teacher-student and student-student). For example, in my course of Russian FL during live classes students were regularly required to carry out activities which consisted in understanding and producing the language, focusing on conveying the meaning rather than on forms (e.g. speaking about where they live, things they like, where to find something they need; ordering food at a restaurant, etc.). During the interaction students received corrective feedbacks – either explicit or implicit – aiming at improving their accuracy and further developing the discussion. In my experience, designing the lesson using the communicative approach enables the creation of a positive and inclusive setting (each learner takes part to the discussion in conformity with his/her personal characteristics, experiences, interests, and motivation) and facilitates students' socialization (which, in the case of a remotely held course, would be difficult to pursue otherwise). Another way to promote student-centred learning is that of flipping the classroom. The flipped classroom is an instructional mode that inverts the traditional learning experience: students must individually review lecture material prior to classes, so that class time can be used for practical activities in which students cement contents and construct knowledge with the help of the instructor and peers. During my course, at times I required my students to watch short video lessons I prepared prior to class – topics ranged from grammar to lexicon – so that live classes became the place to discuss and review concepts, as well as organize participatory activities. Despite the flipped classroom format is an effective methodology in terms of inclusiveness (when reviewing materials individually, each student works at his/her own pace!), I can not help reporting a criticality: the pre-class preparation of new contents demands students a significant commitment outside of lesson time, which is why the use of such strategy must be carefully rationed. The applying of a student-centred approach does not exclude teacher's explanations and presentations. More traditional activities can be organized via frontal teaching. We must always bear in mind that when introducing new lexical or syntactical items, it is essential to spell out the single letters so that VI student can become familiar with the new word(s) and possibly take note of them. If you write on the blackboard, use a large and neat handwriting and frequently repeat what is being written.

Instructional materials. The modern approaches in teaching a FL are still massively based on visual materials. In order to respond to the students' diverse needs, instructors should use, and possibly create anew, multisensory teaching materials, combining multimedia, digital materials, and tactile materials. This means that language inputs must be provided through multisensory channels (visual, audio-visual, auditory, tactile) so that everyone can enjoy them. If you are working in a physical classroom, consider using real objects (the so-called 'realia'): handling, smelling and seeing real objects can make the learning experience more memorable for learners, and ultimately be beneficial for all students (not only those who are visually impaired!). Bear in mind that you must not avoid visual resources just because of the presence of VI students in the classroom: if they are considered useful for your learning

purpose, continue to incorporate photographs, paintings, and pictures, making sure to provide an oral description of visual materials. When designing textual materials, it is essential to follow the guidelines for accessibility (see Microsoft 2022a and 2022b), remembering that, while blind students are prevented from reading without the support of a screen reader, partially sighted may work with written texts, as long as they meet specific requirements. For example, PowerPoint presentations should contain high contrast slides with a simple, non-graphic, black background and withe letters. The font used should be 'sans serif' (e.g. Arial, Calibri, Verdana, Tahoma) in a big size. It is important to avoid the use of italics, which is harder to process, and limit the use of underlining to hypertext links only. Any textual content should be always accompanied by audio descriptions and/or saved in a screen reader-friendly format in order to ensure that students can alternatively use the sight and hearing channels with equal ease. We must be sure that all the materials can fully interact with screen readers. This is why, when drafting any digital textual material, it is preferable to avoid a multilingual situation (e.g. mixing Italian and Russian) that could cause the misreading of words. As concerns materials intended to individual work, it is important to design a set of homework that privileges listening and speaking activities. For example, we may ask students to record themselves when completing a speaking assignment, as so we will be able to give them feedback about their oral skills. At the same time, we must not exclude writing and reading activities. Again, when asking students to complete a writing assignment (e.g., a quiz in Moodle), we have to make sure it can be carried out with a screen reader. If students are asked to complete a reading activity, we can attach an audio file where we read the text; in doing so we will prevent any possible problems of misreading caused by the screen reader.

As a general principle, when working in an inclusive setting, we must be ready to develop our own materials so that to facilitate the access of each student to the learning content. As I mentioned in section 3.1, one of the main challenges I encountered in my course was to teach students the Russian alphabet and thus train them to write in a remote learning environment. To meet this challenge, I took the following actions: (1) I introduced the Russian alphabet by means of a PowerPoint presentation during live classes; for each letter, I provided a description of its graphic asset, stimulating sighted students to help; (2) at the end of the lesson I asked students to write some simple words – monosyllabic/disyllabic and 'transparent' words, such as *mama*, *sport*, etc. – on the Zoom chat using the phonetic/mnemonic Russian keyboard on their computers; (3) as a homework assignment, I asked students to watch a video summary and complete a series of exercises I designed *ex novo*, so that they could improve their skills in pronunciation (through listening and repeating activities) and in writing with the phonetic/mnemonic keyboard. In particular, I created an audio file where I dictated some simple sentences and assisted the students in the process of writing with the keyboard, specifically focusing on those letters whose position does not correspond with the Latin keyboard.

3.3. What to do after classes: how to 'test inclusively' and 'evaluate inclusion'

Evaluation is an essential part of the teaching process since it allows students to get feedbacks from the instructor about their learning achievements. Together with it, it is equally important for teachers to get feedbacks from students about the efficacy of the learning process. Both these forms of evaluation must be leaded inclusively.

Evaluating your students… One of the most common misconceptions when working with students with special educational needs in general or VI students in particular is that our expectations on their learning outcomes should be reassessed. When I was planning the course of Russian FL for VI learners, I was suggested by a colleague to focus only on the development of their oral skills, as if being visually impaired prevents from mastering any written skill in a FL. There is nothing that could be more wrong: "as teachers we must above all hold the same high expectations for the blind [and partially sighted] student[s] as for the student without visual impairments" (Hamilton 2008, 26). Sighted and VI students must be equally tested in terms of language skills (with the only exception of reading). The assessment process of VI students must only *formally* adjust to their needs and working practices. It is easy to predict that VI students will have no difficulties in taking an oral test but when it comes to written activities (e.g. a multiple choice quiz, a fill-in-the-gaps test, or an open-ended task) or reading comprehension activities the issue becomes more complicated. We must alter the testing conditions so that VI students can fully participate to the assessment process just as their sighted peers. This implies a series of adjustments that pertains: timing (give VI students extra-time to complete the exam tasks and, if needed, change the way time is organized); setting (allow students to take the exam in a separate room); presentation (allow students to access exam materials in ways that do not require them to visually read); response (allow students to complete activities using assistive technology).

…and being evaluated. As Hamilton (2008) points out "we must seek out and incorporate the input of the student[s] before, during, and after class" (26). Throughout the course, ask your VI students if they are encountering any technical problems so that you can monitor the accessibility of the resources and materials you are providing. Once the course is over, prepare a questionnaire for students to take in order to evaluate your teaching in terms of accessibility. You can create a survey on Microsoft Form or Google Form (they are fully accessible to screen readers) which contains both multiple choice and open-ended questions. Organize your questions around the following main topics: attendance to classes (e.g. how often did you attend classes? If you did not attend class regularly, can you explain why?), instructional mode (e.g. on a scale of 1 to 5 how do you rate the fact that the course was held remotely/in presence/in blended mode? Justify your answer), learning materials (e.g. how do you rate the learning material used during live classes? And the material provided for individual work?) accessibility on the whole (e.g. where the technological platforms used accessible to you? And the materials, such us Word files, PowerPoint presentations, quizzes

on Moodle, etc.? In your opinion what can be improved?). The responses will help you identifying positive and critical aspects, as well as areas of future improvement.

4. Conclusion

In this paper I provided some tips on teaching FL to VI students within a mainstream university setting. Usually, teachers receive no formal education on how to teach students with special educational needs in general or VI students in particular, ending up developing their own 'know-how' by trial and error. We must invert this trend, by equipping instructors with the appropriate knowledge and training. It goes without saying that the implementation of a consistent inclusion system can be pursued only through active commitment of university administrations themselves that should sensitize, support and train their staff in how to carry out inclusive teaching.

References

Hamilton, E. C. (2008). Teaching German to students who are blind: A personal essay on the process of inclusion. In T. Berberi, E. C. Hamilton, & I. M. Sutherlands (Eds.), *Worlds Apart? Disability and Foreign Language Learning*, (pp. 23–41). New Haven: Yale University Press.

Hartle, S. (2020). Professional development for EMI: The choice of a blended learning format for training EMI lecturers at the University of Verona». *Iperstoria*, (16), 169-91. doi: 10.13136/2281-4582/2020.i16.920.

Kharade, K., & Peese, H. (2012). Learning by e-Learning for visually impaired students: Opportunities or again marginalisation? *E-learning and Digital Media*, 9(4), 439–48. doi: 10.2304/elea.2012.9.4.439.

Leporini, B., & Buzzi, M. (2007). Learning by e-learning: Breaking down barriers and creating opportunities for the visually-impaired. In C. Stephanidis *Universal Access in Human-Computer Interaction. Applications and Services*, (pp. 687–96). Berlin, Heidelberg: Springer, 2007. doi: 10.1007/978-3-540-73283-9_75.

Microsoft. (2022a). Make your PowerPoint presentations accessible to people with disabilities. Retrieved February 10, 2022, from: https://support.microsoft.com/en-us/office/make-your-powerpoint-presentations-accessible-to-people-with-disabilities-6f7772b2-2f33-4bd2-8ca7-dae3b2b3ef25.

Microsoft. (2022b). Make your Word documents accessible to people with disabilities. Retrieved February 10, 2022, from: https://support.microsoft.com/en-us/office/make-your-word-documents-accessible-to-people-with-disabilities-d9bf3683-87ac-47ea-b91a-78dcacb3c66d.

Smith, A. M. (2018). *Inclusive Practices in English Language Teaching*. Oxford: Oxford University Press. Retrieved from: https://www.oup.com.cn/test/inclusive-practices-in-english-language-teaching.pdf.

W3C. (2008). *Web Content Accessibility Guidelines (WCAG) 2.0*. Retrieved from: https://www.w3.org/TR/WCAG20/.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14635

Making international mobility student-friendly: a linguistically embedded assessment of higher education internationalisation strategies

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Abstract

Internationalisation is a desired goal for contemporary universities, which are increasingly using concepts like cultural diversity or globalism as selling points to attract students. However, these concepts are not always clearly defined in terms of underlying values and lived experience. We used a corpus linguistics approach to extract university descriptors of the term 'internationalisation'. For that purpose, we compiled the INTER corpus (Corpus of Internationalisation Terminology in Higher Education Institutions in Europe), which includes texts extracted from the websites of 50 European Universities. We analyse the lexical profile of the tokens semantically connected to the concept of 'internationalisation'. To verify whether the advertised concepts of internationalisation match the lived experience of the students, we use a second corpus, LIVIT (Corpus of Lived Internationalisation Experiences), which includes 300 testimonies of student mobility. All data and analyses capture the pre-COVID situation and are intended to inform the post-COVID university policymaking.

Keywords: *Internationalisation in higher education; corpus linguistics; student experience; mobility programmes; Romanian universities; university ranking.*

1. Introduction

Universities have always been international institutions. The international dimension of higher education (or 'international education') has traditionally been related to "mobility, such as study abroad, exchanges, international students, academic mobility", or to "curriculum, such as multicultural education, international studies, peace education, area studies" (de Wit *et. al.*, 2015, p. 4). Although the development of higher education in the world has never been separated from that of international education, this concept has been regarded as "a rather marginal and fragmented issue in most countries and institutions of higher education until the end of the 1980s" (de Wit, 2017, p. 25). Altbach links this focus on internationalisation to globalisation, namely to " advanced information technology, new ways of thinking about financing higher education and a concomitant acceptance of market forces and commercialization, unprecedented mobility for students and professors, the global spread of common ideas about science and scholarship, the role of English as the main international language of science" (2013, p. 7). These elements have led to certain policy changes in European higher education. The terminology related to 'internationalisation' has also changed. Thus, "the international dimension of higher education" (Knight, 2013, p. 85) has evolved and expanded into multiple meanings spanning from "comparative education", in the last fifteen years, to "planetisation", in recent years (ibid, p. 86).

2. The road to internationalisation in European higher education

2.1. The process of internationalisation

With the launch, in 1987, of the European student exchange programme, Erasmus (EuRopean Community Action Scheme for the Mobility of University Students), 'internationalisation' of higher education institutions (HEIs), as a term, started to gain its ground. Its transfer from a marginal programme of student exchange to a more comprehensive process reflects the increasing importance of the international dimensions in higher education. Three decades later, internationalisation has become the "key driver in modern higher education, in the developed world and in emerging economies […] a mainstream and central component of policies and practices in higher education" (de Wit, 2017, p. 25). In 2013, the European Commission launched "The European higher education in the world" strategy to promote mobility and cooperation between the member states and the third EU countries. With that document, the importance of internationalisation of the curriculum and learning outcomes for all students received a central place, next to mobility, in the European policies for the internationalisation of higher education. According to de Wit, more and more higher education institutions in the world "have an internationalisation policy and/or have integrated internationalisation in their mission and vision" (2017, p. 25).

The process of institutional internationalisation is as diverse as the concept itself. Altbach and Knight identify study-abroad programs, as well as "activities [that] stress upgrading the international perspectives and skills of students, enhancing foreign language programs, and providing crosscultural understanding" (2007, p. 290), as means of internationalisation. Internationalisation, however, comprises several dimensions: recruitment of international students (both for degree and credit/ short-term mobility); participation of foreign professors in teaching and research activities; use of international languages in teaching and administration; joint degrees and cooperative programmes; collaborative activity in the field of research. This diversity of dimensions is fostered at an institutional level by employment of key instruments such as: internationalisation strategies, which ensure that institutional practices are aligned with internationalisation goals; direct partnerships with international universities, facilitating mobilities and research cooperation; framework programmes (such as Erasmus) or bilateral cooperation agreements; and marketing tools oriented towards international students.

In time, equal amounts of attention have been given to both defining the concept and implementing the process of internationalisation in higher education. In this sense, de Wit and Hunter define internationalisation as "the intentional process of integrating an international, intercultural or global dimension into the purpose, functions and delivery of post-secondary education, in order to enhance the quality of education and research for all students and staff, and to make a meaningful contribution to society" (2015, p. 29). Of course this definition, far from being intended as exhaustive, has spurred considerable debate. Although internationalisation is a complex process that is initiated often by governments or institutions, it develops organically due to networking effects and other factors, such as "[w]hen students travel to study abroad, faculty are engaged in collaborative research and publishing, or a university signs a memorandum of understanding with foreign institutional or development partners" (Teferra, 2019). Thus, the most visible dimension of the internationalisation of a higher education is represented by student mobility.

2.2. Internationalisation in the COVID-19 era and post COVID perspectives

In the COVID-19 era, HEIs need to reconsider student mobilites, since physical movement cannot always be taken into account. Although the pandemic brought challenges, it also offers opportunities for universities to redesign mobilities and internationalisation in terms of digital experience: studies already argue that there is a need for more flexibility and stronger emphasis on "new environments and initiatives for global learning […]; internationalisation at home" (Bista et al., 2022, p. 9).

3. Linguistic framework

3.1. Rationale

According to de Wit et al., internationalisation in higher education in recent years has shifted from "cooperation to competition" (2015, p. 6), with universities competing for profit, although not all institutions have undergone this process of commercialization to the same extent. As such, universities are trying to attract more international students according to their own profile and the policies of the countries in which they are based. However, the report released by the British Council and DAAD in 2014 points to the lack of research that measures the benefits of student mobility: "much remains to be done to fully appreciate what these scholarship programmes actually achieve" (p. 6).

3.2. Aim of the study

In the present paper, we investigate the use of terms related to the concept of 'international' and / or 'internationalisation' at the institutional level. We simultaneously address the question 'What role do the concepts used by universities play in the attraction of international students?' Using corpus linguistics methods (see below), we looked at: (a) the correlation between the concepts used by universities and their attractiveness reflected in ranking positions; (b) the correlation between the concepts used by universities and the concepts used by students reflected in their mobility testimonials.

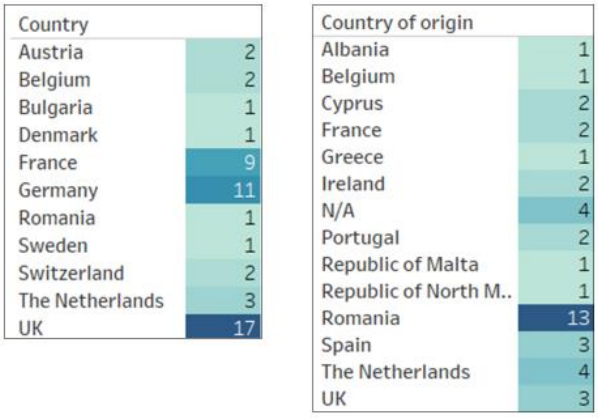
3.3. Corpus data

The data analysed in this paper is organized into two self-compiled corpora: INTER (Corpus of Internationalisation Terminology in Higher Education Institutions in Europe) and LIVIT (Corpus of Lived Internationalisation Experiences). The data selection parameters are the following:

The INTER corpus, comprising 77,476 tokens, consists of sections from the websites of 50 European universities that are regarded to be highly international by online university rankings, such as U-Multirank (2018) and QS Top Universities (2019). From the university webpages, we selected sections dedicated to internationalizstion related to the profile and mission of the universities. A considerable number of webpages featured a section named 'International'. For the websites which did not have such a section, we included parts of sections titled 'About' or 'Our Mission' that addressed the topic of internationalisation.

The LIVIT corpus consists of two data subsets: LIVIT-EN (student testimonials in English) and LIVIT-RO (student testimonials in Romanian). During a preliminary stage of this study, we noted that universities post student testimonials as part of the International section to promote student mobility. The selection of texts was performed by availability, with no other criteria being applied. The testimonials about a study or internship period abroad within the

Erasmus+ exchange programme were the most popular. LIVIT-EN contains testimonials in English from 27 European universities. It comprises 50,297 tokens, from 252 student testimonials. The LIVIT-RO corpus consists of 75,332 tokens, from 145 student testimonials, gathered from 13 Romanian universities.



Country	
Austria	2
Belgium	2
Bulgaria	1
Denmark	1
France	9
Germany	11
Romania	1
Sweden	1
Switzerland	2
The Netherlands	3
UK	17

Country of origin	
Albania	1
Belgium	1
Cyprus	2
France	2
Greece	1
Ireland	2
N/A	4
Portugal	2
Republic of Malta	1
Republic of North M..	1
Romania	13
Spain	3
The Netherlands	4
UK	3

Figure 1. Number of universities per country represented in INTER corpus (left) and in LIVIT corpus (right)

4. Method

The INTER corpus was divided into five sub-corpora, according to university profile criteria: (1) INTER-Prestigious: prestigious universities (ranked in the top 100 by QS Top Universities 2019); (2) INTER-Business: Business schools; (3) INTER-Incoming: higher influx of international students; (4) INTER-Outgoing: more outgoing students; (5) INTER-Balance: balanced incoming/outgoing ratio. The corpora were divided in this manner so that different types of contrastive analyses could be performed. The choice of the INTER-Business sub-corpus, was based on the fact the data showed that some of the most highly regarded international Higher Education Institutions (HEIs) in Europe are Business Schools (U-Multirank 2018).

We used a mixed-method approach (Figure 1) to compare university descriptors to student lived experience. First, we compared the lexical-semantic profile of the tokens semantically connected to the concept of cultural diversity in the two corpora, using frequency analyses, collocation and phraseology categorizations. Then, we conducted discourse analyses on exemplary texts in INTER and LIVIT in order to assess the perception of the term 'international' through the lens of the students' lived experience.

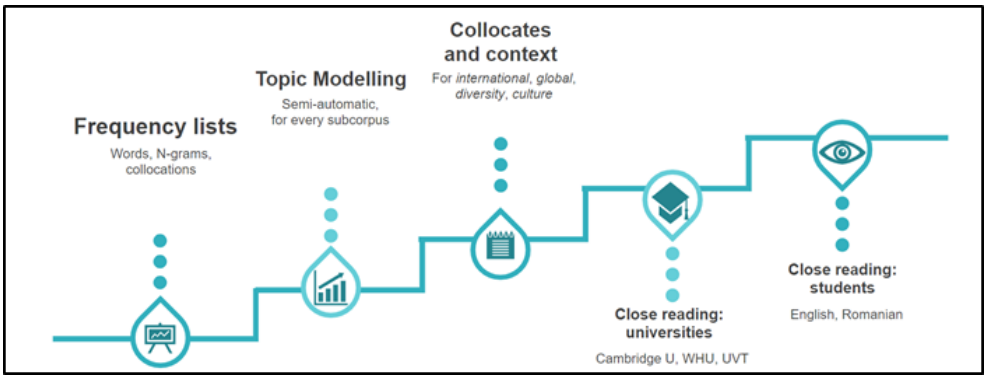


Figure 2. Linguistic analysis methods

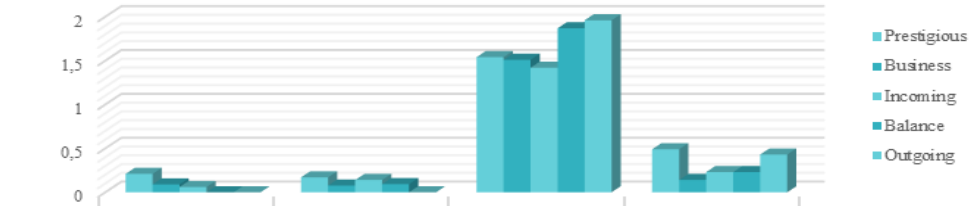
5. Results

The results of our analysis show (Table 1) that universities encompass both teaching, research and administrative aspects when promoting themselves as being 'international'.

Table 1. Selected concordances of 'international' in INTER sub-corpora (from 1116 contexts)

Left	KWIC	Right
develop new ideas for intensifying the **intercultural**,	*international*	, and **global perspectives** of lectures, modules, and entire study programmes.
achieves **global impact** thanks to its strong	*international*	**academic network** and **multilateral partnerships**.
discovering Europe and having a unique	*international*	and **cultural experience**
in the context of internationalisation @home and the acquisition of	*international*	and **intercultural competencies**.
trainings related to the **intercultural** and	*international*	aspects of **teaching** as a means of **support** in teaching.
seeks to strengthen its	*international*	**cooperation** in the field of **research**
a wide range of options for first-hand	*international*	**experiences** through stays abroad.
the unique opportunity to enjoy an	*international*	**learning experience**, which is tailored to their specific interests.

An interesting outcome was the preference for the collocation 'global challenges' in best-ranked universities versus the collocation 'global networks' in business universities. To further verify the occurrence of 'global' in multiple contexts, we looked at three distinct HEIs: Cambridge University, WHU – Otto Beisheim School of Management and the West University of Timisoara. Cambridge University characterises itself as a 'global institution' with numerous concepts of globalism, some interpreted in the sense of their universality ('global challenges', 'global impact', 'global themes,' 'global society'), others suggesting geographic outreach and profitability ('global activities,' 'global position,' 'global networks' 'global audiences,' 'global providers,').



	Culture	Diversity	International	Global
Prestigious	0,21	0,17	1,54	0,49
Business	0,09	0,076	1,51	0,14
Incoming	0,06	0,14	1,42	0,23
Balance	0	0,093	1,87	0,23
Outgoing	0	0	1,96	0,43

Figure 3. Use of the term 'international' in INTER sub-corpora (%). Percentages are calculated per total number of words in each sub-corpus.

Multi-culturality is only scarcely mentioned. At the WHU, surprisingly, 'global' is not a central concept, being replaced by 'diversity' and terms suggesting equal opportunities (e.g. 'cultural background', 'equality of opportunity'). As for the Romanian university, West University of Timisoara, it seems that 'international' is the prefered concept, used in variations such as 'international relations,' 'international cooperation', 'international partners', 'international lecturers' 'international associations'. The notion 'global' appears in a single standard phrase 'globalized labour market'.

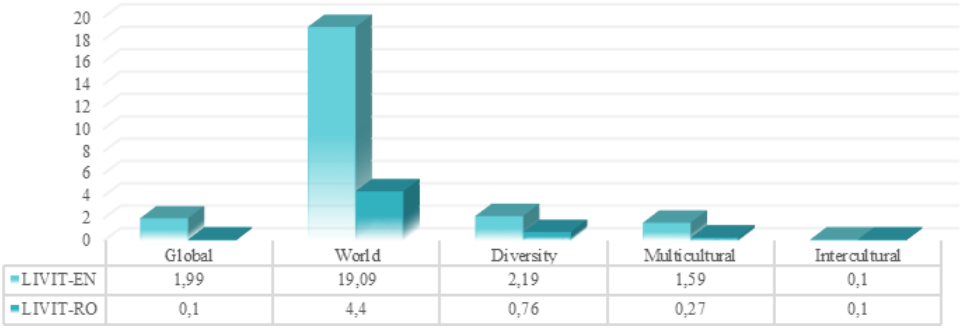
On the other hand, students' testimonials focus more on 'atmosphere', on their contact with other 'international students' and on whether their career opportunities are enhanced (Table 2):

Table 2. Selected concordances of 'international' in LIVIT-EN sub-corpora (from 118 contexts)

Left	KWIC (LIVIT-EN)	Right
has given me the opportunity to meet	*international*	students from **all around the world**.
It is truly an	*international*	place where you meet people from all around the world,
I made a lot of international friends while attending national and	*international*	**conferences**.
it was the pivot moment in my student career that led me to pursue an	*international*	**career**.
high quality education in an	*international*	***atmosphere***.
identify the challenges which exist for	*international*	/**Erasmus students** and were always helpful.
it was a great way to meet other	*international*	students that were also studying law!

In students' view, the key concepts that are connected with 'international' experience are 'global' ("The UvA is so international that my Erasmus sounds more *global* than European!"; "take advantage of the perspective and expertise on *global issues* that SOAS is known for."), 'world' ("It is truly an international place where you meet people from *all around the world*, practice foreign languages and broaden you knowledge and perspective on life."),

'multicultural' ("an insight about the world through the eyes of my *multicultural* colleagues."), 'diversity' ("Also the *diversity* of fellow students will broaden your perspective"):



	Global	World	Diversity	Multicultural	Intercultural
LIVIT-EN	1,99	19,09	2,19	1,59	0,1
LIVIT-RO	0,1	4,4	0,76	0,27	0,1

Figure 4. Key concepts in students' testimonials. Normalized frequency per ten thousand words (pttw)

6. Conclusions

In our study, we have developed and tested a methodology by which we aimed to bridge the gap between theoretical approaches in defining concepts belonging to the semantic field of 'international' (e.g. 'internationalisation', 'multiculturalism', 'global', 'diversity) and practical realisations of internationalisation strategies at European universities. By contrasting results from the two corpora (INTER and LIVIT), we were able to verify whether universities operate with different terminology and examine the degree of correlation between the selection of terms and the profile of the HEI. On the other, the personal dimension of the internationalisation experience was investigated, so that objective conclusions could be drawn on the actual perceptions students have regarding their plunging into an international context.

The results of the analysis indicate a division between concepts clustering around keywords from several categories: Mobility/International, Partnership and Collaboration and World/Regions, Academic or Environment. By looking at the LIVIT corpus, we identified testimonials that are representative of the way students react to their international experience. The outcomes of the study confirm the initial assumptions, namely that the benefits mentioned in official internationalisation strategies are often in contrast with the benefits students seek and reap during their mobilities. We propose therefore that future policy making initiatives should consider linguistic research as a resource for pertinent recommendations. The study is also a source of data-supported information on the internationalisation strategies and their conceptual options in European HEIs.

References

Altbach, P., Knight, J. (2007). The Internationalization of Higher Education: Motivations and Realities. *Journal of Studies in International Education,* 11, 290-305.

Altbach, P. (2013). *The International Imperative in Higher Education.* Rotterdam: Sense Publishers.

Bista, K., Allen, R.M., Chan, R.Y. (2022). A New Golden Age in International Higher Education: Challenges and Successes during the Pandemic and Beyond. In K. Bista, R.M. Allen, R.Y. Chan (Eds.), *Impacts of COVID-19 on International Students and the Future of Student Mobility. International Perspectives and Experiences* (pp. 1-12). New York: Routledge. Retrieved from: https://scholar.harvard.edu/files/roychan/files/impacts_of_covid-19_on_international_students_book_-_chan.pdf.

British Council and German Academic Exchange Service. (2014). *The rationale for sponsoring students to undertake international study: an assessment of national student mobility scholarship programmes*. *Going Global 2014*. Retrieved from: https://www.britishcouncil.org/sites/default/files/e002_outward_mobility_study_final_v2_web.pdf.

de Wit H., Deca L., Hunter F. (2015). Internationalisation of Higher Education – What Can Research Add to the Policy Debate? [Overview Paper]. In A. Curaj, L. Matei, R. Pricopie, J. Salmi, P. Scott (Eds.), *The European Higher Education Area* (pp. 3-12). Springer: Cham. doi: 10.1007/978-3-319-20877-0_1.

de Wit, H. (2017). The Importance of Internationalisation at Home. *TH&MA Hoger Onderwijs*, (5), 25-29.

de Wit, H., Hunter F., Howard L., Egron-Polak E. (Eds.). (2015). *Internationalisation of Higher Education*. Brussels: European Parliament. Retrieved from: http://www.europarl.europa.eu/RegData/etudes/STUD/2015/540370/IPOL_STU(2015)540370_EN.pdf.

Knight, J. (2013). The changing landscape of higher education internationalisation–for better or worse?. *Perspectives: Policy and practice in higher education*, 17(3), 84-90.

Teferra, D. (2019, August 23). Defining internationalisation – Intention versus coercion. *University World News. Africa Edition*. Retrieved from: https://www.universityworldnews.com/post.php?story=20190821145329703.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14507

Teaching creativity to undergraduate engineering students

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Abstract

Over the recent years, it has become more and more apparent that creativity is a skill equally important for both technical and artistic careers. However, methods for teaching creativity that work for arts students are not always appropriate for engineering students. The present study outlines the adaptation of a creativity development session from an artistic degree curriculum (Mascareñas, 2019), to make it suitable for teaching to engineering students. The session was run three times with 1st and 2nd year engineering students at a Russell Group university in the north of England, and both qualitative and quantitative feedback was collected from students after the session. The main findings indicate the importance of a trusting relationship between students and the educator, the need for balance between delivering a memorable experience and offering support, and the significance of subsequent reflection.

Keywords: *engineering education; professional skills; creativity.*

1. Introduction

Creativity is one of the main differentiators between humans and animals (Csikszentmihalyi, 1996), and has a major impact on our lives, from arts to sciences. Innovation and creativity are in the top 5 of desired workplace skills for 2025 (World Economic Forum, 2020), and are crucial for a successful engineering career (Panthalookkaran, 2010).

Evolutionary changes to a technology or product make little market impact, but introduction of a new "disruptive" technology can completely change the market, leading to products that cannot be created through step-by-step improvements. An example of this is the sharp decline in Nokia mobile phone market share from 49.4% in 2007 to just 3% in 2013, after the introduction of the first iPhone in 2007 (Lee, 2013). It has been acknowledged that creativity is a crucial skill for an engineer, and effective strategies for developing creativity in engineers are needed (Zhou, 2012).

One of the main limitations on teaching creativity in an engineering context is the fact that engineering educators value creativity less than the final engineering product (Tekmen-Araci and Mann, 2019). Another difficulty in teaching creativity is the students' opinion of the topic, and the reluctance to step out of their comfort zone. Some typical blocks to creativity include fear of the unknown or of failure, frustration avoidance, reluctance to "play" or to let go, among others (Zhou, 2012). This discomfort of being creative is often coupled with a belief that creativity is a talent one is born with, rather than a skill that one can develop (Olken, 1964). This belief is inaccurate, and multiple authors have shown that creativity can be learnt and improves with practice (Pusca and Northwood, 2018; Tekmen-Araci and Mann, 2019). Different techniques have been tried by different authors, but most of them fall into four categories:

- **Support**: creativity requires risk taking and openness to uncertainty, for which students need support (Cropley and Cropley, 1998), including low-cost opportunities for failure, case studies, hands-on experience, and personal support.
- **Teaching creativity tools**: eg. brainstorming, mind mapping, morphological analysis, problem-based learning, idea checklists, and methods to allow creative ideas to surface (Zhou, 2012; Pusca and Northwood, 2018).
- **Experiencing creativity**: ensure students are well-prepared (they understand the problem through research and had time for incubation of ideas) (Guilford, 1950; Amabile, 1996) and provide a memorable creativity experience which is often not explicitly taught in science or engineering subjects (Sawyer, 2010).
- **Reflection**: review the creative processes and outcomes for future improvement (Guilford, 1950; Amabile, 1996).

Existing studies provide limited approaches to encourage creativity in engineering students, especially when it comes to experiencing creativity. The aim of this paper is to explore the development of exercises to teach creativity to engineering students by adapting methods from arts, originally proposed by Mascareñas (2019).

2. Methodology

The study presented in this paper reviews three years of implementation and evolution of a memorable creativity development session. The first session was run by the creator and author of the Class of Nothing method, Óscar Mascareñas, and the following two sessions were run by the module leader Tim Dolmansley. The general format described below has been used for all sessions but there have been significant changes and developments each year as lessons have been learnt, which are described in the Results and Discussion section. Each creativity development session consisted of four main sections:

Introduction. In the introduction session students were given information about creativity, its impact, and how creative solutions are developed. Research-based practical tools and methods to improve creativity were discussed.

The Class of Nothing. Students were invited into a room where there were no chairs or desks, and were initially given no instructions. Some objects were scattered around the room that were intended to promote creativity, eg. paper, scissors, felt tips, and similar. When the educator had sufficient attention from the students, the following 'rules' were read out and repeated several times:

"This class is about un-doing. Its purpose is not the destination, but who you become along the way. If you have any questions, don't ask (unless you know). I'm not here to answer questions – like you, I'm here to formulate them and try them out. To take part in it, all you need is to be present. Carefully and continuously listen and observe. Awareness is key. Be patient and have no expectations. Contribute if you wish. Communicate, but do not speak (unless it is about nothing). Don't waste time. Nothing is the space of infinite possibilities."

The educator then proceeded with an arbitrary creative task, eg. making origami, and left the students to decide for themselves what to do. It is usual to have an awkward pause (often 15 minutes), followed by an explosion of energy and creativity.

Practical methods. Students had been taught methods to improve creativity, and were given time to practise them. The practical methods included traditional and silent brainstorming, walking, and sorting Lego bricks into colours. This should preferably be related to the specific project students are working on, and carried out in project teams.

Reflection. Students were asked to reflect on their experience in a live lecture to increase participation and promote discussions. The information was gathered through multiple choice and open-ended questions.

The creativity development session was taught as a part of a design module to 1st and 2nd year mechanical, bio- and aerospace engineering students in a Russell Group university in the north of England. The detailed information about each cohort is presented in Table 1.

Table 1. Student cohort details. Mech – Mechanical Engineering; Bio – Bioengineering; Aero – Aerospace Engineering.

Cohort no.	Student group	Cohort size	No. of respondents	Debrief and questionnaire after the Class of Nothing
1	1st year Mech and Bio	205	26	Same day
2	2nd year Mech and Aero	190	106	1 week
			12	1 year
3	1st year Mech	200	90	1 day

3. Results and discussion

3.1. Cohort 1

Cohort 1 had the creativity development session delivered by Óscar Mascareñas, the author of the Class of Nothing method (Mascareñas, 2019). It consisted of a one-hour lecture to introduce creativity, delivered in an unusual, performative style, a half-an-hour creativity exercise workshop, a one-hour Class of Nothing section, and a debrief session. The post-session questionnaire was administered in the debrief section, following the Class of Nothing. The results of the multiple-choice questions are presented in Figure 1.

When asked about the effectiveness of the Class of Nothing through a show of hands in a debrief session, it was found that the class was very successful for the majority of students (85%). Approximately 15% left the class during the 15 minutes of tension, and were very vocally negative towards the class. Through the show of hands it was established that it was mostly these students who responded to the questionnaire, as shown in Figure 1. The negative feedback was further exemplified in responses to an open-ended question, "Do you have any suggestions for running this next year?" The responses ranged between suggesting a gentler introduction to the session, eg. *"prepare everyone before so less people leave when it's not what they expected"*, to urging not to run it the following year, eg. *"it was completely irrelevant and unhelpful in relation to our instrument designs"* and *"the class of nothing felt a bit pointless, so replace that with other creative techniques*

teaching". However, these students were still discussing the class with the module leader or personal tutors a year later, by which time they had processed the experience and had learnt about creativity through personal reflection, achieving the same as had they experienced the class.

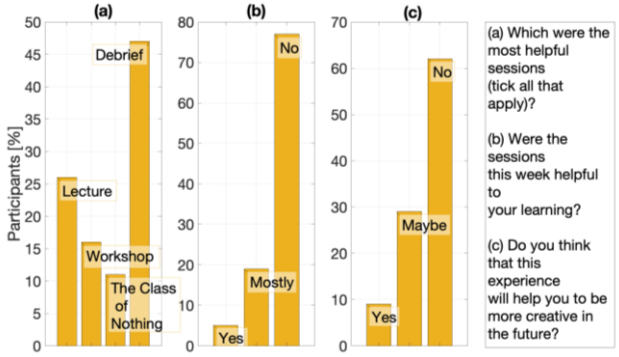

Figure 1. Cohort 1 responses to the post-session questionnaire, immediately after the session.

The timing of the session was unfortunate, as it was scheduled before an exam later in the day, which made it more difficult for students to commit to the session. Furthermore, students needed to feel that creativity was more credible and needed more support. Therefore, better care of timing, preparation and time to build a trusting relationship with the educator was important.

3.2. Cohort 2

After reflecting on the experience, the creativity development session for Cohort 2 was fully delivered by the module leader, Tim Dolmansley. The information lecture was also adapted to include more of the science behind creativity, as well as some practical methods students could use. The Class of Nothing was delivered after the information lecture and a practical workshop followed the Class of Nothing to focus the creativity on the specific design task. A debrief session took place one week after the Class of Nothing, where students were asked some open-ended questions about the creativity development session. Students were asked to say something negative about the session, and their answers could be attributed to the following broad categories: (i) the bizzareness and the lack of direction in the Class of Nothing, eg. *"at the beginning of the session, nobody had a clue what was going on. It was very uncomfortable and there were people considering leaving"*; (ii) reluctance to follow creativity exercises, eg. *"felt like an idiot walking around with a plant pot and feather"* and *"didn't help me generate any ideas. would have been better off having more FEA* (Finite Element Modelling) *sessions … I didn't brainstorm any better for the class."*; (iii) timing concerns, eg. *"each activity ran for slightly too long… slightly too long overall session time as well"*; and (iv) inability to take part in exercises due to team

members missing. The positives focused on (i) unusual experience, eg. *"I really enjoyed brainstorming in different ways, such as the walking and talking and not speaking activities. It was interesting to see how much difference it made"*; (ii) improved creativity, eg. *"it allowed different brainstorming methods to usual and that led to different and novel ideas"* and *"helped me understand how the brain works creatively and how to enable it"*; and (iii) team bonding. When students were contacted one year after the creativity development session, most of the students who responded (68%) said that the lecture on the science of creativity helped them to make the most of the Class of Nothing (see Figure 2).

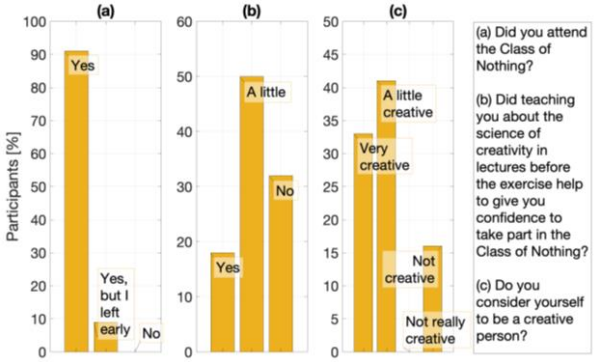

Figure 2. Cohort 2 responses to the post-session questionnaire, one year after the session.

74% of the students stated that they consider themselves creative to some degree. The technical explanation of the validity of the creativity exercises led to more positive feedback from Cohort 2. However, it was observed from the gathered data that students who were previously taught by the educator reported higher benefits from the session. This leads to a conclusion that the relationship between the students and the educator needs to be more established for the creativity development session to be successful.

3.3 Cohort 3

Cohort 3 also had their creativity development session fully delivered by Tim Dolmansley. Its format was the same as that of the session delivered to Cohort 2, with some further improvements made. The session was delivered later in the term (Week 9, as opposed to Week 4 for Cohort 2), which meant that the students had more time to get to know the educator and their peers, and develop a relationship with them. In addition, the students were more settled and independent by this point of the term, which enabled them to be better academically and emotionally prepared.

When asked to say something negative about the creativity development session, Cohort 3 students had very similar feedback to that of Cohort 2, highlighting the lack of instruction and structure, lack of engagement from peers, and struggling to see benefits of the exercise.

Some students also noted that the Class of Nothing could have turned unsafe, and others voiced concerns about suitability and benefits of the class for some groups, eg. introverts or people experiencing anxiety. Positive feedback included statements that the class was *"fun"*, *"relaxed"*, *"different"*, and gave students creative freedom. Students also remarked on the benefits for their creative skill development, eg. *"nothingness forced creative juices to flow"*, as well as impact on their communication skills, eg. *"different interactions with peers"*. The responses to multiple-choice questions shown in Figure 3 point to a significantly more positive feedback. 97% of students found the lecture on the science of creativity useful to some degree, out of which 44% found it very useful, and 97% of students found the Class of Nothing useful (35% of them – very useful).

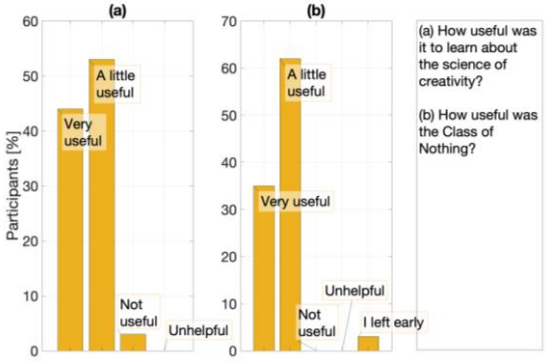

Figure 3. Cohort 3 responses to the post-session questionnaire, one week after the session.

4. Conclusions

This study focused on a creativity development exercise which combined a session on the science of creativity and practical tools with a memorable creative experience, where the latter is usually overlooked in teaching creativity for engineering students. It resulted in the following three main findings. Firstly, the correct timing of the creativity development session is important. It was shown through the gathered feedback that when students did not know the educator well, they reported lower benefits of the creativity development session, at least in the short term. Students should be given sufficient time to build relationships with their educator and peers to make the most benefit of this exercise, as they need to have trust in the educator to follow them through such an unstructured and potentially confusing session. The scheduling of the session is important as well, as it is best to avoid placing it before an important assessment or later in the day when students are more tired. Secondly, it is crucial to give students the right balance of powerful experience and support in this exercise. On one hand, the experience has to be memorable to have a long-term impact on students' creativity skills. On the other hand, there is a need for well-trained staff who can

identify those students who need support and provide it. Furthermore, students with specific needs have to be carefully considered, and it should be made clear to students that there is no obligation to take part in the exercise. Finally, a reflective debrief after the Class of Nothing is crucial to reinforce learning benefits. Students might have mixed feelings after the unusual session, and it is important to give them space to discuss it. Some students might also need support overcoming any anxiety from the session.

References

Amabile, T.M. (1996). *Creativity and Innovation in Organizations*. Harvard Business School Background Note 396-239, January 1996.

Cropley, D. H. & Cropley, A. J. (1998). Teaching engineering students to be creative - program and outcomes. *Proceedings of the Australasian Association of Engineering Education (AAEE) 1998*.

Csikszentmihalyi, M. (1996). *Creativity: Flow and the Psychology of Discovery and Invention*. New York: Harper Collins.

Guilford, J. P. (1950). Creativity. *American Psychologist*, 5(9), 444–454. doi:10.1037/h0063487

Lee, D. (2013). *Nokia: The rise and fall of a mobile giant*. BBC. Retrieved January 20, 2022, from https://www.bbc.co.uk/news/technology-23947212 .

Mascareñas, Ó. (2019). A Class of Nothing. *Proceedings of the 5th International Conference on Higher Education Advances (HEAd 2019)*, Valencia, Spain, 2019.

Olken, H. (1964). Creativity Training for Engineers - Its Past, Present, and Future. *IEEE Transactions on Education*, E-7(4), 149-161., doi:10.1109/TE.1964.4321869

Panthalookkaran, V. (2010). Hour of creativity: an agenda to foster creativity and innovation in the students of engineering. *Proceedings of 2011 IEEE Global Engineering Conference (EDUCON)- "Learning Environments and Ecosystems in Engineering Education"*, 612-617. doi:10.1109/EDUCON.2011.5773201

Pusca, D. & Northwood, D. (2019). Curiosity, creativity and engineering education. *Global Journal of Engineering Education*, 20(3), 152-158.

Sawyer, R. K. (2010). *Learning for creativity*. In R. A. Beghetto & J. C. Kaufman (Eds.), Nurturing creativity in the classroom (pp. 172–190). Cambridge University Press. doi:10.1017/CBO9780511781629.009

Tekmen-Araci, Y., & Mann, L. (2019). Instructor approaches to creativity in engineering design education. *Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science*, 233(2), 395–402. doi:10.1177/0954406218758795

World Economic Forum (2020). *Future of Jobs Report*. Retrieved from http://www3.weforum.org/docs/WEF_Future_of_Jobs_2020.pdf.

Zhou, C. (2012). Teaching engineering students creativity: A review of applied strategies. *Journal on Efficiency and Responsibility in Education and Science*, 5(2), 99-114. doi: 10.7160/eriesj.2012.050205

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14859

Teaching Open Science. What do FNS-Cloud Food Researchers Want to Know?

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Abstract

Training can better meet user needs by involving the potential users early in the process. Here, development of open science training for food science students and professionals began with 11 guided interviews of 15 beneficiaries in a European project aiming to build a 'food cloud' of datasets and services (FNS-Cloud, H2020 No. 863059). Discussions covered what partners want to learn, how they prefer to learn, and who are their ideal trainers. Inductive coding of interview transcripts with NVivo 12 qualitative analysis software revealed an inclination for technical training with a focus on data. Face-to-face learning and on-demand elearning offered by younger scientists were preferred methods and trainers. Most interviewees also talked about 'food cloud'-specific fears and desires. These interviews are now the foundation of three well received elearning courses and two workshop series supporting the value of user input in early course development decisions.

Keywords: *Open science; course development; lifelong learning.*

1. Introduction

Open Science is a system change allowing for better science. It is based on transparent and collaborative ways of producing and sharing knowledge and data as early as possible in the research process, and for communicating and sharing results (European Commission, 2019).

The Food Nutrition Security Cloud project (*FNS-Cloud, H2020 No. 863059*) aims to develop an infrastructure, tools, and services to exploit food, nutrition, security data as a way to make food science less fragmented and more open. To give support to the users of FNS Cloud (the infrastructure not the project), a train-the-initiator program is ongoing and focuses on introducing open science principles and practices and the use of cloud catalogs, tools, and services available within the FNS-Cloud project.

The goal of FNS-Cloud training is to provide and improve the skills needed to successfully use and contribute to the FNS Cloud user communities. Training in specific skills and capabilities is widely recognized to help organizations achieve their goals and create competitive advantage by adding value to their key resources – i.e., employees (Nikandrou *et al*., 2009). The planning of a training program requires defining the goal and the extent of training, selecting the training methods and means, as well as the training place and equipment. A review of factors that influence the success of training highlights the importance of both individual and training design factors (Awais Bhatti & Kaur, 2010) and, notes that when learners perceive that the content of the training is similar to actual job tasks, they tend to react in a positive way. Thus, perceived content validity affects the learner's performance self-efficacy, develops a positive reaction in the learner, and affects transfer or learning motivation (Liebermann & Hoffmann, 2008). Furthermore, the use of a co-design process in which learners and trainers co-create training programs has been shown to enhance identification of learner needs and to create student-instructor bonds (Haraldseid *et al*., 2016). Taken together, these studies suggest that there is value in having trainee input to make an overall training program more effective and, by asking for input in the beginning, there are higher chances of tailoring the training to meet the needs of the trainees.

Training needs analysis is a well-recognized process employing methods including, among others, observations, workshops, questionnaire surveys, desk research, focus groups, and interviews (Gubta, 2007). When the training options are quite open, as in the beginning of a training program, and there are no previous experiences to draw on, interviews are likely to give a dataset with the width and breadth to conceive a program from scratch.

Here, to ensure the content validity of trainings for FNS Cloud user communities, and to reflect the training needs and preferences of FNS-Cloud project beneficiaries, a series of semi-guided interviews with expert representatives of the key food institutions in the FNS-Cloud project focused on what individuals wanted to learn, learning methods, and ideal trainers.

2. Methods

2.1. Interviews

Eleven semi-structured interviews were carried out during the period April-October 2020. Both interviewers (2 persons) and interviewed (15 persons) were food science professionals participating in the FNS-Cloud project. In most interviews, the two interviewers collaborated to pose questions, engage in discussion, take notes, and follow the semi-guided structure. All interviewees were invited to bring colleagues and four of them did. Interviews, which lasted 30 minutes, aimed to identify training needs and preferences related to open science and the use of datasets, tools and services: what beneficiaries want to learn, how they prefer to learn, and who are their ideal trainers.

2.2. Data processing and analysis

Notes, independently taken by the two interviewers during the interviews, were combined to produce almost word-to-word transcripts of the interviews and were stored in a word document. Inductive coding (Chandra & Sang, 2019) of the transcripts was done with the NVivo 12 Pro© software for qualitative analysis, following an iterative approach involving three researchers reviewing interview transcripts, codes, sub-codes, and coded phrases.

3. Results and Discussion

3.1. Respondents

Table 1 shows demographic characteristics of the interviewees.

Table 1. Interviewee Characteristics.

Demographic categories	Number of persons
Sex	
Female/Male	10/5
Age	
under 40/41+	3/12
Education	
PhD yes/no	12/3
Workplace	
Academic/Other	11/4

Respondents were mostly women. Age profile indicates that most of them are in advanced stages of their careers, and they have a high education level. The majority work in academic positions (universities, research institutes) whereas a few work in companies or as advisors. This is a relatively small sample size, but it contains detailed data and does represent FNS-Cloud beneficiaries and is therefore useful in designing a targeted training program.

3.2. Respondent Training Desires

Overall, 330 minutes of interviews were conducted, 5 256 words were transcribed, and 180 phrases were initially coded into the three broad categories of the semi-structured interviews: What to Learn, How to Learn, and Who Should Teach. A fourth category of comments was identified during coding and named FNS Cloud Fears/Desires, and these comprised 18.3% of coded phrases. Here were comments such as, "The home page should be very simple" which did not refer to Training at all but rather to the nascent Community of Practice "myFNSCloud" and the catalogs of data, tools, and services found there. The relatively small number of comments in the FNS Cloud Fears/Desires category likely reflect, in part, the guidance of the interviewers towards discussions on training, but given the overall open quality of the interviews it may also indicate that training, e.g., to know how to use an online site, is more valued than the intrinsic properties of the site itself.

Within the 81.7 % of comments about Training, What to Learn was the most common category, 60.6 % of all respondent comments, followed by How to Learn at 34 %, and Trainers at 5.4 % (Fig. 1).

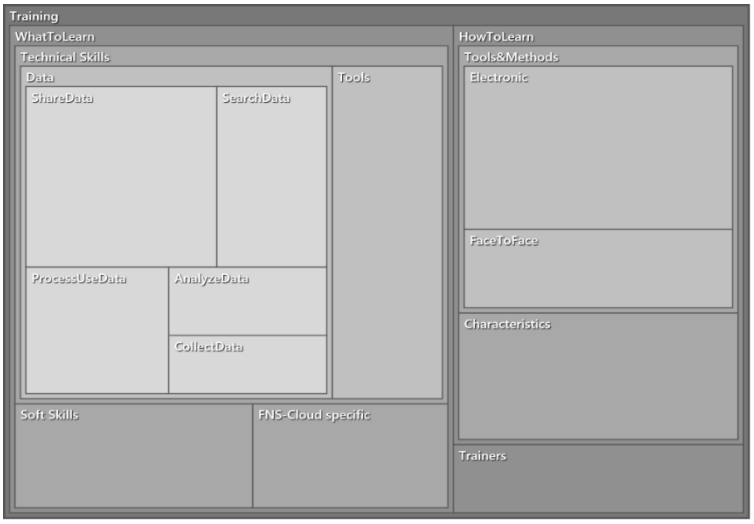

Figure 1. Hierarchical chart of coding references from guided interviews with 15 project beneficiaries.

Within What to Learn, interviewees discussed three categories of material: Technical skills, Soft Skills, and FNS Cloud-specific skills. Comments coded into FNS Cloud-specific skills differed from those in FNS Cloud Fears/Desires in that the former related to trainable skills or knowledge about using the FNS Cloud while the latter were about the technical aspects or design of the FNS Cloud, as shown in the examples below:

Table 2. Differentiating Skills and Fears/Desires.

FNS Cloud-specific skills	FNS Cloud fears/desires
"I need to learn what the content of the FNS Cloud is"	"Is FNS Cloud sustainable? How will FNS be continued in the long term?"
"This is how the FNS Cloud works, this is where things are"	"The home page should be very simple"

Technical skills were the most commonly mentioned in What To Learn, 6 and 7 times more than Soft Skills and FNS Cloud-specific skills, respectively. Within Technical Skills, interviewees talked most about Data, 74 % of comments, while 26 % were about learning Tools. Comments about Tools were most often general, such as "How could I take advantage of each of the tools that are available", or "Will the FNS Cloud be connected to other tools such as GitHub" and this likely reflects the early stage of development of the FNS Cloud infrastructure and the limited number of tools currently available.

Data comments were further sub-coded into desires for skills on how to Collect Data, Process Data, Analyze Data, Search (for other's) Data, and Share (your own) Data. Here, the most common comments were about training in how to Share Data, twice as common as the next most popular topic, Search Data. This supports studies showing that researchers acknowledge the benefits of open data, but data sharing practices are still limited (Wouters & Haak, 2017), and further suggests that a lack of training may be a contributing factor. Comments from FNS-Cloud researchers such as, "I need to know what data to share, how do I do it?" and "Sharing my data: my rights and responsibilities is a course I would take" further support that there is a desire for specific training in how to share data as well as the choices available to the researcher when data is shared.

The 34 % of comments coded into How To Learn were sub-coded into comments about Tools & Methods of learning (68 %) and comments about Characteristics of courses (32 %). In Tools & Methods, two primary themes emerged: comments about Electronic and about Face-To-Face approaches. Most comments, 68 %, were in favor of Electronic training as represented by the following, "An optimal solution would be webinars, recorded so people

could go back to them", but some were clearly the opposite, "Best way to learn is face-to-face workshops."

It is well accepted that people prefer different learning styles, and more recently shown that the preference for online activities is not the same in the older generation as in adolescents (Borun *et al.*, 2010). Nonetheless, our sample of interviewees, who were mostly aged 41 or over and therefore not considered digital natives, suggest that at least among highly educated academic scientists, online learning is appreciated.

Comments on Characteristics of courses often referred to a desire for ease, as exemplified by the following, "Needs to be short and snappy. Must be relevant." but also included several comments on the variability in knowledge of those coming to the trainings, "Group users into two main groups: skilled, that is ICT and data scientists, and unskilled users."

When discussing Trainers, respondents referred to age and qualifications and several expressed a desire for young trainers or trainers with lower qualifications such as "Early career post docs and maybe PhD students." Respondents also referred to skills, mentioning not only experts in the topic but also in related soft skills, "Someone who wants to, needs availability and energy, and needs to be an expert user of the cloud."

4. Conclusions

When designing a training program, a useful way to increase content validity can be to consult with potential users before the program design begins. Even a relatively simple and inexpensive consultation, as the 15 people interviewed here, can provide valuable and specific information relating to course content, design, and instruction. Based on the analysis of these interviews, training for use of the FNS-Cloud began with elearning on data basics ("Introduction to Open Science" and "General Data Protection Regulation (GDPR) in the Data Cycle") and is continuing with practical and hands-on face-to-face workshops ("How to Upload Your Scientific Work"). In an ongoing training program, perceived content validity should be regularly validated by, for example, collecting course evaluations. Only in this way can educators meet the real life demands of training specific skills.

Acknowledgements

Food Nutrition Security Cloud (FNS-Cloud) has received funding from the European Union's Horizon 2020 Research and Innovation programme (H2020-EU.3.2.2.3. – A sustainable and competitive agri-food industry) under Grant Agreement No. 863059 – www.fns-cloud.eu

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References

Awais Bhatti, M., & Kaur, S. (2010). The role of individual and training design factors on training transfer. *Journal of European Industrial Training, 34*(7), 656-672. https://doi.org/10.1108/03090591011070770

Borun, M., Schaller, D. T., Chambers, M. B., & Allison-Bunnell, S.(2010). Implications of learning style, age group, and gender for developing online learning activities. *Visitor Studies*, 13(2), 145 - 159. https://doi.org/10.1080/10645571003621513

Chandra Y., & Shang L. (2019) Inductive Coding. In: Qualitative Research Using R: A Systematic Approach. Springer, Singapore. https://doi.org/10.1007/978-981-13-3170-1_8

European Commision (2019). Open science. Available online at: ec_rtd_factsheet-open-science_2019.pdf (europa.eu)

Food and Nutrition Security Cloud (2019). Project funded by the European Union's Horizon 2020 Research and Innovation programme, Grant Agreement No. 863059. https://www.fns-cloud.eu/

Gubta, K. (2007). *A practical guide for needs assessment.* San Francisco: John Wiley & Sons, Inc.

Haraldseid, C., Friberg, F. & Aase, K. How can students contribute? A qualitative study of active student involvement in development of technological learning material for clinical skills training. BMC Nurs 15, 2 (2016). https://doi.org/10.1186/s12912-016-0125-y

Liebermann, S., & Hoffmann, S. (2008). The impact of practical relevance on training transfer: evidence from a service quality training program for German bank clerks. *International Journal of Training and Development, 12*(2), 74-86. https://doi.org/10.1111/j.1468-2419.2008.00296.x

Nikandrou, I., Brinia, V., & Bereri, E. (2009). Trainee perceptions of training transfer: an empirical analysis. *Journal of European Industrial Training, 33*(3), 255-270. https://doi.org/10.1108/03090590910950604

Wouters, P., & Haak, W. (2017). Open data: the researcher perspective. Amsterdam: Elsevier. Available at: https://www.elsevier.com/__data/assets/pdf_file/0004/281920/Open-data-report.pdf

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14424

A Campus Huakaʻi: Weaving Geological, Historical & Cultural Perspectives in Hawaiʻi

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Abstract

The University of Hawaiʻi at Mānoa is striving to become a Native Hawaiian place of learning. As part of this effort, we developed a huakaʻi (fieldtrip) to explore the intertwined geological, historical, and cultural influences on our campus. Our purpose is two-fold: (1) to showcase an example of how science can be taught in ways that honor Hawaiian culture and history; and (2) to stimulate interest and collaborations among faculty to develop additional place-based curricula offerings that draw connections between Hawaiian culture and Western science. Evaluations of a pilot fieldtrip generated considerable positive and constructive feedback, which was used to significantly improve the fieldtrip. In this paper, we share an abbreviated version of the current fieldtrip, and sincerely welcome any additional comments and suggestions.

Keywords: *Hawaiʻi; Earth System Science; Indigenous Science; Hawaiian History; Hawaiian Culture; Place-Based Teaching.*

1. Introduction

1.1. A brief synopsis of recent Hawai'i history

In 1778, the British Captain James Cook arrived in Hawai'i. Over the next few decades, the Indigenous Hawaiian population was decimated by western diseases, declining by ~84% by 1840 (e.g., Swanson, 2019). Hawai'i remained an independent nation until 1893, when a group of American businessmen and sugar planters, with support from the United States (U.S.) military, overthrew the reigning monarch. To avoid the bloodshed of her people, Queen Lili'uokalani abdicated her throne and was placed under house arrest. A few years later, in 1898, Hawai'i was annexed as a U.S. territory. Throughout the 20th century, Hawaiian language and culture were suppressed and almost lost. By the 1970s, there were only about 2,000 native speakers of the Hawaiian language remaining (Goo, 2019).

Currently, the University of Hawai'i (UH) is striving to be a "Native Hawaiian place of learning" (UH, 2019) but amidst this history, and UH's own history of evicting Native Hawaiians (see *Section 2.5*), what does that really mean? And how can Earth science classes participate in this endeavor? We don't claim to have the answers, but we nevertheless recognize that it is our *kuleana* (responsibility) to work with others to find them, and believe a critically important first step is to acknowledge historical truths.

1.2. Place-based Teaching

Place-based teaching can be defined as using place, people, and their resources as a foundation for learning. It has been shown to be effective across many subject areas and grade levels. A survey conducted at the UH Mānoa (UHM) School of Ocean and Earth Science and Technology (SOEST) revealed that most faculty and students agreed that (1) place-based teaching is important and effective; and (2) all instructors should teach in the context of place (Böttjer-Wilson & Bruno, 2019). However, 87% of SOEST faculty are not from Hawai'i (let alone Native Hawaiian), and many questioned their own ability to teach in a way that incorporates place. Thus, the mandate is clear but a challenge remains: How can SOEST faculty effectively implement place-based teaching approaches in their classes?

2. Campus *huaka'i*

We developed a *huaka'i* (fieldtrip) to explore the intertwined geological, historical, and cultural influences on the UHM campus: it examines the landscape and how it has been shaped by geologic processes, Native Hawaiians, and immigrants. Our purpose is two-fold: (1) to showcase an example of how science can be taught in ways that honor Hawaiian culture and history; and (2) to stimulate interest and collaborations among SOEST faculty to develop additional place-based curricula offerings that draw connections between Hawaiian culture and Western science. This *huaka'i* is based on three existing fieldtrips: (1) *Nā Mo'olelo o*

Mānoa Campus Tours, led by Dr. Kaiwipuni Lipe (Native Hawaiian Affairs Program Officer), which inspired the development of this fieldtrip; (2) *Mapping kuleana: Hawaiian geography and the "untold" history of UH Mānoa campus tour*, led by Dr. Christina Higgins (Chair and Professor, Second Language Studies) and Kapua Adams (Graduate Student, Second Language Studies); and (3) an introductory geology fieldtrip developed by Dr. Scott Rowland (Specialist, Earth Sciences) and colleagues.

After developing the script, we offered a pilot fieldtrip to 20 SOEST faculty and graduate students in July 2021. Fourteen completed a post-trip survey (70% response rate). First, survey respondents evaluated various aspects of the fieldtrip on a scale of 1 (low) to 5 (high) and the results were very positive: Overall Usefulness (4.8), Overall Content (4.7), Discussion (4.6) and Handouts/Guides (4.6). Next, we asked for open-ended feedback. Several participants noted that the integration of Western science and Hawaiian cultural comments was not seamless. For example, one respondent wrote: "*The geology tour was most interesting when it intersected with post-colonial and indigenous themes…I wonder if more local aspects of campus geology can be emphasized to strengthen these connections*". Another respondent commented: "*I like the merge of geology, Hawai`i, and history. These should in theory be merged in a way that we don't know where one starts and stops*." When we reflected on these comments, we realized that we needed to do a better job of drawing connections and demonstrating that Hawaiian culture is rooted in science. This led to considerable revision and, we believe, considerable improvement.

Here, we share an abbreviated version of our revised fieldtrip script with five stops. Each stop begins with the sharing of a historical truth and ends with reflection and discussion. A key focus is on relationships: how geology affects us and how we in turn affect the land.

2.1. Stop 1: Kapa‘akea (Dole) Street @ Kānewai lo‘i

Figure 1: Ka Papa Lo‘i o Kānewai

Truth: Much of Hawaiian culture is observation-based (i.e., scientific) and includes people's relationships with nature. Hawaiians (and other Indigenous people) tend to view themselves as part of nature – not separate from nature.

Native Hawaiians are Polynesians who settled in Hawaiʻi about 1000-1200 CE. Sailing thousands of miles across the Pacific Ocean requires advanced knowledge of oceanography and astronomy. Furthermore, upon arrival, Hawaiians set up an *ahupuaʻa* (ridge-to-reef land management) system indicative of their deep understanding of the connectivity between mountains and ocean.

In Hawaiʻi, trade winds blow from the Northeast, causing the Northeast sides of the islands to be wet and the Southwest sides to be considerably drier. Each area has distinct rain and wind patterns, names for these rains and winds, and stories that relate them to the place and teach a wise lesson. Mānoa's misty rain is Kuahine (Ua Tuahine) and Mānoa's wind is Kahaukani -- these are the parents of Kahalaopuna, the most beautiful woman in Mānoa. When she was murdered due to jealousy, her parents turned into the wind and rain (Adams & Higgins, 2018; Wehewehe Wikiwiki, n.d.).

Largely due to its abundant rainfall and gentle slopes, Mānoa valley has a rich agricultural history. When Kamehameha I conquered Oʻahu in 1795, he came to Mānoa because he knew there was enough *kalo* (taro) to feed his troops. In the early 1980s, a small group of UHM Native Hawaiian students uncovered the remnants of an *ʻauwai* (irrigation channel) and set out to restore it under the guidance of *kūpuna* (elders) such as Harry Mitchell. Their efforts resulted in these *loʻi* (irrigated taro fields) today, called Ka Papa Loʻi o Kānewai (Adams & Higgins, 2018).

Although it rains almost daily in Mānoa, the probability of extremely heavy rainfall and thunderstorms have been historically low, about 2% per year (National Weather Service, 2018). But Hawaiʻi's rain patterns are changing. Overall, the islands are becoming drier, but when it does rain, it often rains a lot harder (e.g., National Weather Service, 2018).

Reflection: As we walk across the street to the next stop, reflect on how people, rainfall, stream, rocks, and the mud under are feet are related to each other.

2.2. Stop 2: Basaltic Lava flows at Kapa‘akea (Dole) Street Bridge, near Kānewai lo‘i

Figure 2: Basaltic Lava Flows

Truth: Hawaiian “deities” are the Westernized translations of Hawaiian observation & culture.

These lavas formed ~2 million years ago, when O‘ahu was over the Hawaiian hot spot. Often we read that Pele is the goddess of volcanoes. This is a Western perspective. To Hawaiians, Pele IS volcanism: Pele is not a person who sends lava down a mountain, but rather Pele IS the lava that flows down the mountain (as well as every other manifestation of volcanism).

Hot spot volcanism is one process that shaped Mānoa. Another is erosion: streams continually erode material from the mountains. The word *mānoa* means “vast or thick, as a substance having breadth and depth” (Wehewehe Wikiwiki, n.d.). In fact, Mānoa valley used to be even deeper, before it was partially infilled by alluvium as O‘ahu subsided.

Well after O‘ahu moved off the hot spot and the Ko‘olau volcano stopped erupting, volcanism reawakened and new vents formed. Lava from one of these new vents (Pu‘u Kākea) flowed down into Mānoa valley and ponded, becoming a dense thick layer. UHM is built on this Kākea lava flow, which was also quarried and used in many local buildings.

Reflection: How does geology affect our everyday lives in Hawai‘i? And how are we in turn impacting the *‘āina* (land)?

2.3. Stop 3: Campus entrance marble pillar @ East-West Road

Truth: Hawai‘i was an independent nation until 1893, when a group of American businessmen and sugar planters forced Queen Lili‘uokalani to abdicate. Fifty years earlier, in 1843, Hawai‘i briefly lost its sovereignty when a British Naval officer (Lord Paulet) occupied the Hawaiian Islands for five months. Paulet’s occupation was later reversed by his commanding officer, Rear-Admiral Thomas (HawaiiHistory.org, 2021a).

Figure 3: Marble Monolith

UHM is striving to be a Native Hawaiian place of learning (UH, 2019), and this monolith was installed to establish a sense of place. The phrase on the plaque, *Ua Mau ke Ea ʻo ka ʻĀina i ka Pono*, is often translated as *The life of the land is perpetuated in righteousness*. Another translation of *ea*, instead of life, is sovereignty. King Kamehameha III said this on July 31, 1843, when the sovereignty of the Kingdom of Hawaiʻi was returned by Rear-Admiral Thomas. Ironically, this phrase was put on the Republic of Hawaiʻi seal in 1896, shortly after the overthrow of Queen Liliʻuokalani, as well as on the Territory of Hawaiʻi seal in 1900. It became the Hawaiʻi state motto in 1959.

As we stand here, we should also reflect on the street name. Some sources (e.g., UHM, 2007) indicate that Dole Street used to be called Kapaʻakea Street, and was renamed in honor of Daniel Dole, father of Sanford Dole. Sanford Dole was a key player in the 1893 overthrow of the Hawaiian Kingdom. He also served as the President of the Provisional Government of Hawaiʻi that was formed after the coup, and then as Governor of Hawaiʻi.

Now let's look at this stone. This is marble, a metamorphic rock made of calcite (light colored crystals), with flecks of pyrite (darker crystals). Marble does not form in Hawaiʻi.

Reflection: Does this pillar or the name Dole Street evoke a sense of place in you? If you were to use rocks to evoke a sense of this place, what would your creation look like? For example, what material would you use?

2.4. Stop 4: Webster Hall

Figure 4: (l) Basalt/Gabbro with Hawai'i state motto. (r) Kukui tree

Truth: Basalt is the most common rock in Hawai'i and can help evoke a sense of place.

The light gray tiles surrounding the word "Mālamalama" are basaltic lava. Basalt flows on the surface of the Earth and cools quickly. That is why it is fine grained. The darker letters and rings are made of gabbro. Gabbro has the same chemistry as basalt, but it cools slowly inside the Earth, which allows larger crystals to form. With hand lenses, you can identify pyroxene, olivine, and plagioclase in the gabbro.

Plants can also help evoke a sense of place. Kukui was brought by Polynesians to Hawai'i because of its many uses. Its English name is "candlenut" because the oil can be lit on fire to produce light. Metaphorically, kukui represents enlightenment, which is why college graduates wear lei made out of kukui leaves (Adams & Higgins, 2018).

Reflection: Compared with Stop 3, does this rock mosaic and kukui better reflect a sense of this place and our *pilina* (relationship) with this land? Why or why not?

2.5. Stop 5: Queen Lili'uokalani Center

Figure5: (l) Ahu (rock altar) and (r) Limestone, with vugs and fossils

Truth: UHM, like the State, has some ugly history. This includes the erasure of Native Hawaiians in pursuit of development.

An ahu is an altar made of rocks. This ahu, *Ke Ahu ʻo Kamakaʻeha*, was dedicated to Queen Liliʻuokalani, the last monarch of the Hawaiian Kingdom (Hawaiʻinuiākea, n.d.). Most of the rocks in this ahu are basalts (some are partially altered to chlorite, appearing greenish). There are also coral heads. Looking at the building, the rocks on the lanai and along the stairs are limestone, a rock found in Hawaiʻi (although this particular limestone is probably not from Hawaii). You can see vugs (cavities) and fossils (such as shell fragments) in the rocks on the lanai and along the stairway railings.

Queen Liliʻuokalani was one of the first people to envision an institution of higher education in Hawaiʻi. In 1907, when Hawaiʻi was a US territory, the College of Agriculture and Mechanic Arts of the Territory of Hawaiʻi was established, and it eventually became UHM. At the time, Native Hawaiians were living on the land, tilling the land and "getting in the way of the construction" of the new college. Archived Board of Regents minutes note that "Hawaiians now dwelling on the land are an obstacle" (May 8, 1911) and "After some discussion on this matter, it was voted that Judge Cooper and Mr. Hemenway should act in conjunction with the Attorney-General to the end of removing these people entirely from the land" (May 15, 1911). Thus the Hawaiians were evicted, which has been a recurring theme all over Hawaiʻi since 1848, when the *Māhele* enabled land privatization (Adams & Higgins, 2018; HawaiiHistory.org, 2021b). Sadly, the experiences of Native Hawaiians parallel those of other Indigenous communities across the country, and the world.

Reflection: What can we as SOEST faculty & students do to create a Native Hawaiian place of learning?

3. Results & Conclusions

This fieldtrip has been shared with SOEST faculty, some of whom have incorporated it into their courses in various formats. We hope that opportunities will arise for students and faculty to discuss their reflections, particularly the final one: *What can we as SOEST faculty and students do to create a Native Hawaiian Place of Learning?* Some ideas shared to date by fieldtrip participants include developing geoscience curricula that honor Hawaiian history and culture, commissioning Hawaiian-themed artwork for SOEST buildings, and changing building names. Currently, SOEST buildings are named by discipline (e.g., Pacific Ocean Science and Technology, Hawaiʻi Institute of Geophysics, Marine Sciences Building), and one suggestion was to rename buildings after prominent Native Hawaiian scientists. Names reflect values, and naming is taken seriously in Hawaiian culture.

Acknowledgements

This campus huakaʻi builds on – and borrows heavily from – three other field trips developed by Punihei Lipe, Kapua Adams, Christina Higgins, Scott Rowland and their colleagues. We are also grateful to Henrietta Dulai and Helen Janiszewski for piloting this fieldtrip with their introductory geology students, and to Hawkins Biggins for taking all photographs in this paper. Anonymous peer reviews improved this paper. This work was supported by the U.S. National Science Foundation (NSF/GEO #2022937) and Hawaiʻi SeaGrant (NOAA# #NA18OAR4170076). This is SOEST Contribution no. 11502.

References

Adams, K. & Higgins, C. (2018). Mapping kuleana: Hawaiian geography and the "untold" history of UH Mānoa campus tour. Walking tour at the Pīkoʻokoʻo Conference, University of Hawaiʻi at Mānoa (October 6, 2018).

Böttjer-Wilson, D. and Bruno, B.C. (2019). Place Matters! Fostering place-based geoscience teaching at the University of Hawaiʻi at Mānoa, *Proceedings of the 5th International Conference on Higher Education Advances (HEAd'19)*, 243-251, http://dx.doi.org/10.4995/HEAd19.2019.9237.

Goo, Sara Kehaulani (2019), The Hawaiian Language Nearly Died. A Radio Show Sparked Its Revival (June 22, 2019) Available at https://www.npr.org/sections/codeswitch/2019/06/22/452551172/the-hawaiian-language-nearly-died-a-radio-show-sparked-its-revival

Hawaiʻinuiākea (n.d.), About UH Mānoa Campus' Ahu. https://manoa.hawaii.edu/hshk/hawaiinuiakea/about-us/about-uh-manoa-campus-ahu/

HawaiiHistory.org (2021a). Lord Paulet temporarily claims Hawaiʻi for Britain http://www.hawaiihistory.org/index.cfm?fuseaction=ig.page&PageID=286&returntoname=Short%20Stories&returntopageid=460

HawaiiHistory.org (2021b). The Māhele to the Overthrow (1848-1893). http://www.hawaiihistory.org/index.cfm?fuseaction=ig.page&PageID=359

National Weather Service (2018). Record Kauai and Oahu Rainfall and Flooding – April 2018. https://www.weather.gov/hfo/RecordKauaiandOahuRainfallAndFlooding-April2018

Swanson, D. (2019), A New Estimate of the Hawaiian Population for 1778, the Year of First European Contact (July 3, 2019). Hŭlili 2019, Available at SSRN: https://ssrn.com/abstract=3917957 or http://dx.doi.org/10.2139/ssrn.3917957

University of Hawaiʻi at Mānoa (2007), Named Buildings, Dole Street. https://libweb.hawaii.edu/names/dole.html#:~:text=Dole%20Street%20%7C%20Building%20Names%20%7C%20University,annexed%20by%20the%20United%20States.

University of Hawaiʻi (2019). Native Hawaiian Place of Learning Advancement Office. https://manoa.hawaii.edu/nhpol/

Wehewehe Wikiwiki (n.d.). https://hilo.hawaii.edu/wehe/

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14576

Normative isomorphism: The patterns of profession of academics at Turkish higher education

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Abstract

Normative isomorphism is derived from professionalization. Professionalization is a collective effort of the members of a profession to define their practices of the members and also to control the services provided within a jointly agreed framework. Its legitimation is based on its power and status of the profession. In line with this framework, the profession of academics relies on the existence of teaching, research, and community engagement. Thus, normative isomorphism is represented by a variety of activities including bureaucratic control, assessments, publishing, and rankings. This paper aims to explain normative isomorphism through the profession of academics and gives evidence of normative isomorphism patterns based on examples from the Turkish higher education system.

Keywords: *Isomorphism; normative isomorphism; professionalization; profession of academics; higher education; Turkey.*

1. Normative Isomorphism

Normative pressures, one of the elements of isomorphic organizational change, have emerged as a source of professionalization (DiMaggio & Powell, 1983). Professionalization is a collective struggle of its members of the profession to define the conditions and methods of their work and to control the production of producers (Larson, 1977). The main goal of the professions is to monopolize services, in other words, to control services through collective effort. Professionalization becomes the essential tool by which privilege including status, high income, and autonomy is obtained in a hierarchy in the work environment. Because the development of a stable and viable market in which service can be provided ensures the continuation of status and privilege (Gitlin, 1982). According to Larson (1977), a key element that distinguishes a profession from the rest of the professions, is based on its power and status. Therefore, specialist knowledge and altruistic practice are perceived as part of the legitimating ideology adopted by the members of the profession as to obtain influence and establish authority. In this regard, ethical codes of a profession provides good practices, others outside the profession are unskilled to assess the tasks related to the profession because of the complexity of the profession. It can be seen that there is an effort to secure the special power of a profession by the professional groups (Malcolm, Pinheiro, & Pimenta, 2014).

There are two important sources of normative isomorphism. One of them grounds on the formal education and cognitive legitimacy produced by academics; the second is the growth of professional networks (DiMaggio & Powell, 1983). First, controlling over the production of the academics themselves and their knowledge bring about the standardization of educational training and licensing of the service. Improvement of educational processes and the standardization of educational training produce the universal equivalent in the market creating value-in-exchange (DiMaggio & Powell, 1983; Larson, 1977). Homogeneous educational training and common membership in professional associations are pivotal in terms of developing shared professional norms (Pouder, 1996). At the academia, professional norms and shared academic culture play an important role as to ensuring the continuation of academic research. Norms created through the social interaction among academics are tools of collegial control over teaching and learning, research, and community engagement. These interactions including formal and informal conversations provide repeated self and cross evaluations on research and effective instruction throughout the academic departments (Dill, 2021). The latter aspect of professionalization is based on its marketability. The professional group must promote the profession in public as necessary which can only be provided for by its members. Besides the peer recognition (Hamann & Beljean, 2020), symbolic capital embedded in power relations (e.g. mass media) provides public recognition of expertise and professional status of professions which have greater authority and less autonomy such as medicine, law, economics, and political science (Arnoldi, 2007). Image of performing for the sake of public confirms the validity of the profession and justifies its monopoly over its

services (Larson, 1977, 69). At the academia, the peacebuilding image of an academic position is effective because it connects the top and bottom levels, and binds various groups, institutions, associations, and organizations to each other (Janke & Medlin, 2015). A scientist has a responsibility to improve understanding; communicate the technological, humanitarian, and economic benefits of science; and contribute to better-quality public and private decision-making (Culum, 2020).

One of the important mechanism of normative isomorphism is filtering of personnel. It occurs through the hiring of employees within the same industry, through common promotion practices, and from skill-level requirements for certain jobs (DiMaggio & Powell, 1983). The other mechanism of normative isomorphism is socialization in a variety of topics including personal behavior, dress code, performance proficiency, politics, language, history, addressing others, and organizational values (Chao et al. 1994; Välimaa, 2020). In the absence of normative structure, employees in the profession would act freely, deciding for themselves whether what behaviors are appropriate or not (Rumyantseva & Caboni 2012). In academia, normative isomorphism is significantly represented by professionalization (e.g. professional associations, conferences) and publications (eg. journals, government publications) (Burruss & Giblin, 2014). Top-down bureaucratic control, students' evaluations of modules, citation metrics, journal, and universities' rankings have been described as powerful disciplinary mechanisms (Gendron, 2015; Espeland & Sauder, 2016).

2. Normative Isomorphism Patterns at the Turkish Universities

2.1. Profession of Academics in Turkey

The administration of higher education in Turkey was restructured by Higher Education Law No. 2547 in 1981. Two institutions were founded in accordance with Law No. 2547. First, the Council of Higher Education (CoHE) was established as an autonomous regulatory body which is responsible for regulating the higher education activities and coordinating the operations of higher education institutions. Second, the Inter-University Council (IUC) was founded to coordinate and evaluate teaching, research, and publication activities of universities, making regulations on teaching, scientific research, and publication activities that concern all universities, determining the principles related to doctorate, and awarding the academic titles and degrees.

Turkish higher education system has become a large ecosystem in recent years. By January 2022, there are 207 higher education institutions, including 129 state, 74 foundation, and 4 foundation vocational schools. By February 2022, in Turkey with a population of more than 84 million, the number of students in associate degree is 3,114,623; 4,676,657 in bachelor's degree programs; 343,569 in Master's degree, and 106,148 in Ph.D. programs. Out of 182,483 academic staff, including 31,918 professors, 19,350 associate professors, 41,106 assistant

professors, 37,994 teaching assistants, and 52,115 research assistants, work at public and foundation universities. In addition to that, the decreasing availability of public financial resources and triggering movement for internationalization have forced Turkish universities take part in global rankings. Thus, academics have started to adopt strategies to improve the quality of the publication, and research (Kondakci, Zayim-Kurtay, Kaya-Kasikci, Senay, & Kulakoglu, 2021). According to Scimago Journal & Country Rank (2021), Turkish scholars published 650,228 articles between 1996 and 2020, and received 11.85 citations per paper on average.

2.2. Scientific Institutions Established by Law

The Scientific and Technological Research Council of Turkey (TUBITAK), the first important institution that plays a role in determining the science and technology policies of Turkey, was established with Law No. 278 on 17/07/1963. TUBITAK was established in line with the transition to the planned economy period in Turkey. Its essential tasks at the establishment stage are to support basic and applied academic research, especially in the natural sciences, and to encourage young researchers. In Law No. 5376 entered into force on 07/07/2005, social and human sciences were also included in the mandate of the work program of the institution, and provisions were introduced to enable the use of effective mechanisms that will improve university-industry cooperation. TUBITAK provides research and development support to academia, industry, and the public; provides scientific event organization support; supports the projects of primary school students to higher school students within the scope of science fairs; provides support to associate degree, undergraduate and graduate students, post-doctoral researchers, and foreigner researchers. Second, Turkish Academy of Sciences (TUBA) was established as Turkey's autonomous and national academy with Decree No. 497 on 13/08/1993. TUBA carries out the studies ıntended to give direction to science policies and provide science-based consultancy service; regulates award schemes for distinguished scientists.

2.3. Ethics Committees of Universities

Ethical behaviour in the public sector has increased its importance with the enactment of the Law on the Establishment of the Public Servants Ethics Committee on 25/05/2004. The CoHE has made it mandatory for universities to establish their own ethics committees and prepare their guidelines. In this direction, the CoHE published the Scientific Research and Publication Ethics Directive of Higher Education Institutions with the decision of the General Assembly taken at its 23rd session dated 10/11/2016. This directive is declared to determine the ethical rules to be followed in scientific research, study, publication, and activities, and to regulate the duties, authorities, and responsibilities of scientific research and publication ethics committees of higher education institutions established by, as well as working

procedures and principles. The Directive is based on Articles 24, 42, and 65 of the Higher Education Law No. 2547. These articles refer to the principles of the title and appointment of associate professorship, intra-organizational scientific supervision, and the issues of Higher Education through by-laws adopted. The directive defines actions that are contrary to scientific research and publication ethics, the formation of scientific research and publication ethics committees, their duties, working procedures and principles, and supervision. In this context, each university has its own Ethics Committee directive that it has issued on its structure, duties, authority, and working principles (reconvention, operation mode, and evaluation of applications). Additionally, these directives consist of the qualifications, and incumbency of members; and unethical practices including plagiarism, fabrication, distortion, republishing, slicing, unfair authorship, ethical violation, and ethical carelessness that are contrary to ethical principles and values.

2.4. Units

Coordinatorship is an administrative unit created to carry out the studies and practices on various subjects within the university and/or coordinate with other institutions/organizations headed by the coordinator authorized by the rector. For instance, Accreditation Academic Evaluation and Quality Coordinatorship, Scientific Research Projects (BAP) Coordinatorship, and Bologna Process Coordinatorship are some of the 20 coordinatorships at Ankara University. University centers are units responsible for postgraduate courses, and they show entrepreneurial behavior by cooperating with industrial organizations and companies (Bozkurt, 2012). For example, the European Communities Research and Application Center (ATAUM), Continuing Education Center (ANKUSEM), and Earthquake Research and Application Center are a few of the 47 centers established within Ankara University. In addition, a support unit, established based on a policy document, is an application center where students and employees can receive legal, psychological, medical, physical, academic, or social support (Senol Cantek, 2013). Ankara University Support Unit Against Sexual Harassment and Assault is one of the examples of a support unit. The support units of universities in Turkey correspond to the structure on equality, differentiation, and inclusion in universities abroad.

2.5. Accreditation

Only academic programs were accrediated in Turkey until 2001 when Turkey joined the Bologna Process. Since then, institutional external evaluation practices have been improved (Uludag et al., 2021). Within the scope of Law No. 7033 dated 18/06/2017, the article on the establishment of Higher Education Quality Board with administrative and financial autonomy, public legal entity, and private budget was included in the Higher Education Law No. 2547. Its purpose is to make evaluations according to national and international quality standards regarding the quality levels of education and research activities and administrative

services of higher education institutions, to carry out internal and external quality assurance, accreditation processes, and authorization processes of independent external evaluation institutions. The Higher Education Quality Assurance System includes the principles regarding the internal and external quality assurance of higher education institutions' educational and research activities and administrative services, accreditation processes, and the authorization processes of independent external evaluation institutions. The decisions made by Turkish Higher Education Quality Council (YOKAK) within the scope of The Institutional Accreditation Program (KAP) are full accreditation (for five years), conditional accreditation (for two years), and providing support to the higher education institution in the context of quality assurance practices. The ratio of accredited undergraduate programs to all undergraduate programs was 8.84 %. In addition, the number of institutions with accredited programs increased by 72 %, and the number of accredited programs increased by 83 % in 2020 compared to 2016. The number of accredited programs in engineering is higher than in other fields. The ratio of accredited programs among the total graduate engineering programs is approximately 35 % (YOKAK, 2021).

2.6. Unions

Unions' interest in economic and professional issues and their search for solutions to social and political problems enable their members to learn about and improve in those issues (Buyruk, 2021). The number of studies in Turkey revealing the union activities of the academic staff is limited. The most important of these is Karakutuk et al.'s (2008) research that unveils a profile of the academic staff of education faculties in Turkey. According to the research findings, the rate of those who are not members of any union among the academics is 77.2 %, and the rate of female academics who are not members of a union is higher than the rate of male academics. Associate professors have the highest rate among those who are members of a union, while research assistants have the lowest rate. 95.2 % of the academics indicate that unions are insufficient in performing their functions in the field of education. 69.5% of the academics stated that unionization could not resolve the problems experienced.

2.7. Associations

The advice of professional associations lead to normative isomorphic responses (Bellé, Belardinelli, Cantarelli, & Mele, 2019). Professional associations play an important role on knowledge development, engagement, collaboration, community building and a sense of professional identity (Huang, King, & Law, 2021). Associations operating in Turkish higher education are established based on Law No. 5253 on associations dated 04/11/2004. Except for revenue, associations are groups of persons with legal personalities created to realize a specific and common purpose that is not prohibited by law. The general aim of associations established in the field of educational sciences is to conduct studies to meet the social, cultural, economic, and professional needs of their members, to carry out activities that serve

the public interest in education and training, and to develop cooperation with institutions/organizations.

2.8. Professional Network

Researchers have been using academic social network sites to contact the other researchers, share research output, and follow other researchers' studies (Jordan, 2019), join in topic-based discussions (Goodwin, Jeng, & He, 2014), disseminate CV, search for a job, find collaborators for research projects, disseminate teaching material, and sign up because other researchers have already signed up (Nández & Borrego, 2013). Among the academic social network sites (ASNS) leading the higher education market, the relatively most widely used ones are academia.edu, ResearchGate (RG), Mendeley, Google Scholar, and Zotero (Williams & Woodacre, 2016). According to Isik (2021), 62.5 % of 128 academicians working in the field of Information and Document Management in Turkey had a RG profile. This rate was lower than the rate of the Google Scholar profile, and the use of these platforms depends on the university, title, and gender.

3. Conclusion

At the micro-level, individuals who have the same educational background and are filtered on a particular set of attributions, tend to view the problems and approve policies, procedures, and structures at a similar level and thus, make their decisions in the same way. At the macro level, as the level of professionalization increases, the amount of institutional isomorphic change gets stronger. Normative isomorphism, resulting from professional training and education, compels organizations to perform their duties and to benefit from professional practices leading to the survival of the organizations. The differences between the educational background, and work experiences may bring about differences of opinion between the bureaucrats and the experts, thus causing the two groups to conflict in decision-making. Also, it can be said that the competitiveness of universities in global rankings and publications shapes the profession of academics regarding in a normative context.

References

Arnoldi, J. (2007). Universities and the public recognition of expertise. *Minerva*, 45, 49-61.

Bellé, N., Belardinelli, P., Cantarelli, P. & Mele, V. (2019). On iron cages and suboptimal choices: an experimental test of the micro-foundations of isomorphism in the public sector. *International Public Management Journal*, 22(2), 373-414.

Bozkurt, S. (2012). *Academicians' point of view about organizational democracy and academic freedom receptivity and applicability level in turkey*. Unpublished doctoral dissertation. Ankara University Institute of Educational Sciences, Ankara.

Burruss, G. W. & Giblin, M. J. (2014). Modeling isomorphism on policing innovation: The role of institutional pressurs in adopting community-oriented policing. *Crime & Delinquency*, 60(3), 331-355.

Buyruk, H. (2021). The role of trade union provision for critical professional learning in supporting member teachers' social justice leadership practice. *Professional Development in Education*, 47(1), 102-114.

Chao, G. T., O'Leary-Kelly, A. M., Wolf, S., Klein, H. J., & Gardner, P. D. (1994). Organizational socialization: Its content and consequences. *Journal of Applied Psychology, 79*(5), 730–743.

Culum, B. (2020). Public enagagement in higher education. In P. N. Teixeira & J. C. Chin (Eds.). *The international encyclopedia of higher education systems and institutions* (pp. 2343-2350). Dordrecht, The Netherlands: Springer Nature.

Dill, D. (2021). A personal reflection on the key challenge for higher education: Improving the quality of university instruction. In H. Van't Land, A. Corcoran, A., & D. Camelia-Iancu (Eds.). *The promise of higher education: Essays in honour of 70 years of IAU* (pp. 269-273). Cham, Switzerland: Springer Nature.

DiMaggio, P. J. & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review*, 48(2), 147-160.

Espeland, W. N., & Sauder, M. (2016). *Engines of anxiety: Academic rankings, reputation, and accountability*. New York, NY: Russell Sage Foundation.

Forsyth, P. B. & Danisiewicz, T. J. (1985). Toward a theory of professionalization. *Work and Occupations*, 12(1), 59-76.

Gendron, Y. (2015). Accounting academia and the threat of the paying-off mentality. *Critical Perspectives on Accounting*, 26, 168–176.

Gitlin, L. N. (1982). *The professionalization of medical superintendents and the treatment of the poor in the United States: The issue of incurability, 1840-1870.* Unpublished doctoral dissertation. Indiana: Purdue University.

Goodwin, S., Jeng, W., and He, D. (2014). Changing communication on ResearchGate through interface updates. *Proceedings of the Association for Information Science and Technology (ASIS&T 2014) Annual Meeting*, *USA, 51*(1), 1-4.

Habenstein, R. W. (1963). Critique of "Profession" as a sociological category. *The Sociological Quarterly*, 4(4), 291-300.

Hamann, J. & Beljean, S. (2020). Academic evaluation in higher education. In P. N. Teixeira & J. C. Chin (Eds.). *The international encyclopedia of higher education systems and institutions* (pp. 28-34). Dordrecht, The Netherlands: Springer Nature.

Herdman, E. A. (2012). Meslekler ve profesyonellik [Professions and professionalism]. *Journal of Education and Research in Nursing*, 9(2), 3-7.

Huang, W. J., King, B. & Law, R. (2021). To engage or not? Leading scholar memberships and involvement in hospitality and tourism associations. *Journal of Hospitality & Tourism Education*. doi: 10.1080/10963758.2021.1963743

Isik, D. (2021). Academics' use of ResearchGate and Google Scholar Citations: a study on the information and records management departments in Turkey. *Journal of Information Management*, 4(2), 240-263.

Janke, E. M. & Medlin, K. D. (2015). A centralized strategy to collect comprehensive institution-wide data from faculty and staff about community engagement and public service. *Metropolitan Journal*, 26(2), 125-146.

Jordan, K. (2019). From social networks to publishing platforms: a review of the history and scholarship of academic social network sites. *Frontiers in Digital Humanities*, 6(5).

Karakutuk, K., Tunc, B., Ozdem, G., & Bulbul, T. (2008). *Egitim fakultelerinin ogretim elemani profili*. Ankara: Ankara Üniversitesi Basımevi.

Kondakci, Y., Zayim-Kurtay, M., Kaya-Kasikci, S., Senay, H. H., & Kulakoglu, B. (2021). 'Scaling' the academia: Perspectives of academics on the impact of their practices. *Research Evaluation*, 30(3), 370-381.

Larson, M. S. (1977). *The rise of professionalism: A sociological analysis*. Berkeley: University of California Press.

Malcolm, D., Pinheiro, C., & Pimenta, N. (2014). Could and should sport coaching become a profession? Some sociological reflections.*InternationalSportCoachingJournal*,1,42-45.

Nández, G. & Borrego, Á. (2013). Use of social networks for academic purposes: a case study. *The Electronic Library*, 31(6), 781-791.

Pouder, R. W. (1996). Privatizing services in local government: An empirical assessment of efficiency and institutional explanations.*Public Administration Quarterly*,20(1),103-126.

Rumyantseva, N. L. & Caboni, T. C. (2012). Are academics in Kazakhstan capable of self-regulation? A study of faculty's normative structure in the midst of higher education decentralization reforms. *Tertiary Education and Management*, 18(1), 1-16.

Senol Cantek, F. (2013). Ankara Üniversitesi cinsel tacize ve saldırıya karşı destek birimi (CTS) nedir? Nasıl çalışır? *Mulkiye Journal*, 37(4), 231-235.

Uludag, G., Bardakcı, S., Avsaroglu, M. D., Cankaya, F., Catal, S., Ayvat, F., Kocer, A., Aksu Yıldırım, S., & Elmas, M. (2021). Investigation of the higher education students' participation in quality assurance processes based on the theory of planned behaviour: a case of Turkey. *Quality in Higher Education*, 27(3), 338-356.

Välimaa, J. (2020). Disciplinary versus institutional approaches, higher education. In P. N. Teixeira & J. C. Shin (Eds.). *The international encyclopedia of higher education systems and institutions* (pp. 293-298). Dordrecht, The Netherlands: Springer Nature.

Weiss-Gal, I. & Welbourne, P. (2008). The professionalisation of social work: a cross-national exploration. *International Journal of Social Welfare*, 17, 281-290.

Williams, A. E. & Woodacre, M. A. (2016). The possibilities and perils of academic social networking sites. *Online Information Review*, 40(2), 282-294.

YOKAK. (2021). *2020 yuksekogretim degerlendirme ve kalite güvencesi durum raporu*. Ankara: Yuksekogretim Kalite Kurulu.

Scimago Journal & Country Rank (2020). *Country rankings*. Retrived from https://www.scimagojr.com/countryrank.php

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14032

A Quality 4.0 Assurance Framework for the Higher Education Institutes

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Abstract

This article presents a framework for the implementation of Quality 4.0 aspect in the higher education institute. Quality 4.0 is a major domain of Industry 4.0 revolution. Beside the industry, educational institutes are also embracing the new technology-based framework, which does not only revolutionize the educational system, but also impact their performance.

In this research, a comprehensive framework for the implementation of Quality 4.0 is presented. The enablers and the components of Quality 4.0 are discussed in detail. The article also discusses the implementation of the framework, consisting of big data analysis, SWOT analysis of the institute, implementation of documentation, digitalization and record management, ERP system and finally the key performance indicators (KPIs).

The framework is specially designed for the higher education institute for the consistency and standardization, through the latest technology and digitization.

Keywords: *Quality 4.0, Industry 4.0, Quality Management System, Higher Education Institutes, Outcome-based education.*

1. Introduction

Core idea of Industry 4.0 is the ability to accumulate and analyze big data from industrial sources, and use this data to make decision for the higher productivities. Concurrent fields of Industry 4.0 are; Quality 4.0, Maintenance 4.0, Pharma 4.0 etc. Due to the advancement in industry and its concurrent fileds, it is the immense need of the era, to transform the quality assurance in higher education into the Quality 4.0 Assurance (Q4A). To address the current needs of higher education a comprehensive framework for the implementation of Q4A is highly needed. The current needs and requirements of the traditional framework of quality assurance and the latest trends of Quality 4.0 are need to be addressed. A comprehensive literature review has been conducted, which is presented below;

Implementation of quality assurance framework, challenges and solutions and the transformation to the new standards are presented in other research (Tufail and Lodi, 2006), (Tufail and Lodi, 2008), (Bhutto *et al.*, 2017), (Wasif *et al.*, 2018), (Shailh *et al.*, 2019a), (Shaikh *et al.*, 2019b), (Bhutto *et al.*, 2019). Rudzki *et al.* developed a generic strategic framework for the quality assurance in educational institutions and presented the components of it that can be implemented in any type of education institute (Rudzki *et al.*, 1995). Gopal *et al.* conducted a survey to assess the maturity of total quality management (TQM) in higher education. They highlighted the positive outcomes of implementing TQM within the higher education institute (HEI) (Gopal *et al.*, 1999). Fumasoli and Lepori presented a genetic strategic framework which can further be customized for the stage-wise standardization in structures and standards in HEIs in the specified environment (Fumasoli and Lepori, 2011). Teichler *et al.* presented their work on the possible risk analysis of globalization and overall impact on the higher education (Teichler *et al.*, 2004). Garrison *et al.* analyzed the issues related to the administration and leadership, for which the controls are developed to improve the blending learning approach (Garrison *et al.*, 2004). Ciolacu *et al.* improved the concept of Education 4.0 by incorporating the artificial intelligence over the big data of students progress (Ciolacu *et al.*, 2017). Wittayasin highlighted the problems in attaining the vision of the government for the Thailand 4.0 (Wittayasin, 2018). Puncreobutr highlighted that the need of communication, mobile app, big data analysis and use of AR/VR will increase the quality in HEIs (Puncreobutr, 2016).

It has been observed from the literature review that the Quality 4.0 implementation in HEIs are not new, although it has several challenges such as; quality of education at different academic levels and segmentations, availability of infra-structure, teaching methodologies and assessment mechanisms, knowledge and skill of faculty and quality assurance division and outcome of curricula. To address these issues, a Q4A framework for the outcome-based education has been developed, which is presented in the following section. A part of this framework has been implemented at the NED University which is discussed in detail.

2. Quality 4.0 Assurance Framework

The current framework is inspired by the philosophy of Juran, which states the concept of Quality 4.0 for the industry bifurcated into eleven axes, namely; data, analytics, connectivity, collaboration, app development, scalability, management system, compliance, culture, leadership and competency. These core axes are further divided into the components as used in the traditional quality assurance frameworks (Juran, 2019). This Quality 4.0 in generic and is quite applicable to the manufacturing industry, however a Quality 4.0 Assurance Framework (see Fig. 1) has been developed in the light of outcome-based education for the higher education institution.

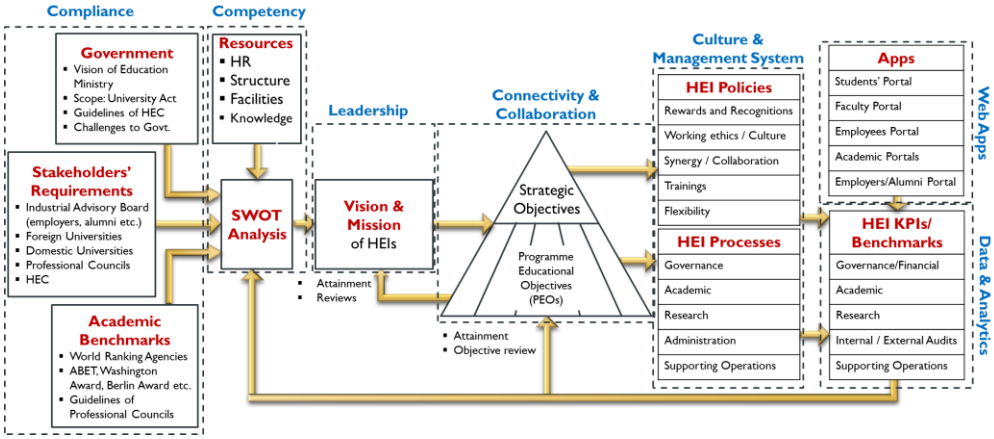

Figure 1. Quality 4.0 Assurance Framework (Q4M) for Higher Education Institutes.

2.1. Compliance

To ensure the compliance, Quality Enhancement Cell (QEC) and Registrar Office gathers the requirements of stakeholders including the regulatory bodies. Qualitative data can be gathered in the form of relational database, whereas, quantitative data can also be gathered in the same way but acts as the benchmark for the further KPIs. Source of compliance data may be government, regulator bodies, funding agencies, collaborative institutions, professional councils, academic benchmarking agencies etc. Online bots and application can be written to continuously monitor the chan8ge in websites and new contents, which can further be added in the database for the further compliance.

2.2. Competency

Resources of the HEI are also proposed to be converted into the quantitative form, so that it can be compared with the benchmark institutions for the SWOT Analysis. Another relational database can be developed to incorporate different types of resources. In SWOT Analysis,

strength and weakness of HEIs are analyzed based on the resources, such as; human resource, infra-structure, equipment, facilities, finances etc. SWOT analysis are also converted into the quantitative evaluation of SWOT, i.e. internal factor evaluation (IFE) matrix and external factor evaluation (EFE) matrix, which will be further used to developed critical profile matrix (CPM) comparing the competitors and benchmark HEIs. Competitive profile matrix (CPM) provide quantitative comparison and highlight the strengths and weaknesses in terms of scoring on Likert scale. Although an automated system for the competency is not currently developed but based on the SWOT analysis presented in the previous research (Shaikh *et al.*, 2019).

2.3. Leadership

Leadership intuition is important to be incorporated to review vision and mission of the HEI. Based on the compliance (majorly scope) and the competency, mission of HEI can be reviewed highlighting the weak or strong areas. Using the ad optic strategy and SWOT analysis, vision of the HEI can be set which would provide a direction to the institution for the future betterment.

2.4. Connectivity and Collaboration

Strategic objectives or long-term objective are the bridge between the mission and vision. Hence it is the core aim of this stage is to develop strategic objectives of the organization based on the vision and mission of the organization. Based on the strategic objectives programme education objectives (PEOs) of the academic programmes are developed. Hence a sample vision and mission statement along with the strategic objectives are presented in the following figure.

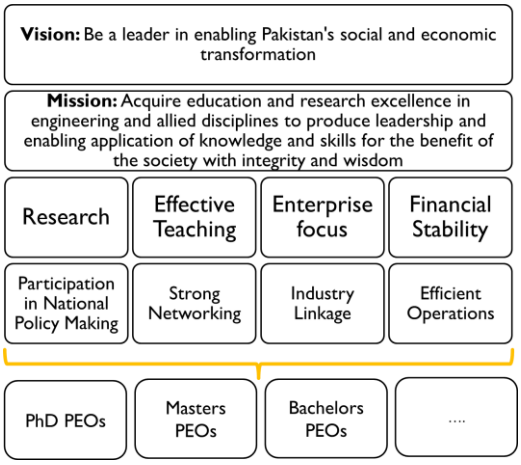

Figure 2. Strategic and Programme Objective.

2.5. Culture and Management System

It is a difficult part of any organization to be captured in Q4M framework. Even though based on database comprising of situation, decisions and precedence, a enterprise decision support system can be implemented. Research qualification reward, ethical policy, environmental policy, quality policy and other high level policies would be developed. In NED University, a comprehensive Quality Management System has been implemented (Tufail *et al.*, 2006), (Tufail *et al.*, 2006). It is an integrated management system managed and updated through different portals, which are linked together to form a University-wide ERP system.

2.6. Web Apps

Different web apps are developed at NED University, to integrate different processes and procedure together. These apps and portals are used to collect and disseminate information to the stakeholders, such as; Faculty Portal, Student Portal, Employees Portal, Chairperson Portal, Deans Portal, VC Portal, Registrar Portal, Directorate of Finance Portal, Procurement Cell Portal, Directorate of Projects and Planning Portal, Undergraduate Programme Portal, Post-Graduate Programme Portal, Admissions Portal, Rapid Notifier etc. Specialized dashboard for the monitoring and control of the NED UET functions are also accessible to the leadership of the university, such as; Vice Chancellor, Pro-Vice Chancellor, Deans and Chairperson/Head of the supporting departments. All portals are integrated to generate consolidated reports and information and are accessible to the leadership of the university. Integrated ERP system of the university comprises of these all portal, MIS system, database and other IT infrastructure. Fig. 3 shows the illustration of the integrated ERP system.

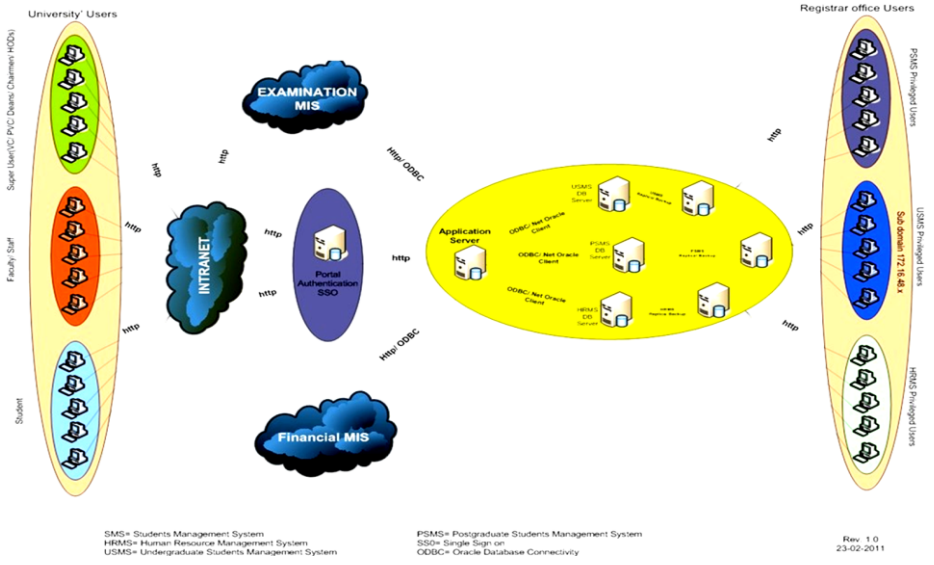

*Figure **3**. Integrated MIS System of NED University.*

2.7. Data and Analytics

To assess the effectiveness of strategic and departmental objectives, data for the KPIs are analyzed periodically. Data is periodically collected from all the academic and supporting departments. Online forms have been developed for each department and division. Although data is gathered in all stages of the Q4A framework, but all the data is accumulated to convert into the Key Performance Indicators (KPIs). Any of the KPI below the benchmark may be intimated to the leadership of the university through the online management system.

2.8. Q4A Integration System

This framework is largely depends upon the database generated through the compliance data, competency data, which are used to developed the vision and mission of the HEIs. Components of the vision and mission will used to develop strategic objectives and programme educational objectives of the academic departments. Based on the objectives, organizational culture and management processes can devised to meet the objectives. These objective would be measured through the KPIs for which data would be gathered through the web apps and portal from different stakeholders of the university. It is proposed in the Q4A framework that in case of lower KPIs than the benchmark, the SWOT analysis may be reviewed, based on the KPIs inflation, programme educational objectives and strategic objective can be reviewed for further benchmark. Based on attainment of strategic and programme educational objectives, vision and mission of the university may also be reviewed. This integrated Q4A framework may be implemented with intensive MIS systems which will be integrated together to form a comprehensive ERP system.

4. Challenges

In implementing the Quality 4.0 Assurance (Q4A) Framework, there are several challenges to be overcome. These challenges are mainly related to the culture, skills, infrastructure and compliance to the regulatory body. The main issue in implementing Q4A is the culture, that is stakeholders are not habitual of submitting data related to their profile in their respective portal. This is due to the complicated relational databases, which sometimes requires detailed information in their MIS portals. Although the stakeholders are also trained for the use of portals but major IT and database related skills are still needed. Due to lack of which, stakeholders are unable to realize the importance of the data and its refinement to be input in the system. NED University is shifted towards the Smart University having an integrated communication system which seems to be a strong infrastructure, but due to the lack of awareness about the IT tools, the effective communication is still a challenge to the HEI. Sometimes, compliance of regulatory bodies also difficult since the consolidated reports generated through the system are difficult to modify according to their need. Sometime, it becomes quite difficult to prepare reports and publications in the form of stakeholder

requirement due to unavailability of data. These the few challenges which need to be addressed for the effective use of Quality 4.0 Assurance Framework.

5. Conclusion

A Quality 4.0 Assurance (Q4A) Framework has been presented in the research which comprises of several components complying with the requirement of Quality 4.0 axes [20]. This work presents an integrated Q4A system which has been partially implemented at the NED University, whereas, the university is trying to completely implement the framework. It has been observed that the implementation of this framework improved the KPIs of the HEI. It also positively affected the culture and management system of the university resulted in the improved skill of employees, faculty and students in using ERP system, conversion of traditional university to smart university, dashboards for monitoring and control the processes and having consolidated reports and publications. It is recommended that implementing the Q4A framework with full spirit will result in an effective and efficient HEI competing in the global environment.

The main limitation of the proposed work is that the effectiveness of the framework is to be measured, which is only possible by implementing the complete framework in the higher education institution.

References

Bhutto, M.A., Shaikh, A.A. & Wasif, M. (2017) Impact of Quality Enhancement Practices, *1st International Conference on Quality Assurance at Higher Education*, December 18-19, 2017, Khyber Medical University, Peshawar, Pakistan.

Bhutto, M.A., Shaikh, A.A., Wasif, M. & Riazuddin. (2019) Implementing Quality Assurance in Universities/HEIs by Ensuring and Promoting Stakeholders' Trust, *INQAAHE 15th Biennial Conference 2019*, March 25-28, 2019, Colombo - Sri Lanka.

Ciolacu, M., Tehrani, A. F., Beer R. & Popp. H. (2017) Education 4.0 — Fostering student's performance with machine learning methods. *IEEE 23rd International Symposium for Design and Technology in Electronic Packaging (SIITME)*, Constanta: 438-443.

Fumasoli, T. & Lepori. (2011) Patterns of strategies in Swiss higher education institutions, B. *Higher Education*, 61, 157-178. doi: 10.1007/s10734-010-9330-x

Garrison, D. R. & Kanuka. H. (2004) Blended learning: Uncovering its transformative potential in higher education. *The internet and Higher Education*, 7(2), 95-105.

Gopal, K., Kanji, K., Malek, A. & Tambi, A. B. (1999) Total quality management in UK higher education institutions, *Total Quality Management*, 10:1, 129-153, doi: 10.1080/0954412998126

ISO 9001:2015 Quality Management System – Requirements (2015) 5th ed. *ISO Central Secretariat*, Geneva, Switzerland.

Juran, *Quality 4.0: The Future of Quality?*, https://www.juran.com/blog/quality-4-0-the-future-of-quality/, June 15, 2019.

Puncreobutr, V. (2016) St. Theresa Journal of Humanities and Social Sciences, *St. Theresa Journal of Humanities and Social Sciences* 2(2), pp. 92-97.

Rudzki, R.E.J. (1995) The application of a strategic management model to the internationalization of higher education institutions. *Higher Education,* 29, 421-441. doi: 10.1007/BF01383961

Shaikh, A.A., Wasif, M. & Riazuddin. (2019) Excellence in Quality Education through Implementation of Strategic Framework and SMART KPIS in Higher Education Institute, *Proceedings of 174th ISERD International Conference*, 16th -17th October 2019, New York, USA.

Shaikh, A. A., Wasif, M. Bhutto, M.A. & Riazuddin. (2019) Risk based approach and Smart KPIs for the Quality Assurance in Higher Education Institutions, *2nd International Conference on Quality Assurance at Higher Education – PNQAHE*, April 23-25, 2019, University of Education, Lahore.

Stock, T. & Seliger. G. (2016) Opportunities of Sustainable Manufacturing in Industry 4.0, *Procedia CIRP*, 40, 536-541. doi: 10.1016/j.procir.2016.01.129.

Teichler U. (2004) The Changing Debate on Internationalization of Higher Education. *Higher Education*, 48, 5-26, 2004.

Tufail, M. & Lodi, S. H. (2006) ISO 9001 Certification for Higher Educational Institutions in Pakistan, *1st International Conference on Assessing Quality in Higher Education (1st ICAQHE, 2006)*, 11th -13th December, 2006, Lahore, Pakistan.

Tufail, M. & Lodi, S. H. (2008) Implementation of Quality Standard in Educational Institutions, *International Seminar on Higher Education in the Muslim World: Challenges and Prospects*, 24th – 25th March, 2008, Kuala Lumpur, Malaysia.

Wasif, M., Shaikh, A. A., Lodi, S. H., Bhutto, M. A. & Riazuddin. (2018) Implementation of Risk Management System to Improve the Quality of Higher Education Institutes, *ICHE 2018 : 20th International Conference on Higher Education*, June 25-26, Paris, France.

Wittayasin, S. (2018) Education Challenges to Thailand 4.0. *International Journal of Integrated Education and Development*, 2(2), 29-35.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14388

External assessors' reports – do they provide valid and useful information?

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Abstract

The engagement of external assessors or examiners is one of the approaches which may contribute to overall quality assurance in institutions of higher learning .

Aims: The aim of the present study was to determine the quality of the reports received following an onsite visit, utilizing a purposefully designed template, and identify any significant shortcomings.

Results: Only 90% of the expected reports were ever received, with 66% of reports being received unacceptably late. Just over 18% were deemed to be of excellent quality, while 32% were classified as being below average or poor demonstrating questionable academic professional responsibility of certain examiners.

Keywords: *External assessor/examiner; reports; quality assurance; University of Malta.*

1. Introduction

Ensuring quality assurance in higher education is a necessary element in the maintenance of standards, enhancing validity, enabling mutual recognition of qualifications across institutions and develop quality culture within institutions (INQAAHE, 2016). The engagement of external assessors or examiners is one of the approaches which may contribute to external quality assurance of the academic process and enable comparability between the host university and other reputable institutions of higher learning (QAA. 2012).

The system of external examiners has received a fair share of criticism, (HEFCE. 2009; QAA, 2009). Medland (2015) has questioned the assessment literacy of external examiners and has suggested ways how the identified gaps can be addressed. Bloxham and Price (2013) make a strong case that while in principle the system appears to deliver, these is a lack of strong evidence that it is a valid system which fulfils its function effectively. Despite all the flaws identified, the external assessor system, still remains a key contributor in maintaining and monitoring academic standards (Universities UK, 2011). It is therefore essential to identify any shortcomings that the system may present and seek ways to address them to strengthen the process.

The research conducted for this paper focuses on the leading university in the Mediterranean island state of Malta, however, it is applicable to wherever external assessors are employed to contribute to the quality assurance process of the university. At the University of Malta (UM), external examiners have, for many decades, been an integral and statutory part of the examination system at all degree levels. This paper relates to the first cycle and second cycle degree courses of university studies., External examiners are required to draw a formal free text report within a month of their visit to the University and forward it directly to the Office of the Rector (UM 2011; UM 2019a). In line with European Guidelines (ENQA 2015), the suggestions made in the report are reviewed and taken into account when revising the current structures and procedures to improve standards.

Our literature search did not identify an objective method by which to assess external examiners reports'. Our aim was therefore, to devise an objective method to assess these reports in order to determine their quality and use it to verify the academic standards, both of examination processes as well as the structure and content of degree programmes.

2. Methods

The quality of the external assessors' reports were assessed by two independent evaluators with long-standing experience in teaching and academic administration: AC1 and AC2. The evaluation of the reports was based on a set of criteria which were assigned a numerical value

and used as a uniform template. The reports were assessed evenly, irrespective of subject or academic discipline.

2.1. Template Development

A specific template was developed based on review of the relevant literature and analysis of reports submitted to the University over the two previous academic years. All reports received by the Visiting Lectures and External Examiners Committee (VLEEC), through the Office of the Rector for the academic years 2015-2016 and 2016-2017 were evaluated in detail by AC1. Each report reviewed was assigned a unique identifier code based on date of receipt, which ensured serial order and provided anonymization of reports.

AC1 assessed the reports by systematically comparing their contents with the brief provided to external visiting examiners together with their letter of appointment (UM 2019b). Based on this review, an initial scoring range constructed on five categories was devised, with 1 being poor/useless, 2 below average/basic, 3 average, 4 above average and 5 very good. A report of the work conducted outlining the methodology used and the template obtained was submitted for scrutiny and eventual approval by the Senate of the University of Malta, the highest body governing academic matters at the Institution. Following discussion and feedback, Senate endorsed the template for assessment of external examiners' reports. The scale used for measurement was then piloted on reports received by visiting external examiners for the academic year 2017- 2018 to ensure applicability. Following the piloting exercise the scale underwent minor revisions which resulted in the template used in the present study- University of Malta External Visiting Examiners Assessment Report Template-UMEVEART (Table 1).

2.2 Assessment of Reports

All reports received by VLEEC for the academic year 2018-2019 were independently reviewed in detail by two assessors; AC1 and AC2. Each reviewed the anonymised reports independently and assigned the scores in accordance with UMEVEART (Table 1) which, together with demographic factors were analysed using statistical software providing descriptive statistics and Spearman correlation coefficient based on the two sets of independently obtained scores. The individual scores assigned by each assessor were discussed during a consensus meeting. A difference in score of 1 point was taken to be minor, while a difference in score of more than 1 point was discussed and a score agreed upon following a joint second review of the report in question. Spearman correlation coefficient was calculated once again following the consensus scores.

Table 1 UMEVEART score and interpretation

Score	Interpretation
5	Excellent
	Analysis and insights detailed Excellently structured and written Extensive in scope Comprehensive Detailed analysis of students' performance Comments on students opinions Detailed recommendations of a practical nature Accurate appraisal of local milieu
4	Above average/ Very good
	Covers all angles of assessment process without going in detail Useful comparisons with other institutions and standards Provides general recommendations Shows insight Demonstrates a passable understanding of the local context
3	Average/good
	Provides the basic requirement and minimum acceptable standard as an expert report Describes standards achieved by students Provides a basic description of the examination process Lists strengths of the process with some comments Lists weaknesses of the process with some comments
2	Basic /below average
	Report of a 'routine' nature Lists facts with little comment No significant comparisons such as between students or with other institutions Any comments provided are deemed unhelpful Poor assessment of the local situation Generally lacks insight
1	Useless/poor
	Very rudimentary narrative No significantly meaningful comments Lacks structure No useful recommendations Contradictory Poor grammar and syntax A 'cut and paste' report

3. Results

A total of 106 external examiner reports were received from an expected 118. During the first two months following the external examiners visit, only 36 reports were received, a further 45 were received within four months whilst 25, trickled in over the last two months of the calendar year. The majority of reports (n=70), were received from external examiners based in the UK, another 33 were from examiners based in EU member states, with 6 originating from Ireland and 5 from Italy. Only 3 reports originated from non-EU countries (Iceland, Ukraine and the USA). Nearly three fourths of the reports, n=68, were drawn up by male external examiners.

3.1. Report Scores

The pre-consensus and post-consensus scores assigned to the reports by the individual assessors were only minimally different. Most reports were of an average quality. Post consensus scores indicate that between 23% and 32% of reports were below average, while 32% were above average. Assessors AC1 and AC2 assigned identical scores in 69 cases. A difference of 1 was recorded in 32 cases and it was only in 5 instances where the difference in score was 2. The Spearman Correlation Coefficient for the pre-consensus scores of the two sets of grades was 0.849, ($p=< 0.01$), while with regard to post-consensus scores, this was 0.902, ($p= <0.01$).

4. Discussion

In the absence of an objective method available to identify the quality of the reports, it was deemed necessary to develop a template and apply it to the reports that were received by the University as an exercise in audit in its own right. The initial step was to establish the necessary criteria against which to assess and grade the report. It is important to clarify that the assessment was a qualitative exercise and the scores assigned do not denote a mathematical approach to assessment. The template used to analyse the reports provided consistent results with a very strong correlation between two independent assessors ($rs= 0.902$, $n=106$, $P<0.001$). Variation in scoring was minimal, mainly denoting one scorer's tendency to grade slightly lower down the scale, however on discussion, consensus was easily reached. Utilizing criteria developed by the European Union (Eurostat, 2014) to support the production of good quality reports, the template demonstrates the ability to provide results which are coherent, comparable and of significance across the diverse Faculties, and disciplines. The outputs from the template are clear, understandable and are very convenient in terms of interpretation. Most importantly, it has provided the University with an objective standard method/framework for assessing the quality of the external visiting examiner's reports, which in turn is an indicator of their individual usefulness to the quality improvement process of the University. The UM has deliberately opted not to provide a standard template

for examiners to fill in, as there is a tendency for the filling of a pro forma to foster a 'tick box' approach, providing very limited insight. Some Heads of Department, took it upon themselves to produce particular templates for the examiners to fill in and submit as a report. When completed template pro formas were assessed, using UMEVART, several of these reports were found to be lacking in detail or substance. While predesigned templates did provide space for free text to be included in addition to tick boxes, in most cases, comments consisted of a sentence or two of text, which proved to be of limited value.

A number of shortcomings were identified through the use of the template. Some of the issues identified were related to questionable academic professional responsibility on the part of the examiner. The academic ethic defined by Dill (2005) as 'social controls and norms that set standards for academic conduct and influence of professional choices' of a number of examiners left much to be desired.

The timely submission of external examiners' reports was found to be problematic since only 38% of the reports were received within an acceptable timeframe, and furthermore 10% of reports were never received. The absence of these reports presents limitations to the overall quality assurance mechanisms that are available to the Institution as a body, and in particular to individual leaders of academic entities, course coordinators and administrative staff. The majority of visiting examiners (66%) were affiliated with UK universities, an indicator of Malta's generally and the UM in particular, historically close relationship with the UK. The language of instruction at the UM is to a very large extent English, while the medium used for administrative purposes is exclusively English.

Women external examiners were in the minority with only 36% of reports being submitted by women. This is reflective of the gender gap in academia, especially evident in senior academic positions. (EUI, 2018) It also demonstrates a lack of sufficient awareness of gender mainstreaming at the UM.

The reports forwarded by the appointed external examiners were of variable quality, and this in turn impacted on the value of the reports themselves to the host university. The level of quality itself was random and the source of the reports could not be stratified by any useful attribute such as subject areas, theoretical components or assessments of a practical nature. In a small number of instances the report sent by particular external examiners was deemed unacceptable in terms of quality as the purported reports consisted of a few bland sentences. In such instances the respective Head of Department was requested to contact the external examiner to rectify the issue. In all the instances, revised improved reports were forwarded and it is these latter versions that were included in the present study.

At the top end of the spectrum of quality, the reports were expertly drafted and addressed all crucial aspects. Very often they afforded penetrating insights into the strengths and weaknesses of the systems they assessed and subsequently offered useful and realistic advice

aimed at improving both the learning experience of UM students, as well as the soundness of their assessment. A total of 18% of reports were deemed to be of excellent quality and a further 13-14% being very good. However, most of the reports received were of average quality, with the provision of very basic information; while tendering some degree of feedback, they lacked depth and were mostly descriptive in nature. On the other hand, the reports of a poor quality were indicative of either incompetence at this particular task assigned, to carelessness, or to a combination of both. Just over 23% of the reports were deemed to be of 'Below Average' or 'Poor' quality. Although this is an improvement over the previous academic year (26%), it is still a matter of concern. The reports of quite a number of external examiners did not sensibly address basic and essential elements of an academic assessment process. This is problematic as it fails to contribute to the University's quality assessment and quality improvement programme. External examiners providing poor reports would have failed the University in its quest to maintain standards. As a corollary, allocation of funds for poor or useless reports may be considered a waste of the University's limited resources. Kerr (1994) indicated that an external examiner's task is one that requires significant commitment but delivers little compensation. He commented on the decline in academic ethic and the rise of a 'new academic' culture which seeks to do less. The findings of this study support this theory and the results are somewhat unpleasant as predicted by Dill (2005).

This study has some limitations. The template was designed with the requirement of the University of Malta and may not be directly applicable to all other universities. However, with some slight modifications and validation to fit different circumstances it may be applied in other settings of higher learning. The results derive from one university, the numbers reported are low, but this is a national university of a small island state. The data represents all the reports received in one academic year, rather than a random sample. It therefore affords clear insight into the issues which need addressing.

5. Conclusion

Being cognizant of its responsibility of producing future leaders and professionals, the University is working on shifting the curve towards a higher quality reports to strengthen its quality improvement process. The problem areas identified therefore need to addressed with sensitivity but firmly. In selecting external examiners, a structured system could be set up whereby the selection is dependent upon a set of agreed criteria and includes gender mainstreaming. This could possibly help overcome issues such as appointing external examiners on the basis of personal relationships, whereby the examiners would find it difficult to criticize a programme or an assessment process run by a close or former colleague. It could also help address the current gender imbalance. While the external examiner system has the potential to strengthen the University's quality assurance ethos, it needs to be

effective in delivering useful robust feedback. Overall, the current system related to external assessors needs to be reviewed and updated. A revised system should be able to address most of the shortcomings identified in this study, primarily the quality of reports submitted as well as their timeliness. Future research could examine the quality of reports both over a number of years as well as discipline-specific in the aftermath of necessary interventions to ensure that the system being employed is effective, valid and reliable.

References

Bloxham, S and Price, ME. (2013). External examiners fit for purpose. *Studies in Higher Education,* 40(2)195-210.Coates, H. (2010).

Defining and monitoring academic standards in Australian higher education. *Higher Education Management and Policy,* 22(1), 41-58.

Dill D.D. (2005). *The degradation of academic ethic: Teaching, research and self-regulation. In: Reshaping the University: New relationships between teaching scholarship and teaching.* (R. Barnette Eds) McGraw-Hill/Open University Press.

ENQA. (2015). *Standards and Guidelines for Quality assurance in the European Higher Education Area (ESG).* Retrieved from: https://www.enqa.eu/wp-content/uploads/2015/11/ESG_2015.pdf

European University Institute (EUI), 2017, *The gender gap in academia*. Retrieved from: https://www.eui.eu/ProgrammesAndFellowships/AcademicCareersObservatory/CareerComparisons/GenderComparisons.

Eurostat, 2014*, European Statistical System(ESS) handbook for quality reports*. Retrieved from: https://ec.europa.eu/eurostat/web/ess/-/the-ess-handbook-for-quality-reports-2014-edition.

HEFCE. (2009). *Report of the sub-committee for Teaching, Quality, and the Student Experience HEFCE's statutory responsibility for quality assurance.* Bristol: HEFCE (2009/40).

INQAAHE. (2016). *International Network for Quality Assurance in Higher Education Annual Report 2016*. Retrieved from https://www.inqaahe.org/sites/default/files/2016_AnnualReport.pdf

Kerr, C. (1994) *Knowledge Ethics and the New Academic Culture*. *Change*, *26*(1), 8-15.

Medland, E. (2015). Examining the assessment literacy of external examiners. *London Review of Education*, 13(3), 21-33.

QAA. (2009). *Thematic enquiries into concerns about academic standards in higher education in England.* Gloucester: QAA.

QAA.(2012). *UK Quality Code for Higher Education.* Retrieved from: http://www.qaa.ac.uk/AssuringStandardsAndQuality/quality-code/Pages/default.aspx
Universities UK. (2011). *Review of external examining arrangements in universities and colleges in the UK. Final report and recommendations*. Retrieved from: https://www.universitiesuk.ac.uk/policy-and-analysis/reports/Documents/2011/review-of-external-examining-arrangements.pdf.

University of Malta (UM) 2011. *Policy on External Examiners*. Retrieved from: https://www.um.edu.mt/registrar/secure/misc/Policy-on-External-Examiners.pdf.

University of Malta (UM) 2019b, Information for visiting/non visiting external examiners for undergraduate and post graduate degrees. Internal document. Office of the Academic Registrar, University of Malta.

University of Malta (UM), 2019a, *Visiting and non-visiting external examiners*. Retrieved from: https://www.um.edu.mt/newspoint/notices/um/2019/02/visitingstaffandnon-visitingexternalexaminers2019-0.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14049

A Critical Reflection Framework Developing Teachers' Growth Competence

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Abstract

Although there are a variety of perspectives and conceptualizations by different researchers of what it means to reflect critically on teaching (Poblete, 1999), there is an agreement that critical reflection entails a higher, more complicated level that challenges the educator (Lucas, 2012). This paper is discusses critical reflection frameworks available in the literature and suggestes a new framework that can capture a complete picture of what critical reflection entails. The framework has five levels of reflection; reacting, recalling, realizing, reconsidering, and reflecting. Those levels stimulate accessing teachers' thoughts and feelings, taking them through a thought and action process that helps them discover; what is happening, why what is happening is happening, how it can change, and ensures continuity of this process. The framework forms a reflective spiral of self-construction of learning that transforms the teacher's behavior and leads to growth competence.

Keywords: *Critical reflection frameworks; Professional development; Reflection; Reflective practice; Teacher education; Teachers' growth competence.*

1. Introduction

In literature, different terms for critical reflection were used. "The terms reflection, critical reflection, reflective practice, reflective thinking, and reflexivity have similar meanings and application in educational literature, as well as, used interchangeably" (Lucas, 2012, p.1). The concept of critical reflection is a form of continuous thought followed by action transforming teachers' behavior. Lucas (2012) saw that the most crucial feature of critical reflection is its ability to conceptualize the experience and lead to transforming learning. The term transformative learning refers to the "ability to revise the meaning structures" (Moon, 2005, P.96).) Conceptualization through the constructivist model of knowing is; "humans developing (forming and reforming) their constructed concepts, and processing their meaning construction" (Badie, 2016, p.293).

2. Literature Review

A wide variety of techniques and approaches are used in practicing critical reflection ranging from informal discussions to a highly structured format (Lucas, 2012). Each framework focused on specific features of reflection, dividing them into levels. Surbeck, Han, and Mover (1991) framework reflective levels were; reacting, elaborating, and contemplating. Lee (2005) levels were; recall, realization, and reflectivity. Larrivee (2008) levels were; surface reflection, pedagogical reflection, and critical reflection. Hatton and Smith (1995) levels were; descriptive writing, descriptive reflection, dialogue reflection, and critical reflection. O'Dowell, Reeve, and Smith (2011) levels were; recall, analysis, and reflection. Korhtagen & Vasalos (2005) levels were; environment, behavior, competence, beliefs, professional identity, and mission. Miller (2011) levels were; reacting, elaborating, and reconstructing.Table (1) and the discussion that follows compare/contrast the key features of different frameworks of critical reflection:

Elaborating on details was the only aspect that all frameworks approached except Korhtagen and Vasalos (2005). Each framework had a different perspective when seeing the details of the experience. Surbeck, Han, and Mover (1991), Larrivee (2008), and Miller (2011) understood the event by relating and comparing it to pedagogical theories. In Lee (2005), O'Dowell, Reeve, and Smith (2011), and Hatton and Smith (1995) frameworks, it was recalling the experience by describing it. Reacting to the experience using 'feelings' was approached only by Surbeck, Han, and Mover (1991), and Miller (2011) as an emotional trigger to bring to consciousness any personal concerns.

According to Lucas (2012), critical reflection is identified by two aspects; first, not accepting the situation at face value but looking 'deeper' to see the influences on the situation, and second the ability to examine the 'broader' the bigger picture and see the situation more holistically by considering the context. Surbeck, Han, and Mover (1991) and Miller (2011)

Table 1. Summary of Key Features of Different Frameworks of Critical Reflection

Researches / Reflective aspect	Surbeck, Han, and Mover (1991)	Miller (2011)	Larrivee (2008)	Lee (2005)	Hatton and Smith (1995)	O'Dowell, Reeve, and Smith (2011)	Korhtagen and Vasalos (2005)
Attending to emotions	✓	✓					
Elaborating Details	✓	✓	✓	✓	✓	✓	
Reasoning (*depth)*				✓	✓	✓	✓
Considering the Context *(breadth)*			✓	✓	✓	✓	✓
Considering pedagogical identity, and mission (*core reflection)*							✓
Considering Pedagogical Theories	✓	✓	✓				
Building conclusions and insights	✓	✓					
Identifying Future plans		✓				✓	

frameworks approached neither the depth of the experience by considering reasons nor the breadth of the experience by considering the broader context. Larrivee (2008) considered the context by examining ethical, social ,and political issues, but it did not consider the depth of the experience.

Although Lee (2005), Hatton and Smith (1995), and O'Dowell, Reeve, and Smith (2011) frameworks considered both the depth and the breadth of the experience, they all missed out on most aspects of what others considered critical reflection--attending to emotions, considering pedagogical theories, building conclusions and insights and identifying future plans, as aspects of critical reflection. Building conclusions and insights, and identifying future plans are two essential aspects of reflection (El Fiki, 2012). Very few frameworks attended to those two aspects. Surbeck, Han, and Mover (1991), and Miller (2011) were the only frameworks that had drawing conclusions and insights as a reflective level. O'Dowell, Reeve and Smith (2011) and Miller (2011) were the only frameworks that gave a chance for the teacher to identify future plans.

Korhtagen and Vasalos (2005) took a different perspective in exploring levels of refection focusing on the teacher. Although their framework introduced novel ideas, it did not clearly approach; elicit feelings and experience, build conclusions and insights, or identify future plans.

3. The Suggested Spiral Critical Reflection Framework Developing Growth Competence

The above discussion of critical reflection frameworks available in the literature showed that each approached critical reflection differently, but none of them was able to capture a complete picture of what critical reflection could entail. Besides, none of the critical reflection frameworks considered 'taking action' as part of reaching critical reflection. Reflection can not be critical unless it ends with taking action and reflecting again. The criticality of reflection increases by repeating the cycle of reflection (EL Souefi, 2021). Kolb, 1984; Wallace, 1991; Korhtagen and Vasalos, 2005; Pollard, 2014; El Fiki, 2012, saw reflection as a spiral, ending by taking action and then reflecting again.

The definition of critical reflection adopted here is the reflection that leads to a transformation of behavior (Moon, 2005) and develops growth competence (Korhtagen and Vasalos, 2005), i.e., taking reflective action is a result of critical reflection. To reach this end, critical reflection has to have a discrete eye exploring the experience from different aspects;

- what is happening
- why what is happening is happening
- how do the teacher's feelings and actions contribute to those reasons
- how the context is contributing to those reasons
- how it can change, and why
- In addition, it ensures that reflection is continuous by taking action and building on discoveries from past reflections guaranteeing self-construction of learning that transforms the teacher's behavior.

Accordingly, the following is a suggested critical reflection framework. The framework has five levels of reflection; reacting, recalling, realizing, reconsidering, and reflecting. Each level deals with significant aspects of reflection in literature; this is illustrated in Table (2) and the discussion that follows:

Table 2. Suggested critical reflection framework with significant aspects for each level

Level	Description of the level	Significant aspects of reflection extracted from literature
Reacting	Attending to emotions and feelings	- Emotions and Cognitions - Cognition and Consciousness
Recalling	Describing the situation in detail	- Expressing ideas and Consciousness - Elaborating Details
Realizing	Interpreting reasoning of personal judgments. Analyzing and promoting dialogue with oneself and others	- Analyzing and evaluating ideas - Considering contextual factors and power issues
Reconstructing	Building insights, drawing conclusions and planning the next steps	- Conceptualization of the experience - Planning Action
Reflecting	Linking experiences to support transformation and personal growth	- Reflection is Spiral - Reflective Thinking-on-action and Reflective Thinking-in-action

3.1. Reacting

The first level explores personal emotions and feelings, which facilitates approaching cognition and consciousness. Miller (2011) argued that to think critically about reflection, we have to start by reacting to the experience by describing feelings related to an event.

- ***Emotions and Cognitions***

According to Immordino-Yang and Damasio (2007), emotions direct aspects of cognition like; learning, attention, memory, motivation, high reason and rational thinking, and social functioning. “Emotions help to direct our reasoning into the sector of knowledge that is relevant to the current situation” (Immordino-Yang and Damasio, 2007, p.8).

- ***Cognition and Consciousness***

Immordino-Yang and Damasio (2007) linked emotion, cognition, and consciousness. The researchers argued that emotions move aspects of cognition that bring the experience to consciousness. Emotional triggers create changes in the body and mind that leads to focusing of attention, calling up relevant memories, and learning the associations between events and their outcomes. Reacting to the experience allows teachers to comment on their feelings bringing to consciousness any personal concerns (Surbeck, Han and Move, 1991); Korhtagen and Vasalos’, 2005).

3.2. Recalling

Components of consciousness operate mainly through the linguistic medium (Bandura, 2006). What the teachers raised to the consciousness is activated when it is expressed, whether verbally or non-verbally.

- ***Expressing ideas and Consciousness***

Our understanding is activated and clarified when we go into a conversation talking about the experience (Connel, 2014). The conversation can act as a theory-building activity when we search for and organize meaning.When teachers articulate their ideas to others, it helps form an open critical perspective (Solomon, 1987).

- ***Elaborating Details***

When expressing ideas, teachers' amount of details gives a good foundation for critical reflection (Korhtagen and Vasalos, 2005). Lee (2005) first level of reflection recalled the experience, describing it without alternatives. Surbeck, Han and Mover (1991) second level of reflection elaborates on the experience, comparing it to a general principle or criteria. Hatton, and Smith (1995) identified the first level as descriptive writing, describing the situation with no discussion beyond description. O'Dowell, Reeve, and Smith (2011) first level was recalled, where teachers remember what happened in the class without looking at alternative explanations. Korhtagen and Vasalos (2005) encouraged description of the experience through questions.

3.3. Realizing

The third level starts to consider influences that made what happened to happen. In this level, the teacher interprets the reasons behind personal judgment and feelings expressed in the reacting level. This dialogue with oneself or others analyses the experience and starts realizing a 'deeper' consideration of the event. Thinking of reasons also can approach some contextual issues that 'broaden' the reflection into new areas.

- ***Analyzing and evaluating ideas***

McKnight (2002) referred to reflection as " an analysis of classroom events and circumstances. By virtue of its complexity, the task of teaching requires constant and continual classroom observation, evaluation, and subsequent action" (p. 1). Most critical reflection frameworks focus on analyzing and evaluating ideas as a vital framework component. Lee's (2005) second level of reflection is realization, where the teachers interpret the reasons behind the situation, and come up with generalizations from the experience. Hatton and Smith's (1995) third level is dialogue reflection, encouraging teachers to 'step back' and analyze the experience. O'Dowell, Reeve, and Smith's (2011) third level is analyses; search for the 'whys' and look for relations between pieces of the classroom experience. Korhtagen and Vasalos (2005) gave weight to analyzing the reasons behind actions by digging deeper into complicated factors. Larrivee (2008) argued that levels of reflection add 'depth' to the second level by considering the rationale behind the incident.

- ***Considering contextual factors and power issues***

For Lucas (2012), one of the critical reflection aspects is to examining the 'broader' picture and seeing the situation more holistically by considering the context. Teachers make their decisions based on complex, practically-oriented, personalized, and context-sensitive networks of knowledge, thoughts, and beliefs (Borg, 2003). Some of the critical reflection frameworks considered contextual factors. Larrivee's (2008) third level of reflection examines ethical, social, and political issues. For Hatton and Smith (1995), critical reflection was an awareness of the multiple (historical, socio-political contexts) influences on actions and events. O'Dowell, Reeve and Smith (2011) second level of reflection was going 'broader' considering the context. Lee (2005) third level framework analyzes the experience from different perspectives with the intention to change.

3.4. Reconstructing

The fourth level is drawing insights and building conclusions by conceptualizing the experience and planning for future actions. This level is crucial in the framework when the experience is conceptualized and ready for application. Dewey (1933) noted that growth comes from a "reconstruction of experience" (p. 87), leading to the reconstruction of approaches to teaching.

- ***Conceptualization of the experience***

Reflection requires cognitive processing of conceptualizing teaching practice, resulting in conceptual development and, consequently, professional renewal (Burton, 2009). The role of reflective practice is to help teachers make sense of meaning and conceptualize the experience (Harvey et al., 2012). Surbeck, Han, and Mover (1991) third level of the critical reflective framework was; contemplating; this is when they start building their own insights. Larrivee's (2008) second level of the critical reflective framework was; pedagogical reflection: considering the theory and rationale for current practice. Miller (2011) third level of the critical reflective framework was; reconstructing: drawing conclusions about one's practices and the practices of others exploring the relationships between practice, literature and theory.

- ***Planning Action***

For teachers to reconstruct their practice, they need to contextualize the experience after conceptualizing it by planning to take action and test the experience in context. When learning is activated in the person's socio-cultural community, transformative learning happens with critical reflection on this activation in context (Webster-Wright, 2009). Planning for action was part of some critical reflection frameworks and reflective models. Lee's (2005) third level of the framework was the reflectivity level: analyzing the experience from different perspectives with the intention of changing. The third level of Miller's (2011)

framework was planning further learning based on reflections. Korhtagen and Vasalos's (2005) model fifth stage was creating alternative methods of action and trial.

3.5. Reflecting

The last level of the critical reflection framework ensures that reflection is continuously linking different reflections that lead to transformation and personal growth. Moon (2005) and Korhtagen and Vasalos (2005) marked this stage as leading to a change of behavior and developing growth competence. For this to happen, the reflection process is to be spiral; being repeated, and reflective thinking on action encourages reflective thinking in action.

- ***Taking Action/Reflection is Spiral***

Reflective action completes the cycle of professional action that follows reflection. Consequently, it leads to modified practice (Hatton and Smith, 1999). Pollard (2014) believed that a fundemental characteristic of reflective practice is not just 'Cyclic' but 'spiral' in which teachers constantly monitor, evaluate and revise their practices. Wallace's (1991) model for teachers' professional learning took the theory to practice approach, by providing teachers with received knowledge and examining those theories in everyday practice.

- ***Reflective Thinking-in-action***

The process of reflection is an extended process of being systematically and constantly aware of the circumstances of teaching and the implications of issues arising during teaching (Burton, 2009). Schon (1983) supported this idea by seeing reflection-in-action occurring inside the classroom while teaching, leading to teachers changing their practice.

4. Conclusion

For reflection to be used for authentic continuous professional learning, it has to help teachers conceptualize their practice and apply it as a basis for further learning. The study introduces a new reflective framework of five levels; reflection, reacting, recalling, realizing, reconsidering, and reflecting, ensuring a deep and complete reconstruction of the teachers' practices leading to their growth competence.

References

Badie, F. (2016). Towards Concept Understanding Relying on Conceptualisation in Constructivist Learning. *Center for Linguistics, Aalborg University.*

Burton, J. (2009). Reflective Practice. In A. Burns and J. C. Richards (Eds.), *The Cambridge guide to second language teacher education* (298–308*)*. Cambridge, England: Cambridge University Press.

Borg, S. (2003). Teacher Cognition in Language Teaching: A Review of Research on What

Language Teachers Think, Know, Believe, and Do. *Language Teaching, 36 (2).* 81-109.Connell, M.T. (2014). Recovering the Social Dimentions of Reflection. Catholic Education: *A Journal of Inquiry and practice, 17 (2)*.

Dewey, J. (1933). How we Think: A Restatement of the Relation of Reflective Thinking to the Educative Process. Boston, New York: Heath.

El-Fiki, H. (2012). Teaching English as a Foreign Language and Using English as a Medium of Instruction in Egypt: Teachers' Perception of Teaching Approaches and Sources of Chance.(Doctoral dissertation), Toronto, Canada.

EL Souefi, N. (2021). Realization of Effective Reflective Practices in Teacher Professional Development in International Schools in Egypt. (Doctoral dissertation) University of Leicester, UK.

Harvey, M., Baker, M., Bosanquet, A., Coulson, D., Semple, A., Warren, V., (2012). Moving Beyond the Diary: Innovation in Design and Delivery of Reflection. *Australian Collaborative Education Network*.

Hatton, N., Smith, D. (1995). Reflection in Teacher Education: Towards Definition and Implementation. The University of Sydney: School of Teaching and Curriculum Studies.

Immordino-Yang, M.and Damasio, A. (2007). We Feel, Therefore We Learn: The Relevance of Affective and Social Neuroscience to Education. *International Mind, Brain, and Education Society and Blackwell Publishing, Inc.*

Kolb, D. A. (1984). Experiential Learning: Experiences as the Source of Learning and Development. *Englewood Cliffs*, NJ: Prentice Hall.

Korhtagen and Vasalos (2005). Levels in Reflection: Core Reflection as a Means to Enhance Professional Growth. *Teachers and Teaching: theory and practice, Vol. 11, No. 1,* 47–71.

Larrivee, B., (2008). Development of a Tool to Assess Teachers' Level of Reflective Practice. *Reflective practice, 9: 3*, 341-360.

Lucas, P. (2012). Critical Reflection: What do we Really Mean? Paper presented at the *Australian Collaborative Education Network (ACEN) National Conference*, Australia.McKnight, D. (2002). Field Experience Handbook: A Guide for the Teacher Intern and Mentor Teacher. College Park: University of Maryland.

Miller, M. (2011). Critical Reflections. *Gowrie Australia. Issue 45*

Moon, J. (2005). A Handbook of Reflective and Experiential Learning: Theory and Practice. Routledge.

O'Dowell, M., Reeve, J., and Smith, J. (2011). Educational Psychology: Reflection for Action. John Wiley and Sons, Inc.

Poblete, J. (1999). Communicating Christian Values Through Teaching English as a Second Language: The Use of Poetry. Institute for Christian Teaching.

Pollard, A. (2014). Reflective Teaching in Schools. Bloombery, London.Schon, D.A. (1983). The Reflective Practitioner: How Professionals Think in Action. *New York: Basic Books.*

Solomon, J. (1987). New Thoughts on Teacher Education. *Oxford Review of Education, 13(3),* 267-74.

Surbeck, E., Han, E., and Mover, J. (1991). Assessing Reflective Response in Journals. *Association for Supervision and Curriculum Development.*

Wallace, M. (1991). Training Foreign Language Teachers. New York, NY: Cambridge University Press.

Webster-Wright, A. (2009). Reframing Professional Development through Understanding Authentic Professional Learning. University of Queensland.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14861

Postgraduate Supervision Practices in low regulated University System in Côte d'Ivoire

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Abstract

Postgraduate supervision is paramount to empower the next generation of researchers. However, time spent to graduation and knowledge gain are of great concern regarding the completion of postgraduate studies. In most African universities, the main cause is the lack of guidelines to frame student-supervisors' relationship and their responsibilities. Study aims to analyse how supervision practices in health research in Côte d'Ivoire hinder or promote timely degree completion.

Drawing on a qualitative methodology, semi-structured interviews were conducted with 32 postgraduate students and 17 supervisors. We purposively selected informants in health research based at public universities in Côte d'Ivoire. Results revealed two models with different supervisors' styles, poorly standardised guidelines, and student's coping strategies in the context of low regulation. We conclude that the absence of formal documents and clear regulations for student's/supervisor's roles, as well as the lack of monitoring system by the administration are factors that delay postgraduate study completion.

Keywords: *Postgraduate supervision; Practices; Models; Regulation; Guideline; Côte d'Ivoire.*

1. Introduction

The University as an institution has within its system different elements which are interrelated, organised, and governed by regulations. A university is defined by Andoh, (2017) as an institution of higher learning, a place where people's minds are trained for rational and independent thinking, and for problem solving at higher levels. In Africa, teaching and advancing knowledge through research are key functions of universities through postgraduate training programmes. Thus, postgraduate supervision is paramount to empower researchers and lecturers skills, and beyond. Most of the literature on postgraduate studies describes supervision as a process of learning and teaching which enables both students and supervisors to produce new knowledge (Anderson et al., 2018; Chugh, Macht, & Harreveld, 2021; Noel, Wambua, & Ssentamu, 2021; Rugut, 2017). Supervisors thus play a critical role in the learning process of research at masters' and doctoral level as students depend greatly on their supervisors for research support, and consequently for graduation (Owusu, 2018). Moreover, Azure, (2016) demonstrated that the quality of postgraduate programme depends not only on the supervision methodology but also other elements such as the research environment, which can include policies, infrastructures, funding, library facilities, computing, office space, conferences, travels, and fieldwork just to name few.

The supervision practices reflect the models, approaches, and styles in the relationship between the supervisor and student. There is currently an ongoing debate regarding supervision models, approaches, and styles. Ngulube, (2021) outlined that Phillips and Pugh (1994) make no distinction between supervision styles and approaches, but Lee (2012) considers supervision models as approaches. Whilst for Mouton (2001), styles or approaches are interchangeable and can determine the roles that the supervisor assumes in relation to the supervisee. He identified styles as those of adviser, pastor, quality controller, expert guide, coach, and broker. Within the debate on models there is no generic accepted definition of styles, approaches, and models. However, for the purpose of the current study, the supervisory style is defined as the principles, behaviours, attitudes and reactions that govern the supervisor and student relationship in research (Boehe, 2014; Bøgelund, 2015). Also, in this article, sole, co-supervision and group supervision are indicators of supervision models as revealed by Amehoe & Botha, 2013 and Bitzer & Albertyn, 2011. Based on the aforementioned debate, the supervisory relationship is considered as the heart of postgraduate research training (Hemer, 2012). A certain number of elements are highlighted for a successful postgraduate supervision such as: effective and good supervision, pedagogy of supervision, supervisory feedback, selecting or allocating and matching students with supervisors, supervisors'-students' roles within the context of the relationship, the level of postgraduate students' satisfaction, different models of supervision and styles of supervisors in supervisory practices (Abiddin, 2007; P. Ali, Watson, & Dhingra, 2016; Azure, 2016; Chugh et al., 2021; Hemer, 2012; Noel et al., 2021). Despite the above mentioned knowledge

produced on postgraduate supervision, the completion of master and doctoral studies is of great concern regarding time spent to graduation and the limited project resources and relation to the project timeline. There is need to assess supervisory practices which are undertheorised and poorly understood (Ngulube, 2021) and to provide further research on how completion rate from four to seven years (4-6 years more in Ghana (Akparep, Jengre, & Amoah, 2017), 6.19 years in Ethiopia (Fetene & Tamrat, 2021) can be improved. In the case of poor or unclear recorded procedures to guide postgraduate supervision, supervisors tend to develop their own rules and styles. Although there exists a wealth of literature on postgraduate studies, the supervision practices in relation to their impact on postgraduate completion have not yet been investigated in african francophone universities such as those of Côte d'Ivoire.

1.1. Theoretital framework

The conceptual framework underpinning this research resulted from Crozier and Friedberg's theory of "Actors and Systems". The concepts drawn on herein are the concrete system of action, regulation, actor, power, and strategy mobilised in the frameworks of the postgraduate supervision relationship. We considered university as concrete system where all actors are interrelated and their actions are governed by regulations and various management policies. However, it was observed that a weak system of regulations existed in relation to the practices of supervision and to the relations between the students, lecturers, and administration staff in the public university system in Côte d'Ivoire. Moreover, this field of supervision, is a field of power and negotiation where the strategy mobilised by stakeholders relied on their interests, expectations, motivations and behaviours towards them.

2. Methods

The study was conducted from July 2019 to June 2021, in three public universities in Côte d'Ivoire: Université Félix Houphouët-Boigny, Université Nangui Abrogoua and Université Peleforo Gon Coulibaly. We purposively selected faculties in which the postgraduate programme is related to human, animal, and environmental/vegetal health. We then identified and mapped the relevant stakeholders within the context of these three Ivorian universities. They include: full time masters and PhDs students and their supervisors. Prior to the survey, the authorisation was obtained from the vice chancelor of each university faculty, and consent was sought from all participants. The ethical clearance was obtained from the Comité National d'Ethique des Sciences de la Vie et de la Santé of Côte d'Ivoire who approved the study with reference number N/Ref : 132-21/MSHPCMU/CNESVS-km.

As research on supervision practices in higher education in Côte d'Ivoire are still scarce, we used an explorative methodology for which qualitative methods were most suitable. An interview guide was developed considering informants and their supervision experience.

Semi-structured interviews were conducted to collect data from 32 postgraduate students enrolled between 2015 to 2019. Selection criteria for students were as follows: (i) second year of master or PhD student irrespective of stage in the programme; (ii) registered in a running programme or already graduated; (iii) being in sole supervision or co-supervision. Of the supervisors (n=17) recruited within this study, five were deans. All supervisors were directly involved in student affairs by handling general thesis of their respective students. Data collected comprised the research objectives: (i) models and styles of supervision; (ii) the governance system of supervision and (iii) the strategies used by students in their process completing their respective degree programme to graduation. Based on the interview guide, postgraduate students were asked to describe the supervision they received, their knowledge about supervision text and rules and their resilience to overcome supervision relationship challenges. Supervisors were asked to express themselves regarding supervision relationship practice. Information was collected in notebooks and with a tape recorder to ensure accuracy. Data were analyzed using content analysis through NVivo 12 software (from QSR International) and presented thematically to reflect the objectives of the study.

3. Results

3.1 Models of supervision and Supervisors' styles: A mix of formal and informal models

This study revealed two supervision models: 1) the delegation of supervision work to a colleague or assistant and 2) co-supervision. We observed that the styles of supervision were shaped by the attitudes, behaviours, and roles of supervisors in supervisory practices. The styles were the way supervisors intervened and the different roles they played in the relationship. Moreover, within the two models, we distinguished styles of supervision linked to the supervisor's personality. The delegated supervision was close to sole or one-one model of supervision and is an informal supervision relationship where the main supervisor delegated the main activities to his/her teaching assistant (in general a PhD holder and former supervisee who benefited from the same assistance). The co-supervision model was a form of collaborative support to the student through interaction between two supervisors with similar or different background and/or grade in supervising students.

Out of 32 students, 18 pointed out that their supervisors had a "style of delegation". In this model, before any work was sent/given to the main supervisor, the student works first with his/her peers or with a laboratory technician and then with the assistant's supervisor. The assistant validates the work in first instance and transfers it to the main supervisor. The students also reported two keys qualities of the assistant : availability and swift feedback. One of the students said: "*Every time I sent the work to my main supervisor, I would first see a Postdoc who was his own PhD student and then he arranged the work before it went to my supervisor*". **(Female PhD student, animal health).** Another student, expressed his

experience with: "*When the Postdoc/Assistant who is also laboratory technician sees that the document is ready, he sends it to the main supervisor. Once it arrives at his level, the main supervisor will examine what was done and give his approval with the signature on the document before the defense*". **(Male Msc student, human health)**. This was also echoed in comments by one supervisor: "*I assign them to my assistant who monitors them in the laboratory. Students first show the results to him. In each meeting session, both the assistant and student present the results to me and explain them*". **(Female supervisor, Associate Professor**, **human health)**.

Another supervision style found was the "expert guide" in which the supervisor did not deal with any private or social/family-related issues of his/her students. Herein the professional relationship is seen as privileged over the personal. Students also mentioned supervisors' styles as involving quality control, document editing and mentorship. These were illustrated respectively by the following statements: "*Sometimes my supervisor rephrases the content in order to help us understand better. He even makes suggestions for us to reformulate objectives or hypotheses. For the interview guides, he guided me when things were not going smoothly*". **(Female Msc student, human health)**. "*She (my supervisor) helps to organize the work. For thesis when the final document is supposed to come out, she passes the documents among her students to edit them. She makes us read our documents page after page. She takes the time to check our work, corrects it, guides us so that we don't make mistakes"*. **(Male PhD student, human health).** *She is truly human. She encourages us, prays for us and finances our experiments. We don't pay anything for our scientific publications, she pays. Each of her students has at least two or three publications. She finds that students don't have money so she helps. She also puts her office at our disposal, an environment to work in.* **(Male PhD student, human health).** To emphasize this comment a supervisor also pointed out: *"The supervisor is rigourous with students in a way so as to build scientific rationale in their works, but at the same time he has to be paternalist. Every year I used to buy computers for students just to boost their work.* **(Male Supervisor, Associate Lecturer, human health)** From our findings, within all the supervisor' styles were the different attitudes and roles played towards their students' behaviour in the relationship.

3.2 Lack of pratical or standardised supervision guidelines

The selected universities had policies for their gouvernance overall. They also had a handbook comprising a charter and a procedure manual for faculties/departments. However, in practice it was reported by the majority of students that these handbooks which should describe the framework for thesis and research work, and requirements for the programme were hardly known by them at the point of their admission registration. Findings showed that there was no explicit or comprhensive guidelines for postgraduates when compared to undergraduate programmes. The postgraduate programmes are less regulated and less institutionalized. Supervisors were asked about the existing documents on supervision, which

they used to guide their supervision role. All the supervisors relied on the rule of limiting supervision ratio 4PhD & 5Msc students/supervisor, the regulations text regarding tasks allocated to supervisors which dealt mainly with the grade/rank of lecturers (A =full Professor or Associate Professor, B= Associate Lecturer) who are able to supervise students research work and documents from the new academic reform known as Licence-Master-Doctorat (LMD). The following two excerpts from supervisors illustrated their general perception : *"There are no texts or guidelines to say how to supervise doesn't mean you can't teach. We are lecturers, so we know how to teach. We have our plan, our methods but there is nothing defined that we have to build on. There is nothing that says the lecturer has to do this or that and the student has to do this or that".* **(Female supervisor, Associate Professor, Human health).** "*I know that we have rules and procedures for teaching and doing research, but we don't have rules and procedures for supervising students. However there is a ministerial decree that says how the Master or PhD (thesis defence) juries are composed, but how the relationship between the supervisor and the student must be, is miningful*". **(Male Supervisor, Associate Lecturer, Human health)**

Furthermore, our results revealed that the different roles played by supervisors were not documented in any guideline document. However, supervisors developed their own methods and shaped their supervisory relationship according to students' capacity and behaviours. Moreover, we observed that this lack of guidelines was linked to the lack of administration's monitoring of student progress (quality, timing). This aspect was illustrated by two supervisors: "*In our institution, at the same time as the professor is asked to follow the student to completion (Master 2 years and PhD in 3 years), there is no clause to force the professor to follow the student. There is no rule that says what to do and what not to do*". **(Male Supervisor, Professor, environmental health). "***A text that serves as a guide, perhaps existed before but there's no written document that tells us how we should supervise. Former deans and presidents of the university have never mentioned them. Even if it exists, it needs to be updated and if it is implemented, it can help students with completion*". (**Female supervisor, Associate Professor, human health**).

Since both supervisor and student were not made aware of the existance of texts regarding expectations and guidelines related their roles and there is no monitoring of the process. This can lead certain people taking advantage to extend student's programme beyond the expected timeframe. This influence the completion: "*On paper it's 3 years for the PhD completion. But in our faculty there are some students who take up to 6 years for completion. The average completion of my PhD students is 4 years*". **(Female Dean, Professor, human health).**

Students also were asked about the existing document on supervision and reported that they did not receive any document regarding the different roles of actors within postgraduate studies at the registration or at enrolement.*"If this charter exists, it should be at the level of the scientific council. We are not aware of it. In all the documents that I know of, there is no*

mention of supervision but rather the laws governing university life. What we know is that students are assigned to a supervisor. I don't think I've seen a text that talks about the rights and obligations in supervision. We know that there are texts on the remuneration of lecturers but not about their obligations. In any case I am not aware of any". **(Male PhD student, human health)**. However, students highlighted the existence of thesis writing charter in some faculties instead of handbook for postgraduate supervision. "*Each department has a written charter. So according to this charter guidelines, we write our thesis".***(Female Msc, Animal health).**

3.3 Students'coping strategies in the context of poor regulation and poor awareness

The observed supervision style within the context of this study is a 'top-down'-power relation between supervisor and supervisee since the supervisor is the main individual responsible for the student and their research project within the academia arena. In this power relationship, the students expectations were not always met. Each actor developped his/her own strategy regarding their interests and resources to overcome challenges since the roles' were not clearly stated or defined. The unknown responsabilities of both student-supervisor impacted negatively the supervision process, as it was found to delays in feedback, related to thesupervisor's attitude and busy schedule due to their teaching, administrative and other engagements. This is illustrated by a student and a supervisor respectively; "*We don't have any meeting scheduled and when I have some issues, I emailed him but he replied always late maybe because of his position as director. He is too busy and this delayed my defense*". (**Male Msc, Animal health**). **"***With my administrative obligations, I refer the work to my assistant who is both in the field with the students and in the lab. My assistant gives me an update on the progress*". (**Male Dean, Environnemental health**)

It was indicated that 29 out of 32 students became more autonomous, proactive, worked with peers to fill gaps from irregular meetings, delays in feedback, and insufficient laboratory equipment. They were not passive knowledge recipients, but rather developed their own capacities to become reflexive researcher. The following extracted illustrate the situation:*"I think that the student should not expect too much from the professor. There are some supervisors who don't like that, they like proactive, innovative students who provide new ideas".* **(Female PhD student, animal health)**. Another student described a system of solidarity among peers as strategy: *"We helped each other. There were three of us and if one of us couldn't do a specific work, the other students came to help. We didn't have the same topic but we worked in the department on the same animal species, with the same equipment, which made us go into the field together".* **(Female Msc student, animal health)**

4. Discussion

Results were based on interviews and aimed at providing information on models and supervisory styles, impact of the absence of supervision guidelines and strategies used by students in this context of low regulation. As the empirical data show, the practices of supervision relationship in the Ivorian university system have become more idiosyncratic. In the absence of clear recorded procedures to guide postgraduate supervision, supervisors tend to develop their own rules and styles.

One of the key functions of any university is to educate and equip postgraduate students with research skills (J. Ali, Ullah, & Sanauddin, 2019). These skills can be built in interpersonal relationship between supervisor and supervisee in the academic and research environement. Our findings showed two supervision models: delegation and co-supervision. It appears that in delagation model the main supervisor was not always available but trusted their assistant because he had already trained them. In each model there were different supervisor's styles such as delegated, quality control editing, and mentorship styles in relation to the student's profile. This finding is supported by previous studies by (Mouton, 2007; Ngulube, 2021).

Results also showed that, there was a lack of defined text regarding the practice of supervision on the roles of each actors in the relationship. The findings of this study are similar to the literature of some anglophone african universities, as supervision guidelines lack clear information. Cekiso, Tshotsho, Masha, & Saziwa, (2019) suggested that the clarification of roles and responsibilities for both the postgraduate student and the supervisor were important so that both parties were held accountable. For this reason Ali et al., (2016) quoted that a clear understanding roles of the supervisor-student was paramount to building a healthy and productive supervisory relationship for successful completion of the degree. Nevertheless, in the anglophone african universities that have supervision guidelines there still exists a lack information on how the relationship should be. Moreover, Masek, (2017) confirmed that there was no prescriptive guideline that establishes mutual expectations of supervisor and student in order to develop a "working" relationship. As a result, both parties do not experience the expected level of supervision. In the context where actors roles were not clearly identified, the postgraduate students developed also their own ways of coping and strategies for the completion of their studies . Their coping strategies were the reaction and effort made to minimize or tolerate some challenges to get their degree certificate. This is in concert with findings of Asogwa, Wombo, & Ugwuoke, (2014) in agricultural education. Evidence from the study showed that the absence of guidelines and clear regulations on supervisory roles, and of administration' monitoring were factors that delay postgraduate completion.

5. Conclusion

The postgraduate student-supervisor relationship is critical for the scientific quality, the individual capacity building, mutual learning and timely degree completion rate of students. The aim of this study was to explore the postgraduate supervision practices in relation to the timely completion of the thesis and associated defence. There are two types of supervision relationship models: delegated supervision and the co-supervision. In each model, the quality control and editing style was appreciated by the students. It was observed that many students do not often complete their thesis on time (up to 6 years for PhD and 3 years for Master) due to the workload of supervisors, lateness of feedback and lack of clear responsibilities of system stakeholders.

References

Abiddin, N. Z. (2007). Postgraduate Students and Their Supervisors' Perception on Effective Supervisor: A Case Study at One Public University in Malaysia.

Akparep, J. Y., Jengre, E., & Amoah, D. A. (2017). Demystifying the blame game in the delays of graduation of research students in Universities in Ghana: The case of University for Development Studies. European Journal of Business and Innovation Research, 5(1), 34–50.

Ali, J., Ullah, H., & Sanauddin, N. (2019). Postgraduate Research Supervision: Exploring the Lived Experience of Pakistani Postgraduate Students. FWU Journal of Social Sciences, 13(1).

Ali, P., Watson, R., & Dhingra, K. (2016). Postgraduate Research Students' and their Supervisors' Attitudes towards Supervision. International Journal of Doctoral Studies, 11, 227–241. https://doi.org/10.28945/3541

Amehoe, C. K., & Botha, R. J. (2013). Postgraduate Throughput at the University of Ghana. University of South Africa.

Anderson, M., Mitchell, B., Northcote, M., Williams, A., Petrie, K., de Waal, K., … Lemke, G. (2018). The Construction of a Postgraduate Student and Supervisor Support Framework: Using Stakeholder Voices to Promote Effective Postgraduate Teaching and Learning Practice. Journal of University Teaching and Learning Practice, 15(2), 6.

Andoh, H. F. (2017). The uptake of doctoral thesis research in Ghana. 340.

Asogwa, V. C., Wombo, A. D., & Ugwuoke, C. U. (2014). Challenges and Coping Strategies Adopted by Postgraduate Students of Agricultural Education in Thesis Writing in Nigerian Universities. American Journal of Operations Research, 2014. https://doi.org/10.4236/ajor.2014.45030

Azure, J. (2016). Students' perspective of effective supervision of graduate programme in Ghana. American Journal O0f Educational Research, 4(2), 163.

Bitzer, E. M., & Albertyn, R. M. (2011). Alternative approaches to postgraduate supervision: A planning tool to facilitate supervisory processes. South African Journal of Higher Education, 25(5), 875–888. https://doi.org/10.10520/EJC37725

Boehe, D. M. (2014). Supervisory styles: A contingency framework. Studies in Higher Education, 41(3), 399–414. https://doi.org/10.1080/03075079.2014.927853

Bøgelund, P. (2015). How supervisors perceive PhD supervision: And how they practice it'. International Journal of Doctoral Studies, 10, 39–55.

Cekiso, M., Tshotsho, B., Masha, R., & Saziwa, T. (2019). Supervision experiences of postgraduate research students at one South African higher education institution. South African Journal of Higher Education, 33, 8–25. https://doi.org/10.20853/33-3-2913

Chugh, R., Macht, S., & Harreveld, B. (2021). Supervisory feedback to postgraduate research students: A literature review. Assessment & Evaluation in Higher Education, 1–15.

De Gruchy, J. W., & Holness, L. (2007). The emerging researcher: Nurturing passion, developing skills, producing output. Juta and Company Ltd.

Fetene, G. T., & Tamrat, W. (2021). The PhD journey at Addis Ababa University: Study delays, causes, and coping mechanisms. International Journal of Doctoral Studies. https://doi.org/10.28945/4744

Hemer, S. R. (2012). Informality, power and relationships in postgraduate supervision: Supervising PhD candidates over coffee. Higher Education Research & Development, 31(6), 827–839.

Masek, A. (2017). Establishing supervisor-students' relationships through mutual expectation: A study from supervisors' point of view. https://doi.org/doi:10.1088/1757-899X/226/1/012200

Mouton, J. (2007). Post-graduate studies in South Africa: Myths, misconceptions and challenges. South African Journal of Higher Education, 21(8), 1078–1090.

Ngulube, P. (2021). Postgraduate Supervision Practices In Education Research And The Creation Of Opportunities For Knowledge Sharing. Problems of Education in the 21st Century, 79(2), 255–272.

Noel, J., Wambua, B. K., & Ssentamu, P. N. (2021). Invest in Research Supervision, Enhance Timely Completion of Postgraduate studies. RMC Journal of Social Sciences and Humanities, 2(1), 35–47.

Owusu, A. A. (2018). Undergraduate Economics Students' Opinion about Research Supervisors: The Ghanaian Public University Context. Advances in Social Sciences Research Journal, 5(7).

Rugut, C. K. (2017). The nature of postgraduate student-supervisor relationship in the completion of doctoral studies in education: An exploration in two African universities. 208.

Van Rensburg, G. H., Mayers, P., & Roets, L. (2016). Supervision of post-graduate students in higher education. Trends in Nursing, 3(1).

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14455

Simulation as part of programmatic assessment to create an authentic learning experience

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Abstract:

Instructionism and experiential learning are the predominant teaching models in undergraduate obstetrics. Challenges such as larger classes, and limited training sites and trainers renders this model inadequate. Simulation provides a safe, authentic environment to facilitate learning. In this action-research-action-learning project undergraduate medical students in their final obstetrics rotation participated in common obstetric scenario simulations. Participants perception of simulation cycles on their learning was assessed.

Twenty students who participated felt that simulation provided a suitable adjunct to the current experiential learning model. Simulation highlighted knowledge-gaps, and also supported theory-practice integration in a logical, sequential manner, applicable in a real-world setting. Simulation provided a safe environment for self-reflection, and cooperative learning, whilst improving knowledge, and developing clinical skills and graduate attributes. Simulation should be incorporated into routine teaching as an adjunct to experiential learning in the clinical attachment in the latter part of the medical curriculum.

Keywords: *simulation; obstetrics emergencies; student-centered teaching.*

1. Introduction

Sustainable Development Goals 3 and 5 (United Nations: Department of Economic and Social Affairs, 2019) aims to reduce maternal and perinatal mortality by 2030. South Africa is not on parr in achieving these goals (Moodley & Pattinson, 2018), with suboptimal management of obstetric emergencies being a major contributor to poor outcomes. It is the expectation that newly graduated general medical practitioners (GPs) will be able to manage common obstetric emergencies (Gulmezoglu, et al., 2016).

Our institution's medical curriculum is a student-centered, outcomes-based curriculum. The students develop knowledge, skills and attributes, which they scaffold and apply in authentic situations in order to practice their professional roles. Undergraduate obstetrics training includes a 6-week rotation in 3rd year, followed by a 7-week rotation in the 6th year. The 6th year of medical school is a structured apprenticeship, where approximately 500 6th-year-students alternate through 6 rotations in a year (±80 students per rotation). The students work as part of the clinical team thus affording them an authentic learning experience. Currently the 6th year is self-regulated learning facilitated via protocols, videos, and clinical observation. However, current obstetric clinical skills are inadequately taught and assessed (Adam, Lubbe, & van Rooyen, 2021). This may be attributed to the increased facilitator:student ratio (1:26), congestd teaching sites, or learner attributes (apathy).

Currently obstetric emergencies as a clinical subject, employs a behaviouristic-approach where students learn from what they observe. (David, 2019) It is expected that students will take ownership of their learning, engage with the material, learn deeply, and create their own learning opportunities. (Smith & Foley, 2016) Exposure in the clinical environment aims to facilitate theory-practice integration (HPCSA, 2014) (Shukla & Limaye, 2016). Simulation (experiential learning) mirrors real-life situations and can support clinical learning. It furthers improve student engagement for students from diverse backgrounds. (Siassakos, et al., 2011) (Smith & Foley, 2016) (Satin, 2018)

Graduate medical practitioners are expected to manage basic obstetric emergencies (HPCSA, 2014) (Gulmezoglu, et al., 2016). Whilst experiential learning is a suitable approach to clinical medicine (Smith & Foley, 2016), it does not cater for hands-on learning in obstetric emergencies, the latter being unpredictable and require speed and acumen in their management. In a high-pressure emergency setting medical students do not have the luxury to appraise the circumstances and construct a management plan. Simulation as a teaching approach can fill this gap by exposing students to an emergency in a save environment.

The use of high-fidility simulators has gained widespread popularity amongst many medical specialties for training, especially in the pre-clinical years. (Siassakos, et al., 2011) (Satin, 2018) However, they can be costly and thus unattainable for institutions in low-middle income settings. We tested medium-fidelity simulation (Ntlokonkulu, Rala, & Ter Goon,

2018) as part of assessment as and for learning in the management of obstetric emergencies. The purpose was to encourage learning and foster co-operative learning. We explored student satisfaction with the use of medium-fidelity simulation to facilitating learning in obstetrics.

2. Research Question

In student-centered medical education the focus is on students' needs and patient safety. In this study we investigated whether the simulation of common obstetric scenarios, including emergencies, fosters co-operative learning. We also explored the role of self-reflection via review of recordings and peer-reflection with the aid of checklists.

3.Research Design

The design is collaborative action-learning-action-research (ALAR), which includes planned action for improvement (Zuber-Skerritt, 2001), complemented by a multi-methods study. A subject matter expert (SME) compiled clinical simulation scenarios based on expected core clinical competencies (HPCSA, 2014). The simulations were facilitated with the aid of the MamaNatalie Birthing Simulator (Laerdal Medical ®). The simulations were video-recorded, and assessed by means of checklists and memoranda. Teamwork were assessed by students (self and peer-evaluation) and the facilitator. The post-simulation debriefing discussions were also audio-recorded and analysed. Students completed a post-simulation questionnaire assessing their experience and perceived knowledge and confidence gained from the experience. Four ALAR cycles (Figure 1) were conducted during this study.

The Institution's Research Ethics Committee (Protocol 164/2019) approved the study. All students in the current Obstetrics and Gynaecology 6th year rotation (±80 students) were invited to participate in the study. Participation was voluntary and informed consent was obtained prior to the study.

3.1. Data Analysis

Recordings were transcribed, and the investigators immersed themselves in the data to identify potential codes and themes. Facilitators and investigators also kept reflective journals. The investigators engaged in debriefing and triangulation to generate initial codes. Qualitative data was thematicaly analysed, using AtlasTi. Further triangulation and searching for theme connections occurred prior to reviewing and reaching consensus on the themes. Rigour and trustworthiness of the data was ensured by recording (audio-visual) and documentation. Descriptive statistics was used to describe the participants' feedback. Data triangulation was employed to enhance validity.

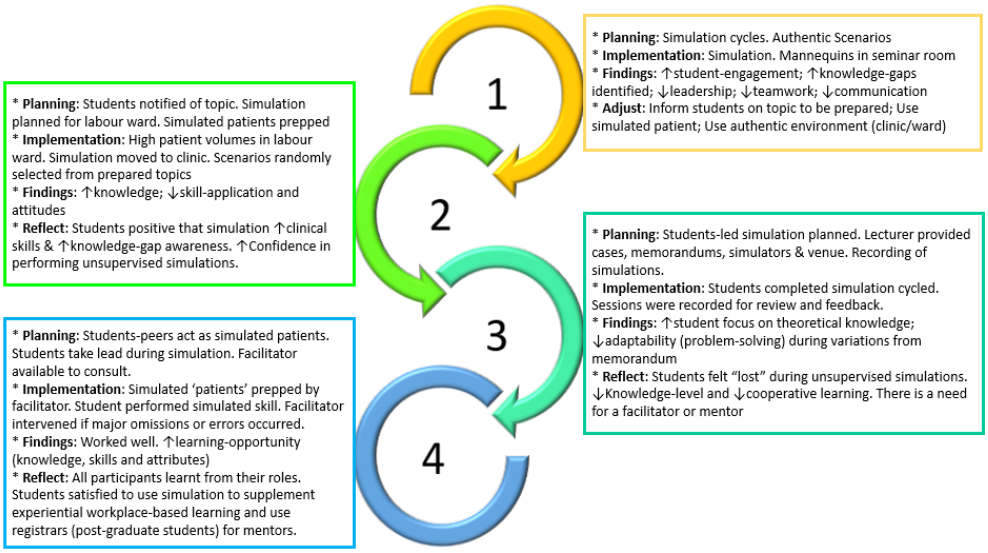

Figure 1: The Collaborative Action Research Process

4. Results

Twenty (25%) of the 80-students invited participated in this ALAR study. Reasons for non-participation included being assigned to a distant hospital, lack of time, busy with gynaecology rotation, and "fear of making a fool of themselves" (Student 5). Students completed a Likert Scale-rated questionnaire pre- and post-simulation (Table 1).

Students experienced the small group tutorials and experiential learning as erratic and sub-standard, as these learning opportunities were dependant on the consultant or registrar that they were assigned to for workplace-based learning rotations. Upon further inquiry, students cited large student groups, high workload demands, and poor definition of learning outcomes and structure of the obstetric rotations as reasons for general student dissatisfaction with the obstetrics learning opportunities. They felt that they "were abused and used as porters and clerks" (Student 3) instead of maximising their experiential learning opportunities. At the start of the study, students felt that more bedside teaching, case-based discussions, and activities that involved critical thinking, and "less time on pulling bloods and putting up drips" (Student 3) would contribute most to improving their satisfaction with the obstetrics rotation. Lack of exposure to holistic patient care seems to be a concern as well "(we) have a lack of exposure because we are outnumbered student to patient ratio especially in management, not in early monitoring so we leave without enough exposure without enough

Table 1: Students perceptions pre- and post-simulation

Question	Pre-simulation (mean, range)	Post-simulation (mean, range)
Rate (1-10) your confidence in manging an obstetric emergency in the labour ward	3 (2-6)	6 (3-8)
How prepared are you to manage the following conditions? (Likert scale 1-5)		
• Abruptio placenta	• 2 (1-3)	• 3 (2-4)
• Eclampsia	• 3 (2-4)	• 3 (2-5)
• Post-partum haemorrhage	• 2 (1-3)	• 3 (2-4)
• Assisted vaginal delivery	• 1 (1-2)	• 1 (1-2)
Rate your perception and emotions during the simulation (Likert scale 1-5)		
• Feeling helpless		• 3 (2-4)
• Control of the simulated situation		• 3 (2-4)
• Ability to recall management protocols		• 3 (2-4)
• Improvement in confidence		• 4 (3-5)
• Improvement in communication skills		• 4 (3-5)
• Positive learning opportunity for obstetrics emergencies		• 4 (4-5)
• Value of feedback following the simulations		• 5 (4-5)
Rate your confidence (Likert scale 1-5)		
• As leader of a team	• 2 (1-3)	• 3 (2-5)
• With communication within a team	• 2 (1-4)	• 4 (2-5)

practice in managing…..focus is more on examining a patient and picking up signs and diagnosing…..that is where it stops and that is a bit problematic" (Student 9)

Analysis of the four ALAR cycles highlighted three themes: "theory-practice integration", "role identification", and "student-centered teaching".

Theory-practise integration: Simulation as a means of facilitating learning scaffolds on the student's prior knowledge. Whilst students were confident about their knowledge, simulation highlighted gaps in knowledge, understanding and application. Student 7 said that "as much as you have the knowledge it is useless if you don't practice and continuously applying it". Simulation integrates knowledge and applies it to an authentic clinical scenario, in preparation for the real world. (Student 7: "(in) emergency situations you don't have time to waste on thinking it just needs to flow and that happens through repetitive practice"). Students felt that simulation was an effective means of learning obstetrics in a safe-to-fail environment (Student 13: "I actually like this because it is a non-judgemental environment so I feel we are able to make mistakes "). It was observed that the students reported

engagement and improved retention of knowledge following application in a simulated environment.

In the medical environment, knowledge needs to be applied and translated into skills in the management of a patient. However, medical students have limited opportunities to practice the essential skills required in an emergency in either the skills laboratory or the work environment. Student 3 expressed that "the problem with students is the approach, we don't have the right approach, we don't have all the steps we should take we have the information but they are all scrambled up", supporting the notion that whilst students knew the theoretical management of patients, they were unable to approach a patient in a given scenario in a logical, sequential manner, nor were they equipped with the necessary skills. Simulation provided a safe environment to "make mistakes that we will repeat" (Student 2), without fear of harming a patient or being judged or humiliated.

Simulation demanded that students "think on the spot" which students felt assisted with examination preparation. Following the summative assessment, participants in this study reported that the simulations were a useful learning opportunity that they would recommend to other students.

Role identification: Graduates are expected to have certain attributes in addition to the core knowledge and skills. These attributes are often neglected and under-developed. Simulation provides an opportunity to develop leadership skills and teamwork. Students were reluctant to assume leadership roles in the simulations (Student 1 "It is difficult for me to take myself out of the role of student into the role of doctor") as they were on par with their colleagues and felt uncomfortable taking charge of the clinical situation. Initially, teams were dysfunctional, with poor communication. Self- and peer-reflection illustrated this deficiency, which was improved upon in subsequent simulations. Participants realised the benefit of cooperative learning which they had previously discounted. The simulated environment provided a safe space for collaboration, team bonding and the formation of study groups.

Student-centred teaching: Students felt that the current obstetrics teaching practice was insufficient and required improvement. They felt that clear learning outcomes and formal synchronous learning opportunities across the training platform were required. (Student 13: "This is good but I wish I could do it with all my knowledge….One thing that this situation does it makes you uncomfortable and that is where students learn"). Students felt that more bedside teaching, and feedback and reflection on experiential learning was required.

The attitude towards simulation was positive. Whist some students were anxious and afraid at the beginning, they realised the benefit of simulation for their learning and "got over the initial insecurity, as we are all in it together… to learn from each other" (Student 11). Participants felt that this was a safe learning environment that facilitated consolidation of their knowledge, skills, and attributes in a logical manner that was applicable to the

workplace. The students expressed that this accommodated their learning preferences, as many "learn by doing rather than by reading or listening" (Student 4). Students found this to be a "fun" learning environment. The major limitation to simulation as a means to facilitate learning is availability of students and facilitators. It was suggested that simulation be incorporated into workplace-based learning, facilitated by the registrars to whom the undergraduate students are assigned.

5. Dicussion

Current medical education is based on transmittal teaching methods and workplace experiential learning (Smith & Foley, 2016) (David, 2019),faced by numerous challenges such as large class sizes, limited training sites and facilitators, large service load, the global pandemic. (Gukas, 2007) (Motala & van Wyk, 2016) The medical educationist is faced with competing interests (clinical work, research, education). Often facilitators of learning are ill prepared for the task and thus it is often difficult to glean support for methods to facilitate learning that do not fall into the transmittal model. Simulation, however has a large body of evidence supporting its positive impact on student achievement in medical education (Kneebone, Weldon, & Bello, 2016) (Smith & Foley, 2016) (Satin, 2018), and in particular obstetrics.

The finding of this study reinforces prior research supporting the ability of simulation as a method to increase student engagement, foster higher levels of learning, increasing student confidence in the clinical scenario, and achieving graduate attributes. Simulation also highlights the importance of indeterminate and opportunistic learning as learners become part of the context and have to make decisions as events unfold. (Hager & Halliday, 2006)

While students in this project did not receive direct instruction in obstetrics, there was theory-practice integration with scaffolding on prior knowledge while exposed to complex, but authentic clinical scenarios. Students who enrolled in the study reported improved attitudes toward novel learning opportunities. Performance on subsequent simulation cycles supports the notion that participants and observers improve their content knowledge, integration and application of knowledge in authentic situations, as well as their attitudes. Certainly if the students find learning opportunities more enjoyable, they will likely be more participative, engaged and thereby improve their performance. Actively engaging students in the simulation learning projects provides students the opportunity to develop skills they may not traditionally have the opportunity to develop (Smith & Foley, 2016). The unpredictability of simulated scenarios allowed students to draw on tacit knowledge, and become attuned to their own values and beliefs in order to make holistic professional judgements and experience indivisualised, often unintended learning. Such adaptability varies amongst students whilst

in the simulation, but is available to those in the observer role, which is unavoidable when there are large student groups. (Kelly, 2016)

Debriefing and feedback following simulations supported effectively analysis and reflection which promotes new awareness of more relevant responses in subsequent clinical encounters. (Kelly, 2016) Participating in simulations, with effective feedback helps students develop contextual content knowledge (Smith & Foley, 2016).

This is an opportunity for students to develop greater capacity to solve problems and think critically, as it provides an opportunity for students to identify a problem that they would likely encounter in the authentic workplace, and then develop and execute a plan to address that problem. Simulation aids helping students move from a predisposition of accepting or never questioning what they see to a position of inquiry and curiosity, through noticing what is occurring in simulation and considering alternative actions and responses.

6. Conclusion

Simulation should be incorporated into routine teaching as an adjunct to experiential learning in the clinical attachment in the medical curriculum for both formative and summative assessments. Simulation laboratories with recording facilities will allow for self-driven learning, self-reflection, and management of large groups with fewer facilitators. Simulation should also be explored as a tool to improve inter-professional care and education.

References

Adam, S., Lubbe, I., & van Rooyen, M. (2021). Do we assess what we set out to teach in obstetrics: An Action Research Study. Afr J Health Professions Educ, 13(2), 118-122. doi:doi.org/10.7196/AJHPE.2021.v13i2.1247

David, L. (2019). "Summaries of Learning Theories and Models," in Learning Theories. Retrieved March 09, 2019, from https://www.learning-theories.com/

Gukas, I. (2007). Global paradigm shift in medical education: issues of concern for Africa. Medical Teacher, 29(9-10), 887-892.

Gulmezoglu, A., Lawrie, T., Hezelgrave, N., Oladapo, O., Souza, J., Gielen, M., & al., e. (2016). Interventions to reduce maternal and child morbidity and mortality. In: Black RE, Temmerman M, Laxminarayan R, Walker N, editors. Reproductive, Maternal, Newborn, and Child Health Disease Control Priorities. (3 ed.). Washington DC, USA: The World Bank, Forthcoming.

Hager, P., & Halliday, J. (2006). Recovering informal learning: wisdom, judgement and community (Vol. 7). Dordrecht: Springer.

HPCSA. (2014). Core competencies for undergraduate students in clinical associate, dentistry and medical teaching and learning programmes in South Africa. Retrieved April, 24, 2022, from

https://www.chs.ukzn.ac.za/Libraries/News_Events/MDB_Core_Competencies_-_ENGLISH_-_FINAL_2014.pdf

Kelly, M, Hopwood, N., Rooney, D., Boud, D. (2016). Enhancing Students' Learning Through Simulation: Dealing With Diverse, Large Cohorts. Clinical Simulation in Nursing. 12. 171-176. 10.1016/j.ecns.2016.01.010.

Kneebone, R., Weldon, S., & Bello, F. (2016). Engaging patients and clinicians through simulation: rebalancing the dynamics of care. Advances in Simulation, 1(19).

MacLeod, A., Kits, O., Whelan, E., Fournier, C., Wilson, K., Power, G., Mann, K., Tummons, J., & Brown, P. A. (2015). Sociomateriality: a theoretical framework for studying distributed medical education. *Academic medicine : journal of the Association of American Medical Colleges*, *90*(11), 1451–1456.

Moodley, J., & Pattinson, R. (2018). Improvements in maternal mortality in South Africa. South African Medical Journal, 108(Supplement 1), S4-S8.

Motala, M., & van Wyk, J. (2016). South African–Cuban Medical Collaboration: students' perceptions of training and perceived competence in clinical skills at a South African institution. South African Family Practice, 58(2), 74-79.

Ntlokonkulu, ZB; Rala, NM; Ter Goon, D. (2018) Medium-fidelity simulation in clinical readiness: a phenomenological study of student midwives concerning teamwork. BMC Nursing, 17:31

Satin, A. J. (2018). Simulation in Obstetrics. Obstetrics and Gynaecology, 132(1), 199-209.

Shukla, S., & Limaye, R. (2016). Graduate Attributes desired for 21st century. Retrieved April 24, 2022, from http://www.srku.edu.in/pdf/3%20%20Graduate%20Attributes%20%20desired%20for%2021st%20century(1).pdf

Siassakos, D., Bristowe, K., Draycott, T., Angouri, J., Hambly, H., Winter, C., Fox, R. (2011). Clinical efficiency in a simulated emergency and relationship to team behaviours: a multisite cross-sectional study. BJOG, 118(5): 596-607.

Smith, M., & Foley, M. (2016).Transforming Clinical Education in Obstetrics and Gynecology: Gone Is the Day of the Sage on the Stage. Obstetrics & Gynecology, 127(4), 763-767.

United Nations: Department of Economic and Social Affairs. (2019). #Envision2030: 17 goals to transform the world for persons with disabilities. Retrieved April 24, 2022, from https://www.un.org/development/desa/disabilities/envision2030.html

Zuber-Skerritt, O. (2001). Action Learning and Action Research: In S. Sankara, B. Dick, & R. Passfield (Eds.), Effective Change Management through Action Research: Paradigm, Praxis and Programs (pp. 1-20). Lismore, Australia: Southern Cross University Press.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14498

Use of Course-based undergraduate research experiences model to enhance research interest of Hong Kong health professional undergraduate students

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Abstract

It has not been easy to recruit postgraduate students from graduates of health professional programmes in Hong Kong. Recent studies show that Course-based undergraduate research experiences (CURE) not only promote students' acquisition of research abilities and collaboration skills, but also changes their career choices and attitude. In this study, we attempted to offer CUREs to students of the Medical Laboratory Science Programme in our institute as extra-curricular activities to arouse their interest in scientific investigations. Students participated in learning research methods and laboratory techniques. They also acquire hands-on research experience. The outcomes were evaluated with the CUREs Survey developed by Prof. David Lopatto of Grinnell College and focus group discussion. Results of the CUREs survey reveal that students obtain positive gains from the CUREs programme with the relevant learning experience. Similar to previous studies, CUREs participants develop content knowledge, confidence, research skills and confirm their interest in pursuing science-research related educational or career paths.

Keywords: *Course-based undergraduate research experiences; health professionals programmes; educational and career paths.*

1. Introduction

Having competent researchers and graduates in health professional training is critical in strengthening the health systems and addressing priority health services. The major challenge in Hong Kong is the succession gap of researchers in various health professional disciplines, e.g. Medical Laboratory Science (MLS), Radiography and other allied health professions. The number of students pursuing postgraduate studies is low. One cannot rule out that an influential factor contributing to the situation comes from the attractive remuneration packages offered by hospitals and medical laboratories. According to an international career platform, the average starting salary for a fresh undergraduate of a health professional programme in Hong Kong almost doubles that of those graduates of all the non-health programmes. The scale is comparable to that offered to a post-doctoral fellow. The situation makes it almost impossible to get our undergraduates persuaded to postgraduate studies.

To nurture talents and encourage academic development, universities are trying different approaches. For example, our institute attempted to offer Summer Undergraduate Research Studentship and implemented an Undergraduate Research and Innovation Scheme to nurture the next generation of innovators by providing early hands-on experience in research. However, in most circumstances, only very few students with high grade-point-averages (GPA) benefited from this short duration of at most two months of close research mentorship via these programs. In addition, this one-on-one research guidance for all undergraduate students appeared impractical.

Recent studies demonstrated that Course-based Undergraduate Research Experiences (CUREs) effectively promote the research interest of undergraduate students by expanding the research element in the undergraduate curriculum and hence improving their attitudes towards scientific careers (Cooper & Brownell, 2018). CUREs is a type of scalable laboratory-learning environment. It works in engaging the whole class of students in a research question or problem of interest to the scientific community (Auchincloss et al., 2014). CUREs offer students opportunities in pursuing discoveries in their interests (Corwin et al., 2018). Mentors support dispelling uncertainties and solving problems (Light, Fegley, & Stamp, 2019). The CUREs model is well accepted in the Western. Universities have developed their respective CUREs in life sciences and chemistry in recent years (Krim et al., 2019; Van Dyke, Gatazka, & Hanania, 2018; Wang, 2017). Nevertheless, CUREs is still new to the curriculum in Hong Kong.

In this study, CUREs model is adopted as after-lecture activities in our courses. The aims of this project were to (1) convey lifelong learning techniques; (2) accentuate the importance of balancing collaborative and individual work; and most importantly (3) through increased chance and duration in research studies, we aim at developing students' scientific literacy skills, proscience attitudes and evidence-based decision-making abilities.

2. Methods

This experimental study is faculty-based. First and second-year students of programmes in Medical Laboratory Sciences or Radiography who did not have previous similar training experience were eligible to participate. Academic performance, such as GPA (Grade point average), was not taken into consideration. In addition, unlike traditional practical sections and final year projects, procedures for investigations were not spelt out for the participants to follow. Rather than following prescribed manuals or procedures set by instructors in laboratory section, participants were asked to set their research questions, design, and implement their investigations. Guidance would be provided in special tutorials on research questions, hypothesis setting, data collection, analysis, interpretation and result communication.

The standard CURE survey designed by Prof. David Lopatto of Grinnell College was adopted for course evaluation. The questions in the pre-course questionnaire investigate participants' learning motives, experiences, attitudes and learning styles. They explicitly but intriguingly indicate the desirable attitude and merits in science learning although students may consider the alternatives. Questions also allow students to understand their capabilities in learning science and the context of the programme. The questionnaire collects feedback from participants on the following areas are: (1) Affective gains, such as increased interest and enjoyment of science; (2) cognitive gains, such as developing science practice skills and learning scientific content; (3) psychosocial gains, such as developing confidence in their ability to do science, increased scientific identity, and improved sense of belonging both at college and within the scientific community; and (4) potential career outcomes, such as clarifying whether they are interested in getting more involved in research or pursuing a research-related career, for better using of CUREs in our courses.

3. Results

Two rounds of CUREs were run as after-class activities in the last academic year. Junior undergraduate students from our department were recruited. During the semester, under teachers' guidance, students work as a team to (1) develop their research hypothesis, (2) design the experiments, (3) repeat and improve the protocols if necessary, (4) analyze the data and (5) finally deduce some meaningful conclusions. The participant background, numbers and topics of CUREs studies are briefly summarized in Table 1.

Table 1. Summary of our Round 1 and 2 CUREs studies

Round # Semester (Year)	Participants (Number)	Controls (Number)	Topic of activity
Round 1 (2020/1)	Year 2 MLS (14)	Rest of classmates (43)	How to setup the COVID-19 tests
Round 2 (2020/1)	Year 1 MLS (7)	Rest of classmates (43)	Accuracy of ovarian cancer tests

Most of the students joined the CUREs out of interest. They wished to pick up some laboratory techniques from the CUREs programme, get a better understanding of science and acquire more hands-on research experience. They all possessed varied experiences on course elements and had been under pre-set structured context with predesigned aims and expected outcomes.

The post-course questionnaire captures the gains and benefits that students considered they have achieved. The key data obtained from CUREs survey from both Round 1 and 2 CUREs students are summarized in Table 2 and 3, respectively.

Table 2. Summary of CUREs survey from our Round 1 study

Gain	No or very small	Small	Moderate	Large	Very large
Understanding of how knowledge is constructed	0	36%	18%	36%	9%
Understanding of how research is constructed	0	36%	18%	36%	9%
Ability to read and understand primary literature	0	0	18%	55%	27%
Ability to integrate theory and practice	0	0	36%	36%	27%
Skill in interpretation of result	0	0	36%	36%	27%
Ability to analyze data and other information	0	0	27%	45%	27%
Becoming part of learning community	0	0	27%	27%	45%
Understanding of how scientists work on real problems	0	27%	36%	18%	18%
Tolerance for obstacles faced	0	0	27%	55%	18%
Self-confidence	0	0	36%	27%	36%
Clarification of career path	0	0	0	64%	27%
Confidence to be a teacher in science	0	0	18%	55%	27%

Remark: n =11, as three participants did not submit their responses. (78.6% response rate)

Table 3. Summary of CUREs survey from our Round 2 study

Gain	No or very small	Small	Moderate	Large	Very large
Understanding of how knowledge is constructed	0	16.7%	16.7%	50%	0
Understanding of how research is constructed	0	0	66.7%	33.3%	16.7%
Ability to read and understand primary literature	0	16.7%	33.3%	50%	0
Ability to integrate theory and practice	0	0	33.3%	50%	16.7%
Skill in interpretation of result	0	0	66.7%	16.7%	16.7%
Ability to analyze data and other information	0	0	33.3%	66.7%	0
Becoming part of learning community	0	0	33.3%	66.7%	0
Understanding of how scientists work on real problems	0	16.7%	33.3%	33.3%	16.7%
Tolerance for obstacles faced	0	0	33.3%	66.7%	16.7%
Self-confidence	0	16.7%	33.3%	33.3%	16.7%
Clarification of career path	0	16.7%	66.7%	16.7%	0
Confidence to be a teacher in science	16.6%	16.7%	33.3%	33.3%	0

Remark: n =6, as one participant did not submit her response. (85.7% response rate)

We also compared their performance in our course based on the continuous assignments, tests and final examinations with their classmates.

Table 4. Summary of the performance of participants and their classmates in our course.

Round	Group	Number	Average GPA
1	Participants	14	3.57
	Non-participants	43	3.30
2	Participants	6	3.39
	Non-participants	43	3.83

The career choice of participants after graduation are summarized in Table 5.

Table 5. The career choice of CUREs participants before and after the CUREs activities

Round	Year of Study	CUREs	Response	Work	Graduate School
1	2	Before	12	10	2
		After	11*	10	1
2	1	Before	7	6	1
		After	6*	6	0

Remark: *One participants in did not response the post-questionnaire.

4. Discussion and Conclusion

To the best of our knowledge, this was the first CUREs study carried out in the universities of Hong Kong. Consistent with previous findings from the universities of Western countries (Beatty, Ballen, Driessen, Schwartz, & Graze, 2021; Connors et al., 2021), CUREs participants agreed that they have moderate to a very large gain in various areas.

(1) Psychosocial gains - the participants agreed that they got confidence in their ability to learn and analyze data from new scientific studies initiated themselves (Table 2-3).
(2) Intellectual gains - the participants also agreed that skills and knowledge in science as reflected by the data from the CUREs survey (Table 2-3). To have a more objective conclusion, we compared their academic results with non-participants; the CUREs participants had better academic performance than those of the non-participants (Table 4). However, here we need to point out that it may be due to selection bias.
(3) Behavioral gains- the CURE survey was anonymous. The drop in the return of the post-course questionnaire makes it premature to conclude if the CUREs programme affects the career choice of participants after graduation. We consider the data recorded in Table 5 as an interim record. Up to the present stage, even though CUREs did not enhance the likelihood of participants going to graduate school in these two cohorts, it is encouraging that the participants agreed of getting a clearer picture of their career paths. They confirmed that the CUREs programme provided a better idea for research studies.

In summary, Year 2 students found more benefits from the CUREs programme than Year 1 students did. However, there were limitations to this study. Firstly, the sample size of this study was small. In addition, the participants all came from the Medical Laboratory Science programme, which might contribute to bias in the study. To have a better picture of the impact of CUREs on the Hong Kong health professional undergraduate students, we will explore the opportunity to carry out a bigger study in collaboration with other departments.

Acknowledgments

This study is supported by the Hong Kong Polytechnique University Teaching Development Grants 2019-22 (SS-HTI).

Ethical approval

This study (HSEARS20200826002) was approved by the institutional review board of the Hong Kong Polytechnique University.

References

Auchincloss, L. C., Laursen, S. L., Branchaw, J. L., Eagan, K., Graham, M., Hanauer, D. I., Lawrie, G., McLinn, C. M., Pelaez, N., Rowland, S., Towns, M., Trautmann, N. M., Varma-Nelson, P., Weston, T. J., and Dolan, E. L. (2014). Assessment of course-based undergraduate research experiences: a meeting report. CBE Life Science Education, 13(1), 29-40. https://doi.org/10.1187/cbe.14-01-0004

Beatty, A. E., Ballen, C. J., Driessen, E. P., Schwartz, T. S., & Graze, R. M. (2021). Addressing the Unique Qualities of Upper-Level Biology Course-based Undergraduate Research Experiences through the Integration of Skill-Building. Integrative and Comparative Biology, 61(3), 981-991. https://doi.org:/10.1093/icb/icab006

Connors, P. K., Lanier, H. C., Erb, L. P., Varner, J., Dizney, L., Flaherty, E. A., Duggan, J.M., Yahnke, C.J., Hanson, J. D. (2021). Connected While Distant: Networking CUREs Across Classrooms to Create Community and Empower Students. Integrative Comparative Biology, 61(3), 934-943. https://doi:10.1093/icb/icab146

Cooper, K. M., & Brownell, S. E. (2018). Developing Course-Based Research Experiences in Discipline-Based Education Research: Lessons Learned and Recommendations. Journal of Microbiology Biology Education, 19(2), 1-6. https://doi.org/10.1128/jmbe.v19i2.1567

Corwin, L. A., Runyon, C. R., Ghanem, E., Sandy, M., Clark, G., Palmer, G. C., Reichler, S., Rodenbusch, S. E.,Dolan, E. L. (2018). Effects of Discovery, Iteration, and Collaboration in Laboratory Courses on Undergraduates' Research Career Intentions Fully Mediated by Student Ownership. CBE Life Sciences Education, 17(2), 1-11 https://doi:10.1187/cbe.17-07-0141

Krim, J. S., Cote, L. E., Schwartz, R. S., Stone, E. M., Cleeves, J. J., Barry, K. J., Burgess, W., Buxner, S. R., Gerton, J. M., Horvath, L., Keller, J. M., Lee, S. C., Locke, S. M., &. Rebar, B. M. (2019). Models and Impacts of Science Research Experiences: A Review of the Literature of CUREs, UREs, and TREs. CBE Life Sciences Education, 18(4), 1–14. https://doi:10.1187/cbe.19-03-0069

Light, C., Fegley, M., & Stamp, N. (2019). Role of Research Educator in sequential course-based undergraduate research experience program. FEMS Microbiology Letters, 366(12), 1-5. https://doi:10.1093/femsle/fnz140

Van Dyke, A. R., Gatazka, D. H., & Hanania, M. M. (2018). Innovations in Undergraduate Chemical Biology Education. ACS Chem Biol, 13(1), 26-35. https://doi:10.1021/acschembio.7b00986

Wang, J. T. H. (2017). Course-based undergraduate research experiences in molecular biosciences-patterns, trends, and faculty support. FEMS Microbiology Letters, 364(15), 1-9. https://doi:10.1093/femsle/fnx157

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14663

Personal narratives about death and dying: a case study with nursing students

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Abstract

This study aimed to qualitatively explore students' meanings of a significant death or dying experience described in the first-person: psycho-emotional and spiritual life reflections. Using a narrative-reflection approach, we performed a multiple case study. Ten nursing students from a 3rd-year palliative nursing course were selected based on the richness of their experiences. Topics such as the timing of the loss, the manner of death, role changes after the loss, and adjustment patterns were discussed. The role of the narrative is clearly multi-faceted – contributing to the development of a student's identity, providing comfort, and helping to make sense of a 'senseless' event.

Keywords: *Narratives; Loss; Nursing students; Self-awareness; Learning strategy.*

1. Introduction

Man's confrontation with finitude is a theme as old as the consciousness of mortality. Death is an inevitable end that seems to be inscribed in the nature of things. No remedy can be used to avoid it, no matter how much scientific and technological advances are applied to solve great problems. Reflecting about death as a stage of life is a way of learning to live with the full knowledge of our human condition and the clear conviction that we are mortal beings, ephemeral and passing. This should be understood as an opportunity to foster dignity and fraternity (Shim, 2020).

In the field of health, professionals deal in their daily lives with health promotion, treatments, rehabilitation, and with the most varied critical situations, constantly facing the duality between life and death (Vázquez-García et al., 2019). Addressing death in any field is not a simple task. Death is seen as a taboo, denied and unaccepted, cloaked in feelings of dread. Each person carries an individual representation of death, influenced by cultural heritage, personal training, social life, the media, and particularities that contribute to its mystification.

Experiencing a death loss is a universal and very idiosyncratic experience for individuals. According to Meleis' theory (cit in Munck et al., 2018), this transitional experience may constitute a crisis requiring a redefinition of roles. This theory relies on self-perception, as individuals must view changes as significant for them to be considered a transition. Thus, the type, context, and impact of the death loss experience are critical aspects of a positive bereavement process (Krychiw, James & Ward-Ciesielski, 2018).

Kovács (2012) points out that health courses have focused more on technical procedures to the detriment of more humanistic education. There is excessive training in domains such as anatomy, dividing the body into parts, and little training in dealing with life or death. Nursing is the profession closest to the patient, facing the course of the disease, its prognosis, and the possibility of death (Kovács, 2012). The same author also notes that nursing education programs offer few opportunities to develop the nurse-patient relationship and discuss the emotions and feelings generated in the daily care of patients and their families (Kovács, 2012).

The sooner students discuss death, the dying processes and human finitude, the more prepared they will be to perform their duties as nurses. According to Araújo and Silva (2012), communication skills are not acquired over time, that is, more experienced professionals will not have greater communication skills if they are not adequately trained for this purpose. Therefore, evaluating what is being taught and what can be complemented in teaching-learning is essential to improve future professionals and their performance in the various practice scenarios (Szczupakowska, et al., 2021).

Nursing care is a complex practice that cannot be thought of reductively, involving only a mastery of techniques and technologies. Care should consider the complexity of dealing with another human being, understanding their life history, beliefs, emotions and desires, among others. Care should permeate the relationship between people and be revealed through effective communication (Kourkouta & Papathanasiou, 2014). Additionally, when dealing with this topic, there is the possibility of involving all of Carper´s patterns of knowing in nursing: theoretical, empirical, ethical, aesthetic (expressiveness and subjectivity), and personal (understanding oneself, authentic and reciprocity relationship with the other) (Rafii et al., 2021).

Creating spaces for awareness, self-knowledge, and reflection about death and dying in undergraduate programs, specifically in nursing, is a crucial step toward enabling students to face life and the process of death, and to die with quality.

1.1. Aims

This study qualitatively investigated nursing students' meanings of a significant death or dying experience. We also explored participant reactions and how they adjusted to the loss of a loved-one.

2. Method

From a constructivist paradigm, a qualitative research design was developed to "illuminate and understand in depth the richness in the lives of human beings and the world in which we live" (Jones et al., 2014, p.11). In order to capture student voices and “rich descriptive experiences, this study utilized a multiple case study featuring a narrative approach” (Shkedi, 2005, p.175).

2.1. Procedures

The research was based on the results of a pedagogical project developed in the Curricular Unit of Nursing in Palliative Care of the degree in Nursing at the School of Health Sciences of the Polytechnic of Leiria (Portugal).

As the education process is undoubtedly influenced by students' experiences in their private lives, they were encouraged to tell their own stories about the death and dying of a loved one. Thanks to this learning strategy, teachers discussed death and dying from the students' perspectives, thus contributing to their preparation.

Written narratives were elaborated between October and November 2021. Several strategies were adopted by the research team throughout the study process to maintain ethical rigour and perceived bias in data collection and data analysis. For instance, narrative anonymity was preserved, the researcher kept a reflexive journal as an audit trail, and interpretations were

shared and validated by researchers. Furthermore, this paper includes data collection details as well as sufficient and accurate citations, allowing the reader to evaluate the research practices used.

2.2. Participants

The authors recruited third-year students enrolled in a palliative care nursing course. To be eligible for this study, students needed to meet two criteria: (1) experienced a death loss that was significant to them while they were enrolled; (2) experienced their death loss at least six months before the start of the study. Purposeful sampling was used for this study to select information-rich cases including participant narratives with different types of losses and different perspectives of coping or adjustment. The research team purposefully chose 10 subjects (five female and five men), all of whom were between the ages of 21 and 37.

2.3. Personal narratives of death and dying

A defining aspect of narrative inquiry involves the researcher re-telling participant narratives. Stories provide a means of contextualizing or locating feelings and emotions within a broader framework of meaning. Narrative analysis is an appropriate way to study students' perceptions of death and dying, allowing the researcher to enter their world and explore their experiences as expressed through stories (Priest, 2000).

We conceived the development of teaching-learning strategies following the principles of experiential learning from the perspective of Burnard (1997). For this author, learning develops through experiences and results from the intersection of personal experiences, reflection on reality, and the knowledge it mobilizes to answer questions about what happens and the changes it can bring. Following this reflective method, some key questions were defined for the narrative structure (see Table 1).

2.4. Data analysis

The study was primarily exploratory and focused on the participants' personal (cognitive and emotional) accounts. Therefore, a thematic analysis approach was chosen because it provides an accessible, theoretically flexible analysis of narrative data. Thematic analysis is a technique for identifying, analyzing, and reporting data patterns (themes) (Braun & Clarke, 2006).

Table 1. Experiential narrative structure on the theme of death and dying

Phenomenon: Describing the experience.
Causality: What factors contributed to this experience?
Context: In what context did it occur and what are the most significant contextual elements of this experience?
Reflection: What was I looking for? Why did I act the way I did? What were the consequences of my action (for myself, for others)? What did I feel during this experience? What factors influenced my decision and actions?
Alternative Actions: At the time, what other options did I have? What would have been the consequences of these other choices?
Learning: How do I feel now about this experience (while I am narrating)? Could I have handled this situation better? What did I learn from this experience?

3. Results and Discussion

Using multiple case narratives, researchers can study how people experience and perceive the world through their stories (Webster & Mertova, 2007). Meleis (2010) states that a situational event, such as a death loss, is linked to how the transition is positively integrated by an individual. Participants discussed issues such as the timing of the death loss, the manner of death, role changes after the death loss, and adjustment patterns.

3.1. Timing of death loss

Several participants evoked that their death losses occurred during significant times in their lives. P1 explained that she had just begun her degree when her mother died. Her mother's death marked her academic performance, as she experienced cognitive difficulties in learning and managing emotions. Other participants (P5, P7) indicated that being a student was challenging around the time of their loved one's death. The transitions were difficult for students, who had to deal with a variety of emotions while maintaining their academic life.

Furthermore, several deaths happened around special events such as birthdays and weddings. P6's two death losses occurred on significant days. On Christmas Eve, he lost his great-grandmother, and on his 19th birthday, he lost his grandfather.

3.2. The manner of death

Aside from the timing of death, the manner of death had a significant impact on how participants reacted to the loss of their loved ones. All participants agreed that those who died

frequently left loved ones behind, including partners and young children. Unexpected deaths were reported by participants: P6's friend committed suicide and P10's friend was shot while being robbed. There was no warning or preparation for their survivors in either case. Evidence demonstrates that suicide survivors experience stigma in the form of shame, blame, and avoidance (Hanschmidt et al., 2016). Nonetheless, natural deaths participants could plan for, such as P8's grandmother, allowed survivors to say their final goodbyes ahead of time.

3.3. Role changes

Survivors' duties and obligations were also altered as a result of death losses (Munck et al., 2018). Although the deaths of his grandmother and uncle were tragic events, P3 no longer had to assume the caregiver role he had played during most of secondary school. P3 said that a big weight had been removed from his shoulders, although he suffered significant losses and was distraught for that reason.

3.4. Adjustment strategies

Participants received help from both internal and external sources as they struggled to overcome adversity.

a) Internal sources of help began with recognizing that a problem existed, followed by resilience and persistence. Resilience and persistence led to a resolution that came from personal values based on family and faith (Howard-Snyder & McKaughan, 2022). P1, P9, and P10 relied on a thought process or self-talk. P9 called it a mindset, saying, "It's just the mindset of what you want to do about it. You just have to somehow find it in you to keep going." P10 thought to herself, "How could I ever give up?".

During some student bereavement narratives, religion and spirituality were also raised. P2, P4, and P7 treasured and depended on their faith, and reported comfort following their loved ones' deaths because their faith assured them that they would be okay. This was in line with the results of Lattanzi-Licht (2013), who stated that religion and spirituality may offer consolation to those who are dying, as well as peace to their families and friends.

b) External sources of help were evidenced by support from others and came from belonging to the community. Some participants expressed gratitude to those who had supported and comforted them during this difficult period. P8 realized "how fortunate I am to have the support structure that I do." Emotional support, encouragement, and academic help were all provided by this sense of belonging. Despite this, P6 found it difficult to connect with her classmates. Although her classmates tried to console her when her brother died, their actions enraged her rather than soothed her, which is consistent with Balk's (2001) observation that not everyone has the ability to converse with someone who has had a death loss.

3.5. Study strengths and limitations

Several participants stated that there were few opportunities in their daily lives to write about or discuss these types of experiences, which drew them to this pedagogical strategy. The insider status of the researchers facilitated the recruitment of participants and meant participants provided data trustingly. However, we recognize that this study had some limitations. It is possible that a common worldview was assumed, with scarce cultural variability. Moreover, our sample was only composed of third-year students, excluding other stages of educational development with different levels of emotional competency and personal maturity. Also, students had no previous clinical experience in palliative care units, so the results only focus on personal experiences of loss and death.

4. Conclusion

Participants indicated several personal and environmental variables that helped them remain resilient after losing someone close to them due to death. We propose some implications for improving the experiences of bereaved students based on our findings: a) the role of teachers and how they respond to their bereaved students, preparing them for caring for others in similar situations; b) educating and training students about death and dying by using adequate learning strategies such as storytelling, photovoice, narrative approaches, and role-playing; and c) providing counselling support for bereaved students. Lastly, it is evident that the role of the narrative is multi-faceted – contributing to the development of a student's identity, providing comfort, and helping to make sense of a 'senseless' event.

References

Araújo, M. & Silva, M. (2012). O conhecimento de estratégias de comunicação no atendimento à dimensão emocional em cuidados paliativos. *Rev. Texto Contexto enferm*. 21(1):121- 129.

Balk, D. (2001). College student bereavement, scholarship, and the university: A call for university engagement. *Death Studies*, 25(1), 67-84.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Burnard, P. (1997). *Learning human skills. Un experiential and reflective guide for nurses*. 3ª ed. Oxforf: Butterworth Heinemann.

Hanschmidt, F., Lehnig, F., Riedel-Heller, S. & Kersting A. The Stigma of Suicide Survivorship and Related Consequences-A Systematic Review. *PLoS One*. 11(9):e0162688. doi:10.1371/journal.pone.0162688

Howard-Snyder, D. & McKaughan, D. (2022). Faith and resilience. *Int J Philos Relig*. https://doi.org/10.1007/s11153-021-09820-z

Jones, S. R., Torres, V., & Arminio, J. (2014). Negotiating the complexities of *qualitative research in higher education. Fundamental elements and issues*, (2nd ed.). New York: Routledge.

Kourkouta, L., & Papathanasiou, I. (2014). Communication in nursing practice. *Materia socio-medica*, 26(1), 65–67. https://doi.org/10.5455/msm.2014.26.65-67

Kovács, M. (2012). *Educação para a morte: desafio na formação de profissionais de saúde e educação*. São Paulo: Casa do Psicólogo.

Krychiw, J., James, R. & Ward-Ciesielski, E. (2018) Suddenness of death as a determinant of differential grief experiences. *Bereavement Care*, 37(3), 92-100. https://doi.org/10.1080/02682621.2018.1539312

Lattanzi-Licht, M. (2013). Religion, Spirituality & Dying. In David K. Meagher, David E. Balk (Eds). *Handbook Thanatology*. 2nd edition. New York: Routledge.

Meleis, A. (2010) *Transitions Theory Middle-Range and Situation-Specific Theories in Nursing Research and Practice*. New York: Springer Publishing Compan.

Munck, B., Björklund, A., Jansson, I., Lundberg, K., & Wagman, P. (2018). Adulthood transitions in health and welfare; a literature review. *Nursing Open*, 5(3), 254–260. https://doi.org/10.1002/nop2.136

Priest, H. (2000). The use of narrative in the study of caring: A critique. *NT Research*, 5(4), 245–250. https://doi.org/10.1177/136140960000500402

Rafii, F., Nasrabadi, A. N., & Tehrani, F. J. (2021). How Nurses Apply Patterns of Knowing in Clinical Practice: A Grounded Theory Study. *Ethiopian journal of health sciences*, 31(1), 139–146. https://doi.org/10.4314/ejhs.v31i1.16

Shim, S. (2020). The existential meaning of death and reconsidering death education through the perspectives of Kierkegaard and Heidegger. *Educational Philosophy and Theory*, 52:9, 973-985. https://doi.org/10.1080/00131857.2020.1716334

Shkedi, A. (2005). *Multiple Case Narrative: A Qualitative Approach to Studying Multiple Populations*. Amsterdam: John Benjamins Publishing Company.

Szczupakowska, M., Stolarek, P., Roszak, M., Głodowska, K., & Baum, E. (2021). Patient's Death From the Perspective of Nursing Students. *Frontiers in public health*, 9, 636582. https://doi.org/10.3389/fpubh.2021.636582

Vázquez-García, D., De-la-Rica-Escuín, M., Germán-Bes, C., & Caballero-Navarro, A. L. (2019). Afrontamiento y percepción profesional en la atención al final de la vida en los servicios hospitalarios de emergencias. Una revisión sistemática cualitativa [Healthcare professionals' perceptions and confrontation at patients' end-of-life in emergency departments: A qualitative systematic review]. *Revista espanola de salud publica*, 93, e201908051.

Webster, L., & Mertova, P. (2007). Using narrative inquiry as a research method*: An introduction to using critical event narrative analysis in research on learning and teaching.* Routledge/Taylor & Francis Group. https://doi.org/10.4324/9780203946268

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14646

Teaching practices in architectural technology courses. An experiment and future perspectives in the Italian context

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Abstract

Architectural technology is a subject in constant evolution due to the specificity of territorial production, which is increasingly becoming more global. The constant change in the way of doing architecture requires the transmission of knowledge and skills that see an ever-greater weight in the acquisition of soft skills rather than hard skills, thus enabling to face situations with new complexities. The paper discusses the innovative teaching methodologies experimented with within an architectural technology course, at the Faculty of Architecture, Sapienza University of Rome. It includes considerations regarding the classroom vs. online learning, experienced during the COVID-19 lockdown phases, elaborating on the results of a survey that collected 158 students' views. The results highlight the importance of active learning environments to support the preparation of architects able to manage emerging challenges and make use of information and communication technologies, that are rapidly changing, especially after the shift caused by the pandemic.

Keywords: *Innovation; experimental learning environment; hard skills; soft skills, architectural technology.*

1. Introduction

Higher education has long been at the centre of debate for the update of objectives and delivering methods through new teaching practices, monitored, and updated in 48 European countries by the European University Association, representing more than 800 universities. The rapid change of contemporary society pushed towards a re-evaluation of the university's role in acquiring soft skills rather than hard skills and in creating learning settings that shift the emphasis from information and knowledge to creativity and critical thinking. If hard skills such as the mastery of science, proficiency in a foreign language and technical skills can be assessed easily through practical tests; soft skills are rooted in actions and experiences; they represent the personal knowledge necessary for managing situations; knowing how to communicate effectively; how to work in a group; and how to manage stress. Traditional "teacher-centred" approach in teaching has fallen out of favour as it is seen to favour passive learning. Therefore, contemporary approaches are shifting toward a "learner-centred" methodology (Bishop et al, 2014; Loukkola, & Peterbauer, 2019) and towards a 'trialogical learning", which uses collaborative learning techniques based on activities of concrete hands-on application through tangible objects (Sansone, Cesareni, & Ligorio, 2016). The teacher, therefore, takes on a new role, from "Lecturer" to "Facilitator" (Doyle, 2011) of learning. Faculties of architecture are traditionally characterized by training and formative profiles of a practical nature, which leads to the enhancement of participatory and collaborative teaching techniques that often revolve around project or design applications. This sometimes happens through consolidated methodologies which should increasingly seek to enhance the integration of a learner-centred approach and of a soft skills acquisition process that is based on a constant dialogue with 'digital natives', a generation that is rapidly developing and changing. As Prensky puts it, "Our students have changed radically. Today's students are no longer the people our educational system was designed to teach" (Prensky, 2001).

This work discusses teaching practices experienced within an Architectural Technology II (ATII) course, taught at the five-year single-cycle master's degree programme in Architecture, coordinated by the first and second author, the latter in the last seven years as instructor as instructor. It is a 10 CFU (University Credit) mandatory course of the second curricular year and it aims to prepare students in the field of applications of architectural construction techniques. ATII's main objective is to provide critical and operational tools and methodologies necessary for technical design and construction technologies; understood as the ability to analyse and operationally integrate the needs, the functional and formal requirements, and the technical and construction solutions of architectural work, so that there is a coherent operational continuity between the moment of the decision-making of the design choices and the moment of the technical realization of the building. The course, therefore, aims to provide second-year students with systematized knowledge of the challenges posed during the construction process of a building, concerning the operational relationship

between design and implementation. After having assimilated the basic knowledge in the Architectural Technology I course in the first year, ATII students learn about construction systems and techniques, components, and industrial products for construction. They develop the ability to read an architectural project as an interdisciplinary design process, characterized by sequential acts of different levels of proficiency, in which various actors intervene (client, design teams, companies, etc.). The programme also intends to enhance the development of a comprehensive set of skills necessary for an intricate professional figure such as an architect. At the end of the course, students should demonstrate an adequate level of understanding of construction systems, building components, and industrial products for construction and their assembly methods. They work in groups to develop the architectural drawings of a building and produce all its execution drawings. They have, on one hand, to show acquired full knowledge of phases, procedures and operational tools of the building process, as defined within the local, national and European regulations; and on the other hand, demonstrate creativity, critical thinking and problem-solving. Accordingly, the activities, operation and assessment methods are designed to take into account both hard and soft skills.

Within this framework, the paper aims to highlight an experimental methodological approach for the creation of a model that integrates different methodologies, tools and activities for the development of both soft and hard skills in a higher education learning experience in the field of architectural technology, emphasizing the role of the teacher as facilitator.

2. Experimental active learning environment

The teacher addresses the programme topics through frontal lectures and seminars. This typically traditional teacher-centred method, however, is complemented by a set of visual and audio-visual tools to enhance direct feedback and stimulate an interactive environment. Therefore, sessions, in ATII, usually start and end with two different types of anonymous online questionnaires for students. The first is used based on the session's requirements, it collects the attendees' feedback regarding the chosen session topics. The second evaluates the level of comprehension of the content addressed during the session. In both cases, results are projected on the classroom screen in real-time and a discussion is initiated to address the collective response. In the first case, the questionnaire represents a tool to stimulate the students' curiosity, setting focus on their role as active participants, sharing their opinion through the questionnaire and the discussion that follows. It also provides the docent with an additional overview of the participants' impressions regarding the chosen topics. This approach has proved to encourage students to actively participate, answer questions raised by the teacher, and proactively ask questions or share feedback during the session, enhancing dialogue, and demonstrating a higher level of involvement. The second questionnaire allows the teacher to evaluate their clarity, adequacy of the content and transfer methods. It creates another space for collective analysis of erroneous answers, facilitating the comprehension of

complicated arguments. On regular basis, the sessions are 'interrupted' by dynamic activities such as tasks, workshops, and presentations, enhancing student-centred learning. Students may sit in small groups and work together to solve an issue that could vary from a research task (e.g., researching recycled construction materials that comply with a local regulation) to working on the elaboration of a conceptual project idea (e.g., defining the suitable set of passive envelope strategies to apply to a case study). The task is often followed by a feedback space through - verbal, written, or audio-visual - presentations that could be informative, demonstrative, or persuasive, and a discussion between the learners and their facilitator. In some cases, the activity could be a one-day workshop to answer a given question within a specific theme (e.g., Green Public Procurement). The classroom dynamics become highly flexible to encourage students to develop their analysis through critical thinking and inquiry-based learning. Occasionally, students are provided with educational material (i.e., educational videos, articles, and literature) and they are given space to study this content, either before class or individually during some of the course hours. The classroom session then is dedicated to the discussion of content, where the facilitator raises questions and initiates a debate for the development of the topics' understanding and comprehension. In the flipped classroom, some examples of the content addressed individually by the learners are online lectures of the docent discussing the current tendencies in the construction sector; educational animations of building elements (e.g., slab blocks types and characteristics); video of a system's installation (e.g., green roof).

During the semester, the students work in groups, of two to three persons, to elaborate architectural execution full package drawings of a case study project, a residential building that they designed (preliminary design) in the Design Studio of the previous school year, enhancing project-based learning. The technical solutions and project drawings progress is supported through regular follow-ups, where two main revision techniques are added to the traditional revisions, with academic staff members. The first technique is the collective revision, where students present their project drawings in front of the whole class and their colleagues provide feedback and share comments openly. This method allows a dialectical comparison between the elaborated outputs, favouring skills for project presentation in front of an audience. The second technique is used at an early phase of the case study progress. The teacher couples the groups , based on defined criteria, for a peer review activity, enhancing cooperative learning. The groups are given a timeframe to assess their colleagues' drawings, then they exchange feedback and improvement suggestions through written documents. Although this technique is supervised by the academic staff, it proved to allow an enhancement of an 'independent' comparison between students' solutions. It resulted in beneficial progress of the case studies, and it received significant appreciation from the students, who applied this method through a collaborative writing technique, and had to think critically, collaborate to analyse their colleagues work and take evaluation decisions.

Construction site activities have been part of the course's programme for years. For three days, students follow the "learning by doing" approach in the educational construction site and laboratories of the Joint Body for Training and Safety in Construction in the Province of Rome (CefemeCtp). They are divided into smaller groups that are followed by CefemeCtp instructors. They first follow a full-scale demonstration of the realization of building part(s) with traditional technologies (e.g., brick walls, masonry arches, etc.), and then each group realizes a building part, then the groups alternate. Participants also meet building materials suppliers who showcase updated technologies and systems in a dedicated seminar hall, explaining their installation methods through full-scale on-site applications. This is almost always followed by the students' realization of the explained system. This experiential learning experience allows architecture students to touch building materials with their own hands, understand their weight, size, and texture, not only through drawings or scaled models; and above all to have a first idea of the activities that take place on a construction site. The whole procedure is supervised by the course staff members that are present on-site, enhancing links with the other course content, and stimulating dialogue. Often, students decide to adopt techniques or systems, that were demonstrated, in their project case studies' solutions.

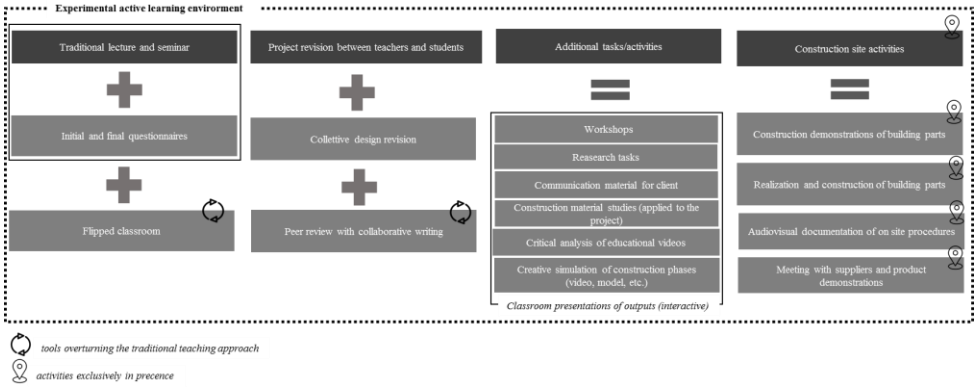

Fig 1. Experimental active learning environment by Authors.

During the course, the academic staff integrates various active learning instruments to stimulate the expansion of soft skills that students will possibly need in their future profession. For example, students create short videos of their CefemeCtp site activities or other construction sites, accompanied by verbal critical analysis of the visual content. They prepare communication and promotional material for their work (i.e., project brochures), where they learn at an early stage to translate the complexity of technical content into a communicative format for clients. Students also present a "book of building materials" that includes a categorized listing of construction and technical products used in the case study. This plays a role in understanding how organise technical information and read detailed project elements. Throughout the year, the staff aspires to create an open environment that welcomes different presentation and communication strategies, encouraging creativity. The

results of this approach are limited due to the students' relatively limited familiarity with advanced presentation tools at an early stage. However, students occasionally adopt the invitation and present original results. One example is a student that showcased the construction phases of his project, in reinforced concrete, brought through a physical model maquette with the video documentation of the sequential installation of the structural and building components from beginning to end of the process.

The students' assessment and grading is based on a set of tools and criteria to inclusively evaluate all the skill sets and knowledge acquired during the course. Assessment includes a detailed evaluation of all the student's activities and participation during the semester, the results of the intermediate test(s), the produced outputs (project drawings, brochure, book of material, elaborated material) and the performance in an oral exam.

3. Classroom vs online learning modalities

Online teaching, forced by COVID-19, pursued the same objectives as classroom "in-person" teaching but was delivered in total remote mode. This required a different time management approach, involving new planning and scheduling methods, and a completely new operation, significantly different from the ones that take place in the classroom. During the online teaching, the TAII's construction site experience was not possible; it was replaced by a selection of educational videos to be assessed and analysed collectively. Most of the other teaching tools, mentioned above, were carried out and the learning practices used in the classroom sessions were implemented, stimulating an active and dynamic setting. Total remote teaching highlighted the potential for reaching a wider audience of students, emphasized the need for flexibility, and reduced the negative environmental impact caused by the mobility and transportation sector. In ATII, the sessions were delivered through G-Meet videoconferencing platform and the other activities were managed through the Moodle platform, which includes multiple settings, including the possibility of linking or providing access to external platforms (G-Drive, YouTube, websites, etc.).

In the United States, some argue that COVID-19 accelerated the transition process between home and distance learning (Stanley, 2020). This could lead to the initiation of courses that are performed completely online, even for universities that are defined by their official statutes as "in-presence higher education institutions". This transition, however, suggests an invitation to reassess the role of public universities today. The primary challenges that can be observed for the launch of full online courses in the university environment are the possibility/impossibility of a fully reliable internet connection, the adequacy of use of information and communication technology tools by everyone, and the lack of a real learning environment when using those tools. This lack means reduced personal exposure and conflicts, and therefore lower ability to develop human relationships and improve critical

thinking and interpersonal skills. Moreover, students with, personal or environmental, vulnerabilities might be subject to additional accessibility barriers for these courses. A further consideration in retrospect is that the students who attended the course in its fully online format used technical language and expressions that can be defined as “poor and basic”, compared to their colleagues who followed the course in class in previous years. This aspect was particularly evident during the oral evaluation sessions and verbal presentations. This could be assumed to be because online sessions allow a flexible, less controlled, and less interactive space, which potentially could lead to the participants' distraction. To date, and predictably soon, the blended learning modality seems to be the method that will prevail. To reinforce this hypothesis are the results of a survey performed between March-April 2020, to 158 students, attending the second and third year of the Faculty of Architecture, Sapienza University of Rome, where the answer to the question "Of all the frontal courses to be followed and attended at the university, how many would you like to follow online?" 39% indicated that they would like to have both possibilities (face-to-face and online) and 25% preferred to take only a few courses online, while only 31% indicated “none and prefer face-to-face (in presence) courses”. When asked about work modalities, 60.8% indicated that they would prefer to work some days from home and other days in the workplace (office, company, etc.), compared to 38% who would prefer to fully work in the workplace.

4. Results and Conclusion

The article presented a learning and teaching model applied in the "Architectural Technology II" course for second-year architecture students at Sapienza University of Rome. The authors of this paper are not pedagogues and without claiming that the highlighted methods and tools experimented with within the course were applied in their full orthodoxy, it is evident that the results were evaluated positively by both students and teachers. The integration of questionnaires with the frontal lectures/seminars resulted in active participation during the sessions. Students showed high involvement and interest in the student-centred learning activities. The integration of group work, presentations of different types, and activities that increase interaction between students enhanced the development of soft skills (teamwork, communication skills, flexibility, adaptability), parallelly with the technical content and practical knowledge acquisition. The variation of the revision technique for the case study project received significant appreciation from the students, who found it as an opportunity to analyse and make assessments from other perspectives, but also present and receive feedback in a different and more stimulating manner. The construction site activities had an evident and straightforward impact on the students' understanding and approach towards the analysis and decision-making process of the technical solutions. The integration of integrated activities and outputs of various formats proved to develop different skills and stimulated the students' creativity. Over the years, the students evaluation surveys of the course (performed

anonymously as a part of the university's processes for quality assurance) showed that interest and appreciation of the subject increased with the increase of the student-centered and experiential learning methods.This experimental model represents an example in an Architecture school in Italy, that is rapidly developing and increasingly becoming more global. The generations and learning means are changing and the role of teachers is continuously evolving, from ''Lecturer'' to ''Facilitator'', to respond to this paradigm shift. In 2017, the Quality and Innovation of Didactics Working Group (GDL-QuID) was established to develop strategies and guidelines for the progress, improvement and innovation of teaching in Sapienza University. Groups like this are functional to providing permanent training, and updating staff members with, hard and soft, skills and necessary tools (e.g., Information Technology and innovative teaching practices) for a process that, while dealing today with a generation of digital natives and digital transition, continues to evolve. This has been highlighted by the implications of COVID-19, which shook the balance between classroom and online learning; and it is leading to the integration of additional, partially or fully performed, online courses, that represent a step towards more inclusive and innovative approach to learning and teaching. This paper, however, highlighted the primary, contextual, challenges to enhance the benefits of both classroom and on-line learning. Adaptability plays a fundamental role for academic staff members, and all actors of the educational process, to face future challenges in architectural education, and higher education in general, and prepare a competitive generation of workforce, with all skill sets to respond to local and international cross-cutting issues. Future work could assess the impact of the experimented methods on student development and employability. It can also assess the optimization methods of the blended, classroom and online, teaching model.

References

Bishop, C. F., Caston, M. I., & King, C. A. (2014). Learner-centred environments: Creating effective strategies based on student attitudes and faculty reflection. Journal of the Scholarship of Teaching and Learning, 14(3), 46–63.

Doyle, T. (2008). Helping students learn in a learner-centred environment: A guide to facilitating learning in higher education. Sterling, VA: Stylus Publishing.

Loukkola, T. & Peterbauer H. (2019). Learning & teaching paper #6. Towards a cultural shift in learning and teaching. European University Association. Available at: https://eua.eu/resources/

Sansone, N., Cesareni, D., & Ligorio M.B., (2016). Il Trialogical Learning Approach per rinnovare la didattica. TDTecnologie Didattiche, 24(2), 82-91

Staley, O., (2020) "History will look back on 2020 as a turning point for US universities" August 23, 2020 Quartz available at https://www.weforum.org/

Prensky, M., (2001). Digital Natives Digital Immigrants. On the Horizon, MCB University Press, Vol. 9 (5), 1-6

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14179

Architectural representation: the image and the sign

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Abstract

The final aspect of architectural projects is nowadays illustrated by computer generated images of photographic quality (photorealistic renders), mostly replacing the old fashioned hand drawn images. Several authors feel that their realism may not convey the desired message to onlookers. We proposed a Web based questionnaire containing 3 tests to assess whether communication, recognisability and engagement were better conveyed by hand drawn images or photorealistic renders. 154 responders took the test, 74% of them were professionals in the architectural field and 26% general public. In both groups, the answers indicated that communication and recognizability were much better perceived in hand drawn images than in photorealistic renders. Engagement was aimed at assessing personal preference towards render or hand drawn images, with an even outcome. It is concluded that architect's idea and spirit are better conveyed by hand drawn images which are a sort of "sign". Such feature should be properly taken into account in academic curricula. Photorealistic renders should be used complementarily to show a virtual reality of the project's outcome.

Keywords: *Image; Architecture; Render; Hand drawn; Communication; Recognisability.*

1. Introduction

This paper focuses on the issue of images illustrating architectural projects. They are now almost exclusively digitally created, though handmade drawings are still in use. After a brief review of pros and cons of the two styles, the results of an original online survey about choices by architects and general public are reported, with potential consequences on educational methods.

1.1. Architectural imagery in the 21st century

Since the first introduction of Computer Aided Design (CAD) in mid 60s of the last century, its undeniable advantages have brought forward a growing enthusiasm to the point that nowadays no architect can present a project that has not been CAD processed. Evolution of software allows now accurate 3D photo simulations of new architectural projects so that virtual postcards, or "postcards from the future" can be produced to allure onlookers (Jacob 2017). Realism through digital images seems to be the ultimate goal of the presentation process. The old traditional hand drawn images, though still in some use, seem to be forgotten, particularly in the educational field. Working preferences for students are strongly biased towards an entirely computerized world (Şenyapili and Basa 2006). Dichotomy between digital and hand drawn images has been the object of several studies inquiring whether digital images are perceived as a more comprehensible and effective tool of communication than the hand made representations (Bates-Brkljac 2009, 2011; Iñarra Abad, Juan Vidal, and Llinares Millan 2013). The results were partially dependent on the background of the audience, mainly whether they were architects or other professionals. Computer generated images were generally perceived as more accurate and realistic than traditional illustrations, a characteristic that mainly appraised the non architects (Bates-Brkljac 2009). All in all, architects prefer artistic images and pay attention mainly to attributes as innovation and functionality, whereas non-architects prefer photoidealistic images and pay attention mainly to the wellbeing feeling conveyed by the digital image (Bates-Brkljac 2011). One more important issue is represented by meeting the consumer's preferences and needs, as already occurs in the field of industrial design (Iñarra Abad et al. 2013; Llinares Millan and Iñarra Abad 2014).

1.2. A tale of two views: visual information and architectural representation

Imagery representing architecture may be split in two categories. On one side there is the "*visual information*" which may be defined as "*documentary act deprived of any inherent significance*" (Maller 1991); in this category may fall the technical working drawings, the survey drawings and the photographic images. Photorealistic renders also fall in this category. On the other side lies the "*architectural representation*", which is the visual synthesis that embraces the critical thinking of the architect (Maller 1991). We may then

assimilate the "*architectural representation*" to an imagery, possibly handcrafted, that enables the communication process between architects and the general public, and conveys the creative spirit of the architect or, in a way, his signature. Such dichotomy could be revealed by the onlooker reactions to our tests. Whilst previous surveys were meant to assess some qualitative and semi-quantitative features of image perceptions by recording choice of adjectives and grading of preference, our questionnaire was mainly addressed at identification of predetermined characteristics of images, thus providing comparatively objective data even on the assessment of authorship. The main objective of the survey was to explore if digital photo quality images could convey the designer message and personality better or worse than hand drawn images.

2. Materials and methods

2.1. The questionnaire

A simple questionnaire was constructed and named "*Architectural Drawing 3.0*". It was an online web questionnaire created on Typeform, an interactive platform which allows to combine images and text. It was run on Instagram and LinkedIn throughout a duration of two months, during which random people were targeted, with no limitation in number. It was conceived for a wide range of different users that could represent the heterogeneous public usually reached by architectural imagery. The questionnaire had been designed according to recent overviews (Mittal and Mittal 2011); the questions were of the following typologies:

1- Text questions which assessed the user background, interests or attitudes towards drawing tools and renders;
2- Multimedia test which provided textual and multimedia contents (images) with a true or false type of answer;
3- Multimedia test with a single preference type of answer, for which the general impression of the user was the parameter we were seeking.
The two multimedia tests were conventional one-stem multiple-choice type with correct answer scored 1 and wrong answer scored 0 (Ng and Chan 2009). The position of correct answer in each question was randomized by the Typeform platform. The whole questionnaire was divided into six sections.

2.1.1. First section on status information

The first section just asked questions #1) age, #2) gender and #3) occupation. All questions were of the close ended type, so the answers could be precisely cathegorised. Age groups were a) 19 and under, b) 20-29 c) 30-39, d) 40-49, e) 50-59, f) 60 and over; gender a) male, b) female; occupation a) architect, b) student, c) civil/construction engineer, d) architectural

assistant, e) architectural illustrator, f) 3D artist, g) academic (in the architectural field), h) interior/product designer, i) developer, j) real estate agent, k) other.

2.1.2. Second section on "Communication"

The second section, containing questions #4, #5, #6. #7, was named "*Communication*", meaning that it was aimed at assessing how much the visual message (vignette) would communicate to the observer its meaning as novelty and originality of a newly designed project, to be recognized among others already existent. The comparison was between hand drawn illustrations versus photorealistic renders: which of the two would best communicate to the onlooker. Question #4 showed a vignette with a hand drawn image which illustrated a new project among other already existing city buildings. Four vignettes with already marked different buildings were offered as possible solutions. Only one marked the correct new project. Question #5 showed a similar hand drawn project, but with only two vignettes as a choice. Question #6 was analogous to #4 but the illustrations were photorealistic renders. Question #7 was analogous to #5 but now photorealistic renders showed the project.

2.1.3. Third section on "Recognisability"

The goal was to assess how much the "*sign*" of the project's author could be recognised in hand drawn illustrations compared to photorealistic renders. The test takers were first shown 3 hand drawn images authored by as many famous architectural companies, and 3 photorealistic renders from the same, in order to familiarise themselves with each company style. In question #8 a set of 3 new images by the same companies was shown, unlabelled: the test takers had to pick up the correct combination of authorship just recognizing the style of the illustrations among 6 possibilities. Question #9 was analogous to #8, but this time the images were photorealistic renders.

2.1.4. Fourth section on "Engagement"

These two questions were just about personal preference between hand drawn or photographic render representation of interior design. Question #10 showed two similar living room projects, one as a hand drawn illustration and another as photorealistic render. The test taker had to choose which one preferred. Question #11 was analogous, but showed a bedroom project.

2.1.5. Fifth section on preferences in the use of images by architects

This section aimed at collecting data about professional use of images according to preferences of architects, and their desiderata about freehand digital drawing.

2.1.6. Sixth section on contacts and comments

This was mainly aimed at collecting comments on architectural imagery in general and suggestions for future questionnaires.

2.2. Data handling and statistical analysis

The web platform provided detailed data on a spreadsheet and some preliminary descriptive statistics and proportions with correct answers per each group of test takers. Differences in the proportions of right and wrong answers were tested by using the chi-squared ($\chi 2$) test. Fishers exact test was used if any of the cells had expected counts less than 5. All tests were conducted with α=0.05 (5% level) and a null hypothesis of no difference between the two groups (reject null hypothesis/accept evidence of a difference if $p<0.05$ i.e. chance of wrongly saying there is no difference (false negative) was less than 5%).

3. Results

3.1. Grouping responders

There were 154 full responders. 75% of them were in the age range of 20-39 and 9% 19 or under. So 84% could be defined young adults; 58% were males and 42% females. Architects represented 28%, students in the architectural field were 21%, civil or construction engineer 6%, architectural assistant 4%, architectural illustrator 3%, 3D artist 2%, academic 2%, interior designer 2%, developer 1%. The "*other*" category scored 26%. So we decided to group all "*professionals*" altogether, scoring a total of 74% of test takers, to be compared to the "*others*" group.

3.2. Communication section: questions #4, #5, #6, #7

Responses to Question #4 (locate hand drawn project image in urban environment, 4 choices) yielded 89.6% of correct answers by "*professionals*" and 87.2% by "*others*". There was no significant difference between the two groups. A similar result turned out for question #5, where correct answers were 93% in the case of "*professionals*" and 82% for "*others*". No significant difference between groups. Questions #6 and #7 concerned photorealistic renders, again there was no significant difference between "*professionals*" and "*others*" in each of the two questions: professionals were 23.5% correct in question #6 and 32% in question #7, while the "*others*" proportions for correct answers were 12.8% (question #6) and 47% (question #7). When comparing the scores of the same groupin recognising the project in hand drawn images (questions #4 and #5) and in photorealistic renders (questions #6 and #7), it came out a difference of 66.10% for "*professionals*" and 74.40% for "*others*" , with a verey high significance level ($p<0.0001$) in both cases.

3.3. Recognisability section: Questions #8 and #9

The images were hand drawn and the test takers, after having familiarised with each company's style, had to spot the answer with the correct labelling combination among 6 possible choices. The 3 styles were correctly recognised by 70,4% of "*professionals*" and 56.4% of "*others*". The difference between the two groups was not significant. For question #9, the same procedure as question #8 was applied, but the images were photorealistic renders. The "*professionals*" scored 20.9% of correct answers, whilst the "*others*" scored 23.1%. No significant difference between groups ws demonstrated. Comparing the same group responding to the two questions, it came out that the "*professionals*" showed a 49.50% score difference between the correct answers to question #8 and question #9, which was highly significant ($p<0.0001$). The "*others*" also showed a significant difference of 23.1% ($p=0.0028$) between the two questions. So, both "*professionals*" and "*others*" scored more correctly in the case of hand drawn images than protorealistic renders.

3.4. Engagement section

Questions in this section simply asked the observer for a personal preference between hand drawn illustration and photorealistic render. The two options were presented in a different order for each participant, randomly organized by the Typeform platform. The perceptive "*engagement*" was seeked, with an answer presumably based upon the general impression and instinctive reaction by the onlooker. We did not perform statistics to compare these results as the choice was strictly based not on performance but on personal taste, and could be dependent on the quality of image. Two images, one hand drawn and one a photorealistic render of two very similar living rooms and two bedrooms were presented. The "*professionals*" group expressed a slight preference for the hand drawn living room (56%) against the photorealistic render (44%), but showed a reversed preference for the photorealistic bedroom (56%) against the hand drawn version (44%). The "*others*" group expressed an almost perfectly even opinion, with 51% preference on the handrawn living room against the photorealistic render (49%), with identical proportion as to the bedroom. We could approximate these results to a 50/50 preference for both groups and for both representations.

4. Discussion and conclusions

4.1 The test takers

The participants to the questionnaire responded to publicisation on some of the Web channels; their recruitment could of course be biased by the chosen channels, but we deem that they represented an audience genereally interested in architecture and images. The "*other*" group can be assimilated to the general public, without specific education on

architecture or image crafting and processing; they were expected to respond more instinctively to the tests, without looking for technical assessments. The "*professionals*", many of them architects, would look at the images from a more educated point of view, and, in theory, spotting better than the "*others*" the correct answers to the proposed questions. We shall see that, eventually, the educated "*professionals*" and the more naïve "*others*" behaved very similarly.

4.2 The tests

The two main tests on communication and recognisability were addressed at assessing the ability of images to convey the correct message. We may consider them as "*objective*" tests, in the sense that they require answers independent from the opinion of the onlooker. They are contraposed to "*subjective*" tests, like our "*engagement*" section or other tests proposed in the literature, where the answers are dependent on the opinion of the onlooker (see figure 1).

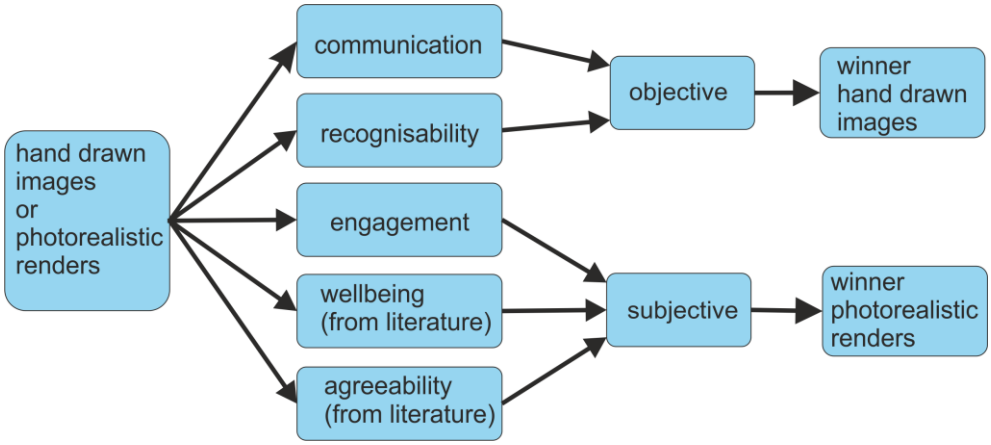

Fig. 1. The flowchart summarises the dichotomy between objective tests, like those on communication and recognizability, and subjective tests on architectural imagery. Hand drawn images score better in the former, whilst photorealistic renders achieve best results in subjectively based judgments. Data on wellbeing and agreeability have been inferred by published literature, as these qualities had not been explored in our tests.

All professionals and students in the architectural field do not only design buildings, they also need to sell their projects to clients, juries, public commissioners. The importance of images is paramount to such an end. When the observer looks at an image portraying more than one building, for example a bird's eye view or simply a view of the neighbourhood contextualizing the proposed design, he/she may experience difficulty in spotting the project in a photorealistic render. In some cases the aim of the image may be how the still non exisent building will perfectly blend with the surroundings, but at the same time, such type of imagery limits the very scope of the architectural representation, which is to tackle the

reaction of the observer to the project, to introduce critical concepts, to communicate the architect's emotions to the customer (Maller 1991). Recognisability is obviously linked with the style in the design and presentation of the project. It is the "*sign*" of the maker. On day, G.L. was at ther desk in her office, when her boss came in and asked: "*I need you to create a new style for the Company. Like Renzo Piano drawings, you know. Something recognizable*". Her thought went straight to the thin lines and the blue/yellow washed colours that are Piano's visual signature. As in every other industry, architecture is nothing less than a product behind which there is the name of the designer. Whether the object comes to life or remains unbuilt, whether it gets published on a magazine or presented at a competition, it is important for the architect, the "*seller*" of the idea, to leave a personal trademark.

4.3 The answers

It may be surprisining to find that architects and the general public had very similar reactions to the images presented. In both cases, the hand drawn images conveyed more correctly the information that we thought should be transmitted to the onlooker; a sure token of the greater efficacy by the hand drawn images to express the ideas and personality of the author. The photorealistic render, though needed in some circumstances in order to provide detailed information about the future results, may not have such important qualities. It is remarkable that whereas the objective qualities of communication and recognisability were assessed as belonging more to hand drawn images than to photorealistic renders, the subjective opinion on aesthetics a propos of the living room and bedroom was a perfectly balanced response by "professionals" and "others".

4.4 Impact on architectural education

The dichotomy between the "*objective*" and the "*subjective*" test suggests that the perception mechanisms of a pleasurable image are disjointed from the meaning that the image should convey (see figure 1). Both factors, on one side the personal feeling elicited by the image and arising inside the observer, and on the other the "*sign*" and "*communication*" of the architect (a more objective quality of the image) should be given attention. In architectural education there is now a preponderance of computerised activity, which may lead towards easier work and sometimes to onlooker's preference (Iñarra Abad et al. 2013; Llinares Millan and Iñarra Abad 2014), but does not accomplish the other fundamental scope of the image, to show the critical idea of the architect (Maller 1991). So, the academic world should emphasise the importance of both syles of images pursueing each one a different but complementary aim.

References

Bates-Brkljac, Nada. 2009. 'Assessing Perceived Credibility of Traditional and Computer Generated Architectural Representations'. *Design Studies* 30(4):415–37. doi: 10.1016/j.destud.2008.10.005.

Bates-Brkljac, Nada. 2011. 'The Character of Similarities and Differences in Perceptions of Architectural Representations'. *Journal of Architectural and Planning Research* 30(2):91–107.

Iñarra Abad, Susana, Francisco Juan Vidal, and Carmen Llinares Millan. 2013. 'Unreal Architectures and Emotional Perspective'. *EGA-Revista de Expresión Grafica Arquitectonica* 21:204–15.

Jacob, Sam. 2017. 'Architecture Enters the Age of Post-Digital Drawing'. *Metropolis*. Retrieved (https://www.metropolismag.com/architecture/architecture-enters-age-post-digital-drawing/).

Llinares Millan, Carmen, and Susana Iñarra Abad. 2014. 'Human Factors in Computer Simulations of Urban Environment. Differences between Architects and Non-Architects' Assessments'. *Displays* 35(3):126–40.

Maller, Alexander. 1991. 'Towards a Critical Architectural Representation'. *Design Studies* 12(2):67–72. doi: 10.1016/0142-694X(91)90047-Z.

Mittal, Sparsh, and Ankush Mittal. 2011. 'Versatile Question Answering Systems: Seeing in Synthesis'. *International Journal of Intelligent Information and Database Systems* 5(2):119. doi: 10.1504/IJIIDS.2011.038968.

Ng, Annie, and Alan Chan H. S. 2009. 'Different Methods of Multiple-Choice Test: Implications and Design for Further Research'. in *Proceedings of the International MultiConference of Engineers and Computer Scientists 2009 IMECS 2009, March 18 - 20, 2009, Hong Kong*. Vol. 2, *Lecture notes in engineering and computer science*, edited by S. I. Ao and International Association of Engineers. Hong Kong: IAENG.

Şenyapili, Burcu, and Ýncý Basa. 2006. 'The Shifting Tides of Academe: Oscillation between Hand and Computer in Architectural Education'. *International Journal of Technology and Design Education* 16(3):273–83. doi: 10.1007/s10798-005-5052-2.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14683

Community-engaged design studios: learning through "live" projects

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Abstract

The paper reflects on a pilot community-engaged pedagogical approach, developed through a second-year housing design studio at the Department of Architecture, University of Cyprus. Underpinned by the Urban Living Labs (ULLs) methodology, and in particular, a participatory action research approach (PAR), a co-creation framework was designed, implemented and evaluated and its impact on students and on the design outcomes has been assessed. Designed as a meeting place for students, educators, researchers, and external stakeholders, the design studio aimed to bridge across architectural research, pedagogy and society, fostering knowledge exchange and co-production on one hand, while contributing towards sustainability, diversity and inclusivity regarding urban decision-making processes, on the other. Reflecting on the results, various suggestions for improvements are proposed in terms of the outcome, levels of involvement, tools, process and schedule.

Keywords: *Co-creation; community-engaged pedagogy; design studio; participatory action research (PAR).*

1. Introduction

Understanding the impact of transformations and tensions between global and local forces, agents and stakeholders, on contemporary cities, highlights the need to address urban issues collaboratively, through a multidimensional perspective. The adoption of new roles by citizens and professionals (urban designers and architects) is needed "to make cities and human settlements inclusive, safe, resilient and sustainable" (SDG - Sustainable Development Goal 11). The new generation of urban planners and architects has to deal with multidimensional issues and should be trained to respond and design in such an uncertain, diverse and transforming living environment. Thus, current learning and teaching programs in architecture and urban design curricula have been under consideration. The discussion of whether current academic programs can provide helpful and appropriate knowledge, skills, competencies and experiences for their graduates reveals an opportunity to revisit and review current educational tools, methods, and policies at all levels (Charalambous 2018).

A number of studies argue that architectural pedagogy in general and the design studio in particular, are isolated from the real and dynamic world. As Schon (1988) points out, the design studio is "a virtual world that represents the real, but it is relatively free of its pressures, distractions, and risks". According to Dutton (1991) the design studio may lead to isolation from the real world, resisting change and reproducing existing preconceptions. The challenge is to bridge academia and society by reformulating the studio framework itself (Tzonis, 2014) to promote effective interaction with the community and to produce graduates who are able to deal with a multidimensional and challenging built environment. Such a pedagogical approach aims to bring together architectural research, pedagogy and society and can be part of a broader strategy for increasing sustainability, diversity and inclusivity regarding urban decision-making processes.

A community-engaged pedagogical approach can help students to gain valuable experiences and knowledge, bringing them in touch with the community they will eventually serve. Through their collaboration with all stakeholders involved in the shaping of the built environment, students will be exposed to the complexities of the real world and to the principles, tools (physical and digital) and challenges of co-creation. By acting in a transdisciplinary context, they will also develop skills regarding identifying, managing and prioritizing complex issues, fostering critical thinking, cooperation, communication, negotiation and leadership skills, as well as evaluation and reflection competencies.

In this framework, this paper reflects on a pilot community-engaged pedagogical approach developed through a second-year housing design studio at the Department of Architecture, University of Cyprus. The framework of the studio is prompted by the theoretical underpinnings of participatory approaches and builds on the methodology of ULLs (Marvin et al., 2018). Through a PAR approach the studio embraces the training of the future

architects to think and design within a co-creation framework, enhancing sustainability, inclusion, and a "sense of belonging". Research objectives include the design, implementation and evaluation of a co-creation framework within the design studio and the assessment of the impact of such a pedagogical model on students' motivation, skills and the design outcomes

2. Methodology

The proposed pedagogical model brings together three main groups of participants: students, stakeholders (agents/municipality and residents) and mentors (educators/researchers). PAR methodology is employed, due to its participatory, and reflective framework and the circular process of improvement and revision that gives the opportunity for linkages between research findings and the educational approach. Repetitive cycles of design, action, observation and review, connect theory with practice, encouraging reflection and change (Menny et al., 2018). Every circle consists of four phases: 1. the design of the co-creation framework which includes a preliminary site analysis, identification of stakeholders, development of the participation toolkit and action plan, 2. the implementation of the co-creation framework phase which includes 2.1 the co-identification and co-validation phase (identification of needs, issues, opportunities, threats), 2.2 the co-development and co-selection phase (development of scenarios and solutions, selecting the ideal scenario/scenarios), 2.3 the co-implementation and co-creation phase (detailed design and implementation) and 2.4 the co-assessment and co-evaluation phase (assessing the process, tools and design result), 3. the assessing the impact of the co-creation framework phase when the impact of the process is being assessed both for the students' motivation (pleasure and interest, opinions about usefulness and importance, attitudes such as confidence, stress, anxiety) and for the design result (inclusivity, accessibility, functionality, efficiency, sustainability, innovation) and 4. the reflection and recommendations phase which includes improvements and recommendations for the design and implementation of the co-creation framework as well as for the assessment of the impact. (Franta et al., 2018; Ravetz et al., 2018; Reid & Sietchiping, 2015) (figure 1).

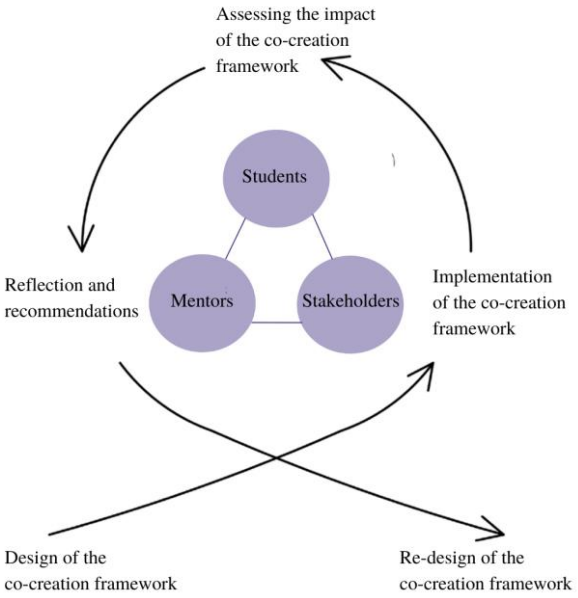

Figure 1. Proposed pedagogical model and PAR methodology.

2.1. Sample, Tools and Limitations

This pilot study was implemented during the spring semester 2021 through a housing design studio, attended by 28, 2nd year architecture students. The theme of the studio explored concepts of "collective living" and "sharing" in a specific site in Nicosia, through the proposed community-engaged approach. A reflection diary, interviews and questionnaires formed the study's data. The reflection diary was used for observing both the students and the design process and outcomes as well as for assessing the co-creation framework and process on both. Questionnaires were used to record the motivation of the students before, during and at the completion of the design studio while interviews and open questionnaires were conducted with the stakeholders at the evaluation phase, to evaluate the tools and the whole process, to record their feelings and spontaneous reactions.

A limitation of the pilot study is the very specific sample (specific students, specific year and university) which may lead to conclusions that cannot at the moment be generalized. In addition, PAR has been questioned for its unclear timeframe and indefinite repeating (Walter, 2009).

3. Outcomes

3.1. Design of the co-creation framework

Step 1: introduction and identification: Students were introduced and informed about the basic definitions of the co-creation process, the objectives and principles.

Step 2: site analysis: The area/neighborhood was analyzed in depth, in order to identify its characteristics and various important aspects (uses, populations, spatial characteristics, demographics, flows, densities, etc.).

Step 3: identification of stakeholders: Students were asked to identify the key stakeholders of the area ensuring a balanced and broad representation (inclusiveness). A group of stakeholders was created with a balance of ages, representation of both genders and representation of different social groups (religion and nationality).

Step 4: development of the co-creation toolkit: The toolkit was developed based on the goals, the desired level of involvement and to achieve transparency and inclusiveness. The selected tools were the questionnaires, the focus groups, the mental maps and the online discussion forum via Facebook.

Step 5: development of a detailed plan: The meetings of the students with the stakeholders were planned in detail and although the combination of digital and physical tools was preferred, due to the pandemic of COVID-19 and the online nature of the design studio, all participation tools were limited to digital format with some of them being adapted accordingly.

3.2. Implementation of the co-creation framework

Step 1: co-identification and co-validation: stakeholders were informed about the process, Iand received information about the site. A Facebook group was created for informing participants about the process, facilitating discussion. A questionnaire on Google Forms aiming at the identification of their needs, was also shared through Facebook (completed by 22 people, with different genders and ages, figure 2). The 1st focus group then took place through Zoom, with the participation of all the stakeholders, to further discuss any issues/opportunities. At the same time, through an interactive Miro online platform, a map of the area was created in which the residents marked important and collective places in their neighborhood. Through the above methods and tools, the main characteristics, challenges and opportunities of the site under study, as well as both the residents' needs and the municipalities' visions were collaboratively identified and discussed. (such as the lack of green/public spaces and collective activities among others).

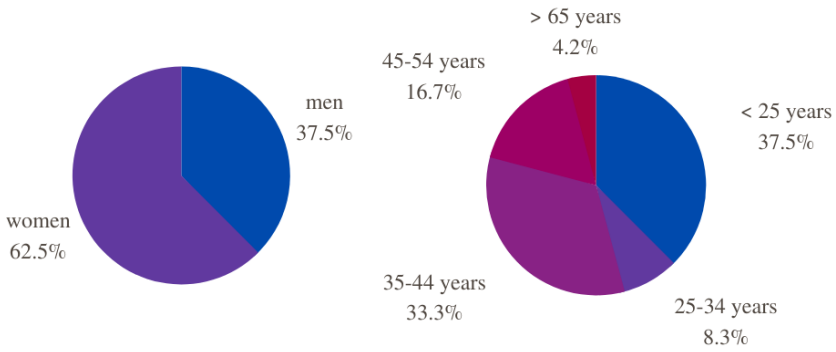

Figure 2. Questionnaires statistics.

Step 2: co-development and co-selection: Based on the needs identified and on the site analysis, students developed preliminary ideas (sketches, concepts, diagrams) and presented them to the stakeholders for feedback and comments, through Microsoft Teams. At the same time, material from the presentations was posted on Facebook to initiate discussion and to ensure transparency and inclusivity. Step 3: co-implementation and co-creation: During this phase, students developed and shared with stakeholders detailed design proposals. None of the stakeholders managed to attend this meeting but all the material was posted on the Facebook group for discussion and feedback.

3.3 Assessing the impact of the co-creation framework

The students' interaction with the stakeholders enabled them to discuss and identify the community's needs as well as to enrich the analysis of the area. During the presentation of the design proposals, and in the 3rd meeting, students referred to the residents' and users' needs and suggestions. They proposed collective spaces with green areas, biological and food markets, spaces for sharing, events and performances. In the following meetings, the students addressed more the issues raised by their teachers concerning the design proposal and less the comments or suggestions of the stakeholders. The process affected to a great extent the initial ideas and concepts, and less the final development of the design solution. Due to Covid restrictions and the lack of on-site meetings, experiential "interpretations" of the area were also limited.

The stakeholders' participation in the whole process was recorded through the observation diary and the interviews, revealing scheduling issues and a gradual decrease of interest and involvement. A lack of face-to-face contact between students, teachers and participants that could encourage further dynamic discussions, spontaneity, a sense of community and trust, was also noted due to the pandemic. The Microsoft Teams tool has been commented by

some participants as inappropriate for an effective collaborative process, as it reduces interactivity. Also, some participants expressed dissatisfaction with the online tools as they did not fully understand their use. Moreover, when answering the online questionnaires, the age of 55-64 was not represented, probably due to the difficulty with online tools. However, it was observed that some participants seemed to have the confidence to express their opinions through online meetings and there was continuous access to information through the Facebook group.

3.4 Reflection and Recommendations

The final design proposals were not significantly affected by the process, probably due to the relatively long periods between the meetings with the stakeholders and the lack of face to face interaction. Reflecting on the above, there are a number of recommendations: discussion forums could be activated more frequently, to enhance interaction; "hands-on" workshops and activities could be organized at different phases, with different levels of participation to enhance an active and personal involvement of the stakeholders in collaboration with the students and mentors. Such workshops as well as more frequent interaction, could facilitate an increased and continuous interest and commitment of the stakeholders. In addition, the possibility of implementing parts of the students' proposals in collaboration with the municipality and the residents could provide further motivation for co-creation and participation. A detailed, step by step schedule and a handbook with the details of the process from the beginning could also help to overcome any difficulties with the scheduling. Difficulties and opportunities of the online tools due to Covid restrictions, highlighted the need for a combination of digital and non-digital tools to enhance interactivity, inclusiveness, spontaneity and transparency.

4. Conclusions

Live project pedagogy can enrich future graduates' ability to deal with the complexity of the built environment. Students have the opportunity to gain valuable experiences by actively being involved in real-world living conditions and by interacting with different actors and disciplines, as well as with the practice. Bridging academia with both the community and the profession in a transdisciplinary manner, gives students the opportunity to act as mediators, to lead, to negotiate, to work collaboratively and to develop transversal skills and competencies (Charalambous 2018). A community-engaged design studio model enhances active participation of the citizens, empowering and engaging them in the shaping of their living environments through shared common goals and vision, as highlighted by the UN-Habitat (Reid and Sietchiping, 2015). Public sensibility about sustainability is embraced in this framework, facilitating the long-term development of sustainable, resilient and responsive living environments.

References

Dutton, T., A. (1991). The hidden curriculum and the design studio: Toward a critical studio pedagogy *Voices in architectural education:* Cultural politics and pedagogy, 165-194.

Franta, L., Dangschat, J. S., & Haufe, N. (2018). D2. 2 Mobility Labs in Practice.

Marvin, S., Bulkeley, H., Mai, L., McCormick, K., & Palgan, Y. V. (Eds.). (2018). *Urban living labs: Experimenting with city futures*. Routledge.

Menny, M., Palgan, Y. V., & McCormick, K. (2018). Urban living labs and the role of users in co-creation. *GAIA-Ecological Perspectives for Science and Society*, *27*(1), 68-77.N. Charalambous and G. Kyriazis, "*Inter Actions*" in Inter Actions. JOVIS Verlag GmbH, 2018.

Ravetz J., Evans J., & Astbury J. (2018) *Looper: Learning loops in the public realm: D4.2 framework for monitoring and evaluation of the Looper living labs.* Retrieved February 10, 2022, from https://looperproject.eu/

Reid, J. & Sietchiping, R. (2015). National urban policy: *a guiding framework*. Retrieved February 10, 2022, from https://unhabitat.org/national-urban-policy-a-guiding-framework

Schön, D. A. (1988). Toward a marriage of artistry & applied science in the architectural design studio. *Journal of Architectural Education*, *41*(4), 4-10.

Tzonis, A. (2014). A framework for architectural education. *Frontiers of Architectural Research*, 3 (4), 477-479.

Walter, M. (2009). Participatory Action Research. Social Research Methods.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14469

Integrating the SDGs into econometrics teaching: An application of the education-research-sustainability learning approach

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Abstract

This article proposes a teaching innovation aimed to deepen the education-research-sustainability teaching strategy by integrating the major challenges facing the planet as set out in the United Nations' SDGs. Thus, the teaching process acquires a professional identity that integrates teaching and research through the interrelation between teaching in the classroom, the analysis and measurement of the SDGs and the research that the teaching staff has been carrying out in this area. This framework is applied to the teaching of econometrics in the different degrees offered by the Faculty of Economics and Business of the University of the Basque Country (UPV/EHU). Results show that the teaching methodology has been supported by the opinion of the students, who state that the teaching methodology proposed has contributed to consolidating the knowledge acquired, has encouraged teamwork, participation in the classroom and has fostered the students' interest in the subject and the SDGs.

Keywords: *sostenibility; SDG; teaching innovation; PBL/RBL; econometrics.*

1. Introduction

Human well-being depends crucially on the Earth's natural resources. Economic, social and technological advances in recent decades have come at the expense of the planet's capacity to sustain present and future human well-being (Rockström et al., 2009; Steffen et al., 2015). Human prosperity today is further threatened by growing inequalities, not only in the distribution of wealth, but in the way global environmental degradation hits the poor and vulnerable hardest and falls hardest on today's youth and future generations. In this context, the 2015 World Summit on Sustainable Development marked a historic milestone by adopting the 2030 Agenda for Sustainable Development, a global roadmap aimed at eradicating poverty, protecting the planet and ensuring prosperity for all people. Since then, the Sustainable Development Goals (SDGs) have become the essential framework for public institutions and social and economic actors to establish their own strategy and action plan.

An example of this is the EHU Agenda 2030 for sustainable development (2019-2025) adopted by the University of the Basque Country, UPV/EHU (UBC, 2018). This agenda includes the contribution of this university to the 2030 Agenda, as well as the rereading of its educational model. The UPV/EHU's IKDi^3 educational model (UBC, 2010) is based on a cooperative, multilingual and inclusive teaching-learning strategy, which makes students the center of their learning with comprehensive, flexible training adapted to the needs of society. This educational model also proposes to multiply learning through research and sustainability, in order to align it both with the most recent pedagogical orientations and with European political priorities.

The aim of this teaching innovation is to deepen the IKDi^3 teaching strategy by integrating the major challenges facing the planet as embodied in the SDGs. In this way, the teaching activity acquires a professional identity that integrates teaching and research through the interrelation between teaching in the classroom, the analysis and measurement of the SDGs and the research that the teaching staff has been carrying out in this area. This framework is applied to the teaching of econometrics in the degrees of Business Administration and Management, Economics and Double Degree in Business Administration and Management and Law offered by the Faculty of Economics and Business of the University of the Basque Country.

The rest of the article is structured as follows: section 2 covers the methodology applied; section 3 the implementation and evaluation of the proposal; section 4 shows the main results, which are discussed in section 5 and section 6 concludes the article.

2. Methodology

2.1. The IKDi³ learning methodology: education-research-sustainability

The teaching-learning strategy of econometrics in the Quantitative Methods department has been developed following the IKDi^3 educational model, approved by the UPV/EHU in 2010 (UBC, 2010): using active methodologies (Project/Problem Based Learning), promoting the use of free software for data analysis, articulating cooperative work and self-learning. Sustainability issues can be also integrated in this learning methodology, as shown by Sáez de Cámara et al. (2021). In this teaching innovation, we aim to explore this educational model in greater depth, aligning it both with current pedagogical guidelines, which consist of multiplying learning through research, and with current political priorities and the great challenges facing the planet as set out in the SDGs. Within this framework, we propose a teaching-learning methodology based on two pillars: i) the incorporation of the SDGs into classroom work, and ii) the use of the Research-Based Learning (RBL) methodology (Healey, 2005). This approach aims to integrate teaching and research by interlinking classroom teaching, analysis and measurement of the SDGs and the research that teachers carry out in this area, thus giving teaching a professional identity.

The teaching strategy for incorporating the SDGs into the empirical econometric analysis is organized as follows. Firstly, the SDGs are presented in the classroom to provide students, with an overview of the sustainable development challenges using the UN website material and with a concise explanation of each SDG using videos from different institutions, including the Rotterdam School of Management, Erasmus University. This material is available on the university's teaching platform. Secondly, the SDGs become the focus of the empirical work by means of the tasks proposed to students in the practical classes.

With regard to the teaching approach, our proposal seeks to ensure that theory and practice are interconnected. We chose the RBL methodology, which integrates theoretical knowledge with appropriate data collection and procedures to analyse and test hypotheses both on the degree of overall compliance with the SDGs and on the factors that may influence their positive evolution. This methodology is applied in practical classes through tasks designed for students to generate new knowledge, either by searching for and synthesising new information, or because the results obtained lead them to work on new aspects of the problem posed. They are structured as follows:

1. Proposal to students on the teaching platform of a script of the work to be done on a given SDG (search for information, detection of problems, etc.) along with some basic references. This work is done in teams outside the classroom.
2. The results obtained by the teams are discussed and compared in the classroom. Students must provide the teacher with evidences of the research carried out, as well as the conclusions obtained from the common work in the classroom.

3. Each team, with the teacher as facilitator, will pose research question(s) and select data sources and econometric modelling.
4. The team works outside the classroom along the above lines. The results and conclusions obtained are presented in the classroom and the teacher offers feedback on the evidence delivered so that the students may know what they have learnt and change, if necessary, their learning strategy to improve their results.

The aim of these tasks is for students to internalise and practise research methods such as formulating a research question, following research procedures, analysing results, presenting them and proposing actions. The first part of the tasks focuses on the search for, preparation and consolidation of the information acquired autonomously, the second helps to resolve any doubts that may have arisen, the third focuses the research work, and the fourth consolidates the progress achieved. In this way, students acquire research skills, which are important for their professional future, and develop skills to deal with uncertainty, independence, teamwork and organisational skills.

2.2. Implementation

A first practical session was devoted to explaining this project framed in the IKDi[3] educational model and to presenting the SDGs by visiting the websites of the UN, the UPV/EHU's Sustainability Office, etc. All this information on the SDGs (presentations, reports on sustainable development, links to websites and videos and final degree projects) was gathered in a specific folder available in the teaching support platform.

Table 1. Topics

Topics	SDG
Overview of the SDGs	SDG1 – SDG17
Wage discrimination	SDG5, SDG8
Life expectancy	SDG1, SDG2, SDG3
Residential demand for water	SDG6
Real state market	SDG11
Recreational demand	SDG3, SDG15
Residential demand for energy	SDG7
Inclusive and equitable education	SDG4, SDG10
Mobility and modal split	SDG11, SDG13

Source: Own source.

The tasks for the practical sessions were designed to explore basic research studies on some topics related to different SDGs (see Table 1) using official databases and the free

econometric software Gretl. The development of these tasks had to be adapted to the special circumstances of the pandemic. Thus, the teaching team made it easier for students to make the connection between their learning and the research frontier sought with the RBL methodology by providing them with worksheets with the proposed research topic, the associated SDGs and the database for them to work on outside the classroom, and by proposing specific research questions for teamwork in the classroom to analyze the SDG in question. In addition, three individual tasks were proposed to ensure that students achieve the minimum level of competences. The students had to analyse the database, specify an econometric model to determine the factors influencing the variable of interest and describe actions to achieve the SDG analysed.

2.3. Evaluation

Two online questionnaires were designed to measure the degree of achievement of the project's objective and the level of student satisfaction with the proposed methodology, using Likert scale responses. The questionnaires were accesible on the teaching platform.

The first questionnaire was administered at the beginning of the course, before introducing the SDGs in the classroom. The first block gathered some basic questions on respondents' personal and academic characteristics; the second block contained 7 questions related to the degree of knowledge about the SDGs, and the third block 7 questions about attitudes, concerns and personal interests about the importance of achieving the SDGs. The results of this first survey gave information about the initial situation of students on this topic.

The second questionnaire, to be completed at the end of the semester, consisted of four blocks: the first two were the same as the first questionnaire; the third, added a few more questions on personal attitudes towards climate change and issues related to the SDGs to the ones included in the first questionnaire; and the fourth block contained some additional questions for the students to evaluate the teaching methodology. The comparison of students' answers to the second and third blocks of both questionnaires and the students' evaluation of the teaching methodology (block 4 of the second questionnaire) used in the course were the basis for evaluating the implementation of the teaching innovation.

3. Results

The sample includes the responses of students in the degrees of Business Administration and Management, Economics and Double Degree in Business Administration and Management and Law. In total, 130 questionnaires were completed in the first survey and 74 in the second.[1]

After completing the course, students seem to have improved their knowledge on what the SDGs are and when the date for achieving these goals is (out of 7 questions on this topic, the students get, on average, 4.38 correct answers in the first survey compared to 4.61 in the second survey). However, the test of equality of means shows that this difference is not statistically significant (p-value=0.257). But when analysing this relationship accounting for the students' interest in climate change, we find that students showing lower interest for climate change significantly improve the number of correct answers (from 3.87 to 4.69, with a p-value of 0.0337). In regard to the students' assessment of the teaching methodology, nearly half (42%) change the way they see climate change, 51% are satisfied with the teaching methodology and 57% consider the work with SDGs to be rather or very motivating. Figure 1 shows that the teaching methodology has contributed to consolidating the knowledge acquired, encouraged teamwork, participation in the classroom, and fostered students' interest in the subject and the SDGs.

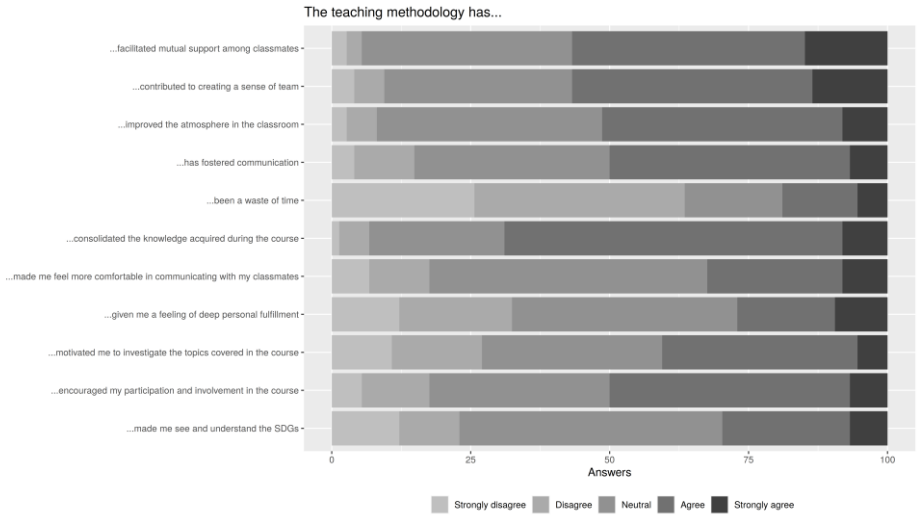

Figure 1. Students' evaluation of the teaching methodology. Source:own elaboration.

[1] Collection of data was affected by the COVID19 pandemic situation. While the first questionnaire was mostly answered in class time, the second questionnaire was mainly answered outside the classroom due to time constraints. As a result, participation was significantly reduced from the first questionnaire to the second.

4. Discussion

Given the implementation of the project methodology and the responses obtained in the initial and final surveys, we find that students have improved their general knowledge of the SDGs and that they have learned that the UPV/EHU has its own agenda for sustainable development. Concerning the students' personal attitudes, the implementation of the project has not significantly changed their involvement with the issues related to the SDGs. It seems that this methodology has encouraged them to think more of them, but it has not motivated them to take the SDGs into account in their daily lives and to take personal actions and initiatives. This is probably due to the fact that changes in attitudes require a longer period of time than a semester. However, quite interestingly, the attitudes towards climate change issues and recycling have improved significantly among students who initially showed a low interest on these issues, suggesting that attitudinal improvements may be easier to capture when starting from lower grounds.

As for the assessment of the teaching innovation itself, although students are generally satisfied with the teaching methodology, they do not seem to have a good understanding of its purpose and functioning. The work done with the SDGs did not have a significant influence on their motivation to study econometrics. This result suggests that students are motivated to carry out exercises and practices that apply the econometric methods explained in the theoretical classes, but not so much in the specific subject they are working on.

A proposal for future improvement would involve to increase the team work time in the practical classes devoted to the SDGs. Each team would elaborate a poster showing the results obtained in the classroom, including an introduction to a chosen SDG, the research questions to be reaised from the point of view of econometrics in relation to the SDG, and a summary of the main conclusions obtained. Later, the poster would be uploaded to the teaching platform so that it is available to the rest of the teams in the classroom. Besides, the work of each group would be presented in a seminar, to promote the cooperative knowledge of the rest of the students and the discussion on the chosen SDGs. Finally, students would prepare a final research report summarising their findings during the semester.

It is important to stress that although the general objectives of the project were achieved, the pandemic situation experienced in the course 2020-2021 significantly altered the planning of the teaching innovation, delaying its implementation in the classroom from the second term of the academic year 2020/2021 to the first term of the academic year 2021/2022. In addition, this last course began with bimodal teaching, so that student attendance was reduced to 50% during the first 3 weeks of the course (20% of the total hours). The sessions delivered with the bimodal system did not progress at the stipulated pace, the time spent on the scheduled tasks was reduced and the RBL methodology used in the tasks was loosened. This has almost certainly influenced the results, which should be read with caution.

5. Conclusions

This article presents the main results of the teaching innovation developed by the econometrics teaching team of the Department of Quantitative Methods of the UPV/EHU. The teaching innovation has been based on a rereading of the UPV/EHU's own educational model, IKDi^3 consisting of multiplying learning through research and sustainability. Our goal was to integrate the international framework of the SDGs and the research developed in this field within the Department of Quantitative Methods into the teaching of econometrics in the different degrees offered at the Faculty of Economics and Business.

To measure both the degree of achievement of our objective and the students' level of satisfaction with the chosen methodology, two questionnaires were designed to be filled in by the students at the beginning and end of the course. The results show a slight increase in the average number of correct answers to the basic questions on the SDGs, although this difference is not statistically significant. However, further analysis, differentiating students by their initial interest in climate change (high interest or low interest), shows that the intervention has a greater effect on students who start with a low interest in climate change. This result suggests that the teaching innovation has succeeded in arousing interest in this topic, especially among those students who initially viewed it with more distance.

The teaching methodology has been supported by the students' opinions in terms of their vision of climate change and their positive assessment of the teaching-learning process and the integration of the SDGs. Furthermore, students state that this methodology has contributed to consolidating the knowledge acquired, encouraged teamwork, participation in the classroom, and fostered their interest in econometrics and the SDGs.

References

Healey, M. (2005). Linking research and teaching to benefit student learning. *Journal of Geography in Higher Education*, 29, 183–201.

Rockström, J. et al. (2009). A safe operating space for humanity. *Nature*, 461, 472–475. doi.org/10.1038/461472a

Steffen, W. et al. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science* 347, 1259855. doi.org/10.1126/science.1259855

UBC, University of the Basque Country (2010). IKDi3 strategy. Retrieved January 29, 2022, from https://www.ehu.eus/en/web/iraunkortasuna/ehuagenda-2030/ikd-i3-estrategia.

UBC, University of the Basque Country (2018). EHUagenda 2030 for sustainable development. https://www.ehu.eus/documents/4736101/11938005/EHUAgenda-2030-ENG.pdf/487b2c83-51e1-d0e2-dcd1-af419b2b5c26?t=1559656838000

Sáez de Cámara E, Fernández I, Castillo-Eguskitza N. (2021). A Holistic Approach to Integrate and Evaluate Sustainable Development in Higher Education. The Case Study of the University of the Basque Country. *Sustainability*. 2021; 13(1):392.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14590

Increasing Students' Felt Need for Teamwork: An Experiential Learning Exercise that Sets the Stage

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Abstract

This paper describes an innovative learning exercise used in three management classes and inspired by the popular group experience-based game of "escape rooms." Within one 75-minute period, the exercise engaged students and increased their awareness of and motivation for effective teamwork. Our qualitative analysis of the reflection reports students individually wrote immediately after the lesson, shows that the exercise was successful in increasing their knowledge of effective teamwork, creating the felt need for proactively planning their team process, creating the desire to develop more of their own teamwork skills, and arriving at the undeniable realization that working as a team is better than working individually on complex tasks. This exercise adds to the instructor interventions needed in college classes when professors assign term-long team projects with the goal of helping students develop their teamwork skills and be better prepared for the workplace.

Keywords: *Team building; team effectiveness; classroom teams; collaboration; experiential learning; higher education.*

1. Introduction

The importance of teamwork skills in today's organizations is well accepted (Gresch et al, 2020). As businesses deal with increasing complexity due to globalization, the rapid pace of technological change, and intense competition, they look to hire and retain employees who can effectively collaborate with others in teams to produce creative outcomes, complex decision-making, and problem-solving (Gresch et al, 2020; Saghafian and O' Neill, 2018). Therefore, organizations often seek to hire and retain college graduates with not just technical skills but also soft skills such as communication, conflict management, and teamwork (Halfhill & Nielson, 2007; Schartel Dunn et al, 2021). In preparation, many college professors, particularly in business schools, place students in small groups, assign them a semester or term-long team project, and expect that, through first-hand experience, students will acquire the wisdom and skills required to be productive members of work teams (Hunsaker *et al.,* 2011). However, scholars have found that college professors need to do more than simply assigning students to team projects (Schartel Dunn et al, 2021). Leaving students to decipher the ins and outs of effective teamwork without instructor intervention often leads to confusion, frustration, and deep cynicism about teamwork itself.

The literature offers advice on how and when professors should conduct team building, in particular: (a) requiring student teams to construct a team charter or contract that generates discussion, makes explicit members' expectations on team goals, how progress will be measured, rules of conduct and engagement, and how members will hold each other accountable – thus helping to navigate the often confusing forming stage of team development (Hiller and Dunn-Jensen, 2012; Hunsaker *et al.,* 2011); (b) implementing a detailed, consequential (substantially impacting each student's grade) peer evaluation system that includes multiple specific criteria communicated up front and utilized by students who must complete a formative mid-project as well as summative end of semester evaluation (Jassawalla & Sashittal, 2017).

Despite offering instructors advice on multiple team building activities, the literature reflects that the challenge of helping students learn teamwork skills continues (Schartel Dunn et al, 2021). While utilizing team building early in the semester by assigning student teams the task of creating a team charter is a sound suggestion, it is based on the assumption that students can meaningfully discuss their expectations in a vacuum. Scholars who have provided guidelines for the team charter activity, often ask students to reflect on experiences and problems encountered in previous teams (Hillier & Dunn-Jensen, 2012). One flaw is that the team charter is built on expectations from other, previous teams rather than the specific team for which the charter is being written. We therefore propose a new learning activity that will fill this gap.

2. An Innovative Experiential Learning Exercise to Set the Stage

This paper introduces an instructor-guided learning exercise that, we contend, provides a stronger basis for team building than previous advice because it (a) provides students authentic initial experience working with their assigned team as a basis for discussing expectations and next steps, and (b) shapes students' initial attitude towards teams and the team process. This could lead students to more enthusiastically undertake the steps prescribed in the literature and introduced by their instructor such as the team charter and formative and summative peer evaluations. Scholars have hinted at this, indicating that before undertaking team building activities the professor should prepare students and create positive attitudes that increase their motivation for developing effective teamwork (Bryant and Albring, 2006). Additionally, active and experiential or experience-based learning are widely seen as the best ways to help students acquire new attitudes and soft-skills (Conklin & Boulamatsi, 2020; Kolb & Kolb, 2005). However, the literature provides scant evidence of such immersive experiential exercises designed and implemented in ways that trigger positive attitudes and complex learning up front. Therefore, we describe an innovative classroom activity we implemented for this purpose.

The exercise was designed by a co-author in collaboration with fellow librarians. It was inspired by *Escape Rooms* that are a popular leisure activity among students along with their friends and families. The escape room game combines the challenges of working with a group and solving a series of puzzles together by interpreting clues. Another co-author who teaches business management courses, after hearing about the exercise, had the idea to use it as a prelude to team building activities for their classes in which they utilize both the team charter and a consequential peer evaluation system. Many games involve problem-solving and teamwork, but the escape room game was appealing because (a) it includes more than one puzzle or problem to solve at once, incentivizing cooperation and teamwork, and the puzzles escalate in level of difficulty and creativity needed, (b) the combination of escalating difficulty and competition with other teams in the class simulates the challenge of changing strategies and actions as the task gets more difficult, and (c) it efficiently provides students with first-hand experience and data that shape their attitudes towards teamwork and raise awareness of new skills and actions needed.

Together, the co-authors designed follow-up reflection questions that students would individually answer at the end based on their experience in the escape room exercise. The learning objectives were to provide initial experience with teamwork that enables students to: 1.) identify key components of effective teamwork, 2.) explain individual and group actions that should and should not be used to achieve successful group outcomes, and 3.) recognize whether team or individual work is better for complex tasks and projects.

This exercise was conducted in the third week of a 16-week term in three management classes taught by the co-author at an AACSB-accredited business school in Northeast USA – two undergraduate classes in Organizational Behavior (required course for students pursuing their Bachelor's degree); and one graduate class in Leadership in Organizations (elective class for Master's program). Students, between 20-25 years of age, were assigned to teams of 3 to 5 members. There were 14 teams (5 in two of the classes and 4 in the third class), and a total of 49 students participated in the exercise with each student submitting their report of reflections and learning. Only one team from each class successfully completed all the puzzles and "escaped" within the allotted time. While teamwork is a topic of discussion in these classes, this exercise was conducted before any lecture, reading, or discussion on the topic had taken place. Students answered the follow-up questions reflecting purely on their experience during this exercise.

3. The Escape Room Exercise: Implementation Guidelines

The in-depth documentation for this exercise, which includes more detail about each puzzle and how it fits into the whole, can be found at https://bit.ly/InternOpDB.

3.1. Physical Setting

The exercise requires a classroom with seating around tables large enough to accommodate up to 6 students (less if the class is small), a student body with their own laptops (or sufficient laptops to provide at least one per group), and a whiteboard.

3.2. Preparations

The instructor should prepare one manila folder for each group of students, containing the two elements of the Gantt chart puzzle (the Gantt chart and the transparency with lines and circles) as well as the Critical path puzzle. These can be pre-placed or handed out during the explanation of the exercise. On the whiteboard, write the following hints: "Things to keep in mind: 1.) Bit.ly links are CASE SeNsItIvE, so type them in exactly as you see them. 2.) Read the instructions on everything you find. 3.) Every website involved with the challenge will be obviously connected to it. 4.) Some googling may be required for solving some puzzles."

Write down the link for the students to get to the starting document either as a handout or on the board: http://bit.ly/InternOpSafeT. Conceal it until the start of the exercise.

3.3. Initial Instructions

Start the experience by reading and performing the predetermined script to set up the framework for the scenario. The framework was as follows: a surveillance technology company with a long-standing relationship with the fictional McConie School of Business

(of which the students are told they are now members) created a competition as a non-standard interview process for a series of paid internships. The first team to complete the challenge within the time limit (45 minutes) will be guaranteed consideration for those paid positions, pending background checks. A secondary (also fictional) prize of non-paid internships is awarded to groups that complete the puzzle after the first group and within the time limit. Once the scenario is introduced, reveal the link and tell students to start.

3.4. Running the exercise

Apart from the basic conceptual hints posted on the board, do not provide active assistance or hints. The instructor's role during the 45 minutes is to monitor the groups and take notes on their group dynamic. Apart from that, there should be no interaction with students apart from referring them to the whiteboard when they have questions.

On the student side of things, the experience consists of two stages designed so that a group of up to 6 people can productively engage with it simultaneously. This is achieved using interlocking puzzle features that force participants to communicate to solve each other's puzzles. The first stage includes two tracks of puzzles; a physical set of puzzles in the folder and an online form with multiple links leading to web pages with clues and a password-locked google form. The physical puzzle unlocks one half of the stage 2 puzzles, and unlocking the google form leads to the other half. The second stage comprises the two forms unlocked by the physical and online challenges, which work together as the final challenge. Once all of the puzzles are successfully unlocked, the group gains access to a google form that records the time stamp to win the experience.

3.5. Discussion following the exercise

At the end of the 45 minutes, instruct students to take 10 minutes and individually note their responses to the following questions based on the Escape Room exercise – each students' reflection report must be submitted at the end of class for participation points:

1. What puzzles did your group complete quickly? Identify and briefly explain at least 2 ways in which your group dynamics (how your team communicated/shared information, connected/worked together, provided leadership) helped with that progress?
2. What puzzles did your group have trouble with? Identify and briefly explain at least 2 ways in which your group dynamics hurt progress?
3. If you were able to do this group activity again, what would you do differently to improve your group dynamics? Note (a) at least 1 action you would take individually and (b) at least one action/improvement you would recommend to the group overall?
4. How did this team activity work compare to if you had to solve all the puzzles on your own/individually?

The last 10 to 15 minutes are used for class discussion during which the instructor asks students for their response to each question, probes for clarity and examples, notes key points on the whiteboard, and summarizes the key conclusions.

4. Students' Reactions and Learning

A qualitative analysis of students' written reflections was conducted to identify the major themes. These reveal that the Escape Room Exercise served well to raise students' awareness and understanding about what constitutes effective teamwork, the felt need to focus on team process planning before diving into the project, and the individual skills and attitudes each team member felt they needed to develop if their team is to achieve its goals. An overarching theme was (47 out of 49 participants noted) students' experientially based understanding that teamwork is much better for accomplishing complex tasks compared to individual work. Surprisingly, this included students in majority of the teams that failed to complete all the puzzles and were unable to "escape" or win, and instead faced disappointment and defeat. Yet students weighed in favor of teams and recognized what worked and where they needed future improvements and skill-building. Next, we highlight the themes we drew from students' individual responses to the reflection questions.

Table 1: Students' Learning from the Escape Room Exercise

Theme	**Key Learning**	**Quotes from students' reflections after the exercise**
Effective Teamwork Components.	Open & frequent Communication. Collaborative attitude from every member. Absence of social loafing.	"Open communication with every member sharing ideas (lack of social loafing) helped the team to solve puzzles efficiently. This showed that combining the efforts of team members results in swifter task completion." "Working collaboratively, encouraging and accepting attitude aimed at finding the right answer to the puzzles without arguments or judgments, increased team members' motivation. This showed that accepting and trying out every idea, no pressure to solve parts any member did not know because others were there to help out - increased team members' feelings of responsibility towards the team."

Felt need for planning the team process.	Need to proactively plan team process. Need for team roles, especially leader role Need for constructive conflict.	"When task got more complex and required more creativity and out-of-the-box thinking, simply pooling individual ideas and brainstorming did not work (as it had before). With complex, creative aspects of the exercise, rushing ahead without adequate planning and thinking through instructions, getting everyone on the same page, does not work. Team did not know how to generate and utilize synergy." "I would ask someone to take leadership so that our efforts would be more organized and streamlined. "Groupthink crept in – members realized the team's strategy was not working but withdrew rather than expressing that the team needed to change its game-plan."
Felt need for individual skill development.	Combination of assertiveness and cooperativeness. Taking a "big picture" view. Taking initiative & leadership.	"Individually, I would let team members know when I thought they should give up on their idea and move to something else." "Individually, I would focus more on coming up with new approaches more rapidly in the future to try and make progress instead of only focusing on one aspect or task. "One action individually would have been to take charge. I think we lacked a leader in our teamwork."
Teamwork benefits vs individual work	Teams are more efficient for complex tasks. Teamwork increases member motivation on complex tasks.	"If I had done this on my own, it would have taken me much longer than it did with the group. Everyone had different approaches and knowledge that helped speed the process up." "Being able to work with a team allowed me to ask for others' help and get their insight on puzzles I struggled with. "Working with other people kept me motivated (and gave) better chance of completion."

5. Conclusion

This paper is aimed primarily at two types of college professors: (a) those who want to educate their students on the importance of team over individual efforts and highlight how working in teams requires a different set of attitudes and skills, and (b) those who are already utilizing team building steps such as the team charter and peer evaluations, and are looking for an efficient way to "set the stage," increase students' receptiveness to team building and development of soft skills. As our results indicate, the Escape Room exercise actively engages college students and generates insights through their first-hand experience. It creates the felt need for (a) teamwork in complex endeavors, and (b) early attention to planning the process of team interactions. It also increases students' awareness of which actions add and subtract from team effectiveness, and how they should develop their own skills to aid in the process. Thus, college instructors can, within one 75-minute class period, take an important step in shaping students' positive attitudes and motivation for team building. This exercise is particularly well-suited to classes that include team dynamics as a topic such as Organizational Behavior, Leadership, Group Dynamics, Organizational Communication, and Conflict Management. Future research could generate additional findings by conducting this exercise in other classes, both in and those outside the business school, that utilize team projects to enhance students' teamwork knowledge and skills. College professors in other disciplines who utilize team projects in their classes could consider using this innovative approach to increase students' awareness of the team process and how to improve it in order to do well on the team project.

References

Bryant, S. M., & Albring, S. M. (2006). Effective team building: Guidance for accounting educators. *Issues in Accounting Education*, 21 (3): 241-265. https://doi.org/10.2308/IACE.2006.21.3.241

Conklin, T., & Boulamatsi, A. (2020). Decision-making: The process is the content in an experience-based classroom. *Decision Sciences Journal of Innovative Education*, 18(4): 635-658. https://doi.org/10.1111/dsji.12224

Gresch, E., Saunders, M., & Rawls, J. (2020). Are we bonding yet? Using a mixed-methods survey design to evaluate team-building exercise outcomes. *Business Education Innovation Journal*, 12(1): 83-91. http://www.beijournal.com/images/V12_N1_final_9_11.pdf

Halfhill, T. R., & Nielson, T. M. (2007). Quantifying the "softer side" of management education: An example using teamwork competencies. *Journal of Management Education*, 31(1): 64-80. https://doi.org/10.1177/1052562906287777

Hillier, J. & Dunn-Jensen, L. (2012). Groups meet . . . Teams improve: Building teams that learn. *Journal of Management Education*, 37(5): 704-733. https://doi.org/10.1177/1052562912459947

Hunsaker, P., Pavett, C., & Hunsaker, J. (2011). Increasing student-learning team effectiveness with team charters. *Journal of Education for Business*, 86(3): 127-139. https://doi.org/10.1080/08832323.2010.489588

Jassawalla, A., & Sashittal, H. (2017). What students think and do in classroom teams when peer evaluations are highly consequential: A two-stage study. *Decision Sciences Journal of Innovative Education*, 15(2): 219-247. https://doi.org/10.1111/dsji.12127

Kolb, A., & Kolb, D. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of Management Learning & Education*, 4(2)(: 192-212. https://doi.org/10.5465/amle.2005.17268566

Saghafian, M., & O' Neill, D. K. (2018). A phenomenological study of teamwork in online and face-to-face teams. *Higher Education*, 75(1): 57-73. https://doi.org/10.1007/S10734-017-0122-4

Schartel Dunn, S., Dawson, M., & Block, B. (2021). Teaching teamwork in the business school. *Journal of Education for Business*, 96(6): 381-386. https://doi.org/10.1080/08832323.2020.1840322

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14658

The Agile Paradigm and Organisation Development in Higher Educational Institutions

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Abstract

This article has two objectives. First, is to provoke consideration as to whether a set of constructs known as 'the Agile Paradigm' provides a relevant model for organisation development in Higher Education Institutions as they confront a period of increasingly VUCA (volatile + uncertain + complex + ambiguous) conditions, a changing and threatening competitive environment, a need to become stronger in facilitating personal development and a different landscape of opportunities and threats largely provoked by the onset of the 4th Industrial Revolution.

The second objective is to outline the findings of a scoping research study into the range of competences that will be needed by future students of Management to enhance their ability to be agile – resilient, efficient and effective - when facing 21st century challenges.

Keywords: *Agile Paradigm; 4th Industrial Revolution; Requisite Agility; Organisation Development in HE; Competences of Students of Business; Entrepreneurship and Management.*

1. Introduction

This article draws from three decades of research and scholarly analysis to present an argument that a set of constructs, collectively known as the 'Agile Paradigm', provides a timely organisation development model for Higher Education (HE) Institutions. This is needed as many HE Institutions are seeking to acquire the range of organisational competences required to address novel challenges that many currently face, resulting from (i) the emergence of the 4th Industrial Revolution; (ii) increasingly VUCA (volatile + uncertain + complex + ambiguous) conditions; (iii) high levels of radical technical innovation; (iv) growing requirements for responsible strategies; (v) a need to prepare students for careers that will be replete with uncertainty and (vi) major changes in the competitive environment for HE products and services.

In addition, we outline the findings of a scoping research study into the specific competences that will be required by students of management to enhance their ability to be resilient, efficient and effective when working in agility-intensive enterprises.

The article is structured as follows. First, the early development of the Agile Paradigm is described; second, later developments related to agility-orientated organisation development are summarised; third, the relevance of the Agile Paradigm for HE Institutions is explored; fourth, the findings of a scoping study into the competencies needed to be efficient, effective and personally resilient in the mid-21st century are presented and, fifth, implications for educators are outlined.

2. The Development of the Agile Paradigm

The context for the development of the Agile Paradigm was a worsening crisis for western manufacturing companies that became, pervasive severe and damaging in the 1980s. Asian rivals had gained comprehensive competitive advantages and entire western industries were at risk of collapse. Analysists found many generic weaknesses, including slow responsiveness, a lack of flexibility, high costs, intractable quality problems, a weak capacity to reconfigure resources rapidly, ineffective project-based management and an inability to undertake rapid value-creating innovation (Womack, Jones, & Roos, 1990).

In 1991, to seek ways to address these pressing industrial, social and economic problems, the US government sponsored a major industry-led study that brought 100 senior executives from major American companies to the Iacocca Institute in Bethlehem, Pennsylvania for an in-depth problem-solving process. This high-level taskforce concluded that American companies needed to be reconfigured radically, so that they became *Agile*, meaning that they (i) were quick to create and seize opportunities; (ii) able to customise products for individual customers; (iii) were early and capable adopters of hard technologies (like digitalisation) and

(iv) soft technologies (like quality control) and (v) utilised fully the latent talents of employees through directed empowerment. This combination of needed organisational attributes was dubbed by the Iacocca taskforce as the 'Agile Paradigm'.

3. Agility-Orientated Organisation Development

Concepts and techniques that enable organisations to adopt the Agile Paradigm have evolved considerably since the Iacocca study. This was needed as those who manage organisations became aware of the transformational impact of socio-technical forces that are reshaping many aspects of society, described as the 4th Industrial Revolution. Key features have been summarised by Kuzin (2021, p. 194) who stated that: "Globalization and Fourth Industrial Revolution have transformed technology, society and the way of our life, global economy, markets and competition, industries and organizations, communications, and business models". Of great importance are the consequences of advances in digital technologies that create opportunities and destroy key elements of competitive advantage in many industrial sectors, including HE. Also important are changing corporate ethics, as environmental sustainability becomes an increasingly important agenda item for top managers. These are examples of a world that will be increasingly characterised, at least in part, by being VUCA (volatile + uncertain + complex + ambiguous).

Early developers of concepts and techniques for structured agility-orientated organisation development were military organisations, including NATO, (Alberts & Hayes, 2003). As it was shown that advances in digital technology could enable previously impossible levels of competent decentralised decision-making. Large companies, like IBM, previously castigated for being ponderous and bureaucratic, (Gerstner Jr., 2002) adopted ways of organising that greatly strengthened their dynamic capabilities. Work at the Centre for Research in Innovation Management in the UK identified the specific characteristic of enterprises that were systemically agile (Bessant, Francis, Meredith, Kaplinsky, & Brown, 2001). Developments in project management, especially in the software industry, made huge strides in developing capable and intrapreneural teams (Verheyen, 2019). More recently, techniques have been developed for achieving *requisite* agility that is needed "as not all organisations need to be agile; not all parts of an organisation need to be equally agile and not all organisations need to adopt the same type of agility" (D. L. Francis, 2020, p. 169). Extremely influential are case studies of outstandingly successful 21st century businesses, like Amazon, Facebook and Netflix (Dutta, 2019; Smith, 2018), as these demonstrate the importance of developing high levels of personal and organisational agile competences in people and systems and embedding agility-orientated values into an organisation's culture, both at organisation-wide and local levels.

4. The Relevance of Agility-Orientated Organisation Development for HE Institutions

Larger HE Institutions, but not all specialised HE colleges, have unusually complex organisational challenges which hinder them from developing agile capabilities. This is because they face a range of fundamental tensions between functions that are not present in enterprises with a single strategic driving force. Especially significant are tensions between: (i) providing quality-assured qualifications for students; (ii) ensuring that academic staff to remain at the cutting edge of their disciplines; (iii) taking multiple steps to increase the probability that students will enjoy a life-affirming experience; (iv) requiring that professional staff undertake developmental projects to complete research, increase impact, develop new capabilities and adopt beneficial technologies and (v) ensure that different areas of study develop a distinctive identity, acquire relevant dynamic and operational capabilities and develop governance procedures specific to their specialisation.

Each of these functions requires a different type of organisation, thereby greatly increasing complexity. Adapting Mintzberg's contingent organisational model (1998), the first key deliverable mentioned above (providing assured qualifications) requires a *disciplined bureaucracy* form of organisation in which individuals competently perform their prescribed roles; the second (maintaining expertise) requires a *professional bureaucracy* organisation in which specialists act as intrapreneurs within their areas of influence; the third (building an inclusive and supportive culture) requires a *values-led* organisation that drives institution-wide socialisation to develop a coherent organisational culture; the fourth (undertaking new initiatives) requires short-term adaptive micro-organisations or '*adhocracies*' and the fifth (having appropriately differentiated specialist units) requires a *divisionalised* form of organisation. Each of these forms of organisation needs a very different managerial approach that increases complexity and slows enterprise-level adaptation.

A recently developed model for agility-orientated organisational development (D. L. Francis, 2020, pp. 18–20) addresses this type of organisational complexity by using a two-level framework: (i) systemic and (ii) local. Level One (systemic agility) refers to the organisation as a whole that needs, through actions and patterns of commitment decisions, an evolving and agile-friendly organisational personality or identity, held in place by shared beliefs, common values and shared intent to realise an enterprise ambition - the 'kind of organisation that we want to become'. Level Two (local agility) relates to 'sub-units' that may be departments, services, functions, initiatives or capabilities. Local agility is needed as not all parts of an organisation need to be equally agile and not all sub-units need to be agile in the same ways. A localised approach to organisation development requires working with sub-units separately, thereby increasing the developmental workload, but this increases the probability that the deliverables required from requisite agility will be entirely apt for sub-units.

Localised agility capability development will be targeted at one or more of the domains of the 6Ps model (D. L. Francis, 2020, pp. 33–35). These are *Product Agility* (P1) that targets outputs of a sub-unit that are provided to external and/or internal customers and/or other stakeholders. *Process Agility* (P2) targets sequences of activities that enable core tasks to be accomplished and integrated. *Positional Agility* (P3) targets how a sub-unit communicates with customers (internal and external), potential customers, entities in its ecosystem and stakeholders or influential bodies. *Paradigm Agility* (P4) targets principles of organising and systems of thought and includes the constructs that people within a sub-unit use to make sense of the world. *Provisioning Agility* (P5) targets where and how resources are obtained including financial, knowledge, technological, locational, contractual, reputational or legal assets. *Platform Agility* (P6) targets how outputs are integrated to be readily accessible.

The inherent complexity of larger HE Institutions means that many, perhaps all, of the sub-units will be significantly differentiated in terms of their outputs, organisation type, functions performed, dynamic and operating capabilities needed, exposure to change drivers and their need to be proactive in relation to 'do-different' and 'do better' opportunities and threats in any, or all, of the 6P areas described above. Accordingly, each sub-unit needs to possess considerable strategic competence that includes determining where and how their sub-unit needs to be agile by: (i) appropriate use of organising frameworks known as 'scrums' (self-managed teams); 'tribes' (interdependent teams that work in the same area); 'chapters' (individuals with similar specialisms who learn from each other) and 'guilds' (knowledge-sharing communities); (ii) adoption of technological advances to facilitate step-changes in process cycle-times and to facilitate beneficial coordination; (iii) improving processes for creating or identifying potentially beneficial opportunities and establishing ad hoc organisations to progress them; (iv) developing people, technologies, systems and learning practices situationally relevant agile competences.

It is essential to note that the empowerment of sub-units as strategic hubs in the way described above can become dysfunctional if increasing diversity undermines institutional-level strategic coherence. For this reason sub-units need to be constructively confined to act as entities with strong fractal characteristics (Sihn, 1998) meaning that their permitted individuality will be limited by a requirement to adhere to the vision, mission, values, collective ambition and core processes of the wider organisation.

5. Changing Required Managerial Competencies

The arguments presented above have focused on HE institutions but the need for requisite organisational and personal agility is widespread, probably ubiquitous, as it affects all forms of enterprise. This is widely recognised and the acquisition of requisite agility is a top-five priority for many of the world's larger companies (Wouter, Handscomb, Salo, & Thaker,

2021). In the remainder of this article, we consider the implications for those who educate future managers, entrepreneurs and leaders.

Curricula for delivering managerial education programmes should be based on an insightful and evidence-based conceptualisation of the likely changes in the nature of managerial work in future decades. This facilitates the development of a comprehensive definition of the range of competences that will be needed by individuals who will play these roles. Subsequently a facilitative pedagogic architecture for students of management, and kindred disciplines, can be constructed.

It is predicted that, in the next 20 years, much routine work will be performed by intelligent machines so the centre of gravity of managerial work will shift towards performing non-routine activities that, by their nature, will require high levels of organisational and personal agility. As explained above, the competent management of non-routine activities requires that an organisation be systemically facilitative and sub-units must be responsibly opportunistic in driving progress in one or more of the 6P areas specified above. This enables managers to be capable of developing and implementing situation-specific theories of Winning, Change and Action.

Although managerial situations vary significantly it is necessary for educators to develop a generic model to enable them to develop a core pedagogic architecture. To experiment with constructing such a framework the author undertook a scoping research investigation to develop a model using input from practicing senior managers undertaking non-routine tasks. The research design was straightforward. Earlier the author and a colleague had written a book (D. Francis & Woodcock, 1996) that had listed 12 competences needed by managers to enable them to cope creatively with the uncertainty, complexity and opportunities of managerial life. The competences assessed concerned: (i) self-management; (ii) values clarification; (iii) visioning; (iv) creativity; (v) personal development; (vi) problem-solving and decision-making; (vii) goal setting; (viii) management style; (ix) organising skills; (x) teambuilding skills; (xi) developing others and (xii) customer focus.

Between 2016 and 2019 the author was given access by UK's Henley Management College to 16 management teams (average size 5 team members) who were studied as they explored radically different futures for a global civil engineering company. Each team was observed for at least eight hours by the researcher who used the 12 categories outlined above as a coding system and recorded when each was demonstrated. In addition, the researcher noted when an additional competence, not included in the coding system, was demonstrated. It is important to state that this study required subjective assessments that were not validated by an independent researcher so the findings must be considered as illustrative, not definitive. When the data were analysed, it was found that each of the 12 competences listed above had been demonstrated and six additional competences were identified. These were (a) influential

networking; (b) risk assessment; (c) systems (especially digital) design; (d) reflective practice; (e) fast responsiveness and (f) willingness to take responsibility.

In this short article we cannot explore these dimensions in depth but can use them identify a key challenge for HE Institutions. Put simply it is this. Most of competencies needed for an individual to be capable of operating effectively in an agile-intensive environment concern issues like the character, grit, emotional intelligence, interpersonal skills and self-management. Attributes such as these are not developed in libraries or lecture halls but when students face real-life issues, overcome difficulties, build teams, achieve success, receive feedback and participate in experiential learning. Many, probably most, HE institutions currently see their core task as conveying bodies of knowledge and developing academic skills. Although beneficial, this orientation provides insufficient personal development in the areas mentioned above as these need inner-directed competencies that fall outside of the scope of traditional academic learning. So, should we consider that HE institutions are institutionally unable to provide the required capability building? In the opinion of this researcher the answer is firmly 'no'. Although not mainstream, there are many examples of HE professionals who have developed educational initiatives that address a generic need for individuals, teams, organisations and enterprise ecosystems to become resilient, adaptive, opportunistic and dynamic using methods such as Action Learning (Sanyal, Rigby, Nicholds, & Hartog, 2015), Team Academy (Tosey, Dhaliwal, & Hassinen, 2015), Emotional Intelligence Development (Boyatzis, Goleman, & Rhee, 2000) and Scrum Organisation (Verheyen, 2019). It is possible to build on these initiatives and use similar processes to develop those who have management roles in HE Institutions so that students experience learning within a requisitely agile organisation.

References

Alberts, D. S., & Hayes, R. E. (2003). *Power to the Edge: Command, Control in the Information Age*. CCRR Publication Series. https://doi.org/10.1038/nri2836

Bessant, J., Francis, D. L., Meredith, S. E., Kaplinsky, R., & Brown, S. (2001). Developing manufacturing agility in SMEs. *International Journal of Technology Management*, *22*(1/2/3), 28–54.

Boyatzis, R. E., Goleman, D., & Rhee, K. (2000). Clustering competence in emotional intelligence: Insights from the Emotional Competence Inventory (ECI). *Handbook of Emotional Intelligence*. Retrieved from http://www.eiconsortium.org/pdf/eci_acticle.pdf

Dutta, S. (2019). Netflix Flexes Muscle to Take On Competitors. Bangalore: Amity Research Centers Headquarters.

Francis, D. L. (2020). *Exploiting Agility for Advantage: A Step-by-Step Process for Acquiring Requisite Organisational Agility*. Berlin: De Gruyter.

Francis, D., & Woodcock, M. (1996). *The New Unblocked Manager: A Practical Guide to Self Development*. Aldershot: Gower Publishing Company Ltd.

Gerstner Jr., L. V. (2002). *Who Says Elephants Can't Dance?: Inside IBM's Historic Turnaround*. London: HarperCollins.

Kuzin, D. V. (2021). Rethinking Management of the 21st Century: An Approach to Contemporary Business Education. *Revista Eduweb*, *15*(2), 194–207. https://doi.org/10.46502/issn.1856-7576/2021.15.02.16

Mintzberg, H. (1998). The Structuring of Organizations. In H. Mintzberg, J. B. Quinn, & S. Ghoshal (Eds.), *The Strategic Process* (European, pp. 332–353). Hemel Hempstead, UK.: Prentice Hall Europe.

Sanyal, C., Rigby, C., Nicholds, A., & Hartog, M. (2015). Why & how action learning works within a Leadership Development Programme: a case study within a UK Public Sector Leadership & Management post-graduate programme. In *16th International Conference on Human Resource Development Research and Practice UFHRD Annual Conference* (pp. 1–27).

Sihn, W. (1998). Paradigm Shift in the Corporation: The Fractal Company. *IFAC Proceedings Volumes*, *30*(19), 131–136. https://doi.org/10.1016/S1474-6670(17)42288-9

Smith, J. (2018). *How Jeff Bezos Built an E-Commerce Empire: The Unwritten Story of Amazon.com*.

Tosey, P., Dhaliwal, S., & Hassinen, J. (2015). The Finnish Team Academy model: Implications for management education. *Management Learning*, *46*(2), 175–194. https://doi.org/10.1177/1350507613498334

Verheyen, G. (2019). *Scrum: A Smart Travel Companion* (2nd ed.). Van Haren.

Womack, J. P., Jones, D. T., & Roos, D. (1990). *The Machine that Changed the World (summary)*. Simon and Schuster.

Wouter, A., Handscomb, C., Salo, O., & Thaker, S. (2021). *The impact of agility: How to shape your organization to compete*. Retrieved from https://www.mckinsey.com/business-functions/organization/our-insights/the-impact-of-agility-how-to-shape-your-organization-to-compete

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14468

Reflections on a virtual reality soft skills teaching intervention

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Abstract

The paper analyses undergraduate finance students' reflections on the impact of a VR soft skills teaching intervention and their understanding of the influence of soft skills on their future work environment. The contribution of the research can be found in the self-developed VR soft skills videos, the analyses of the reflections using the Pedler reflective framework and the findings that focus on the insights students gain through the teaching intervention. The research question is: What is the impact of the VR soft skills teaching intervention on the insights of undergraduate finance students when confronted by work-place scenarios? The findings of the study show that the students were able to reflect effectively using the Pedler reflective framework and to develop strategies of their responses to similar situations in future. The VR soft-skills teaching intervention is therefore an effective tool in developing the insights of students to be applied in their future world of work.

Keywords: *Virtual reality; soft skills; teaching intervention; reflections; finance students; undergraduates.*

1. Introduction

"Young professionals are therefore well placed **if** they polish their soft skills as digital transformation permeates our organizations and work structures" (Spencer, 2022). Spencer (2022) emphasized the importance of soft skills training in the digital age as the world is moving out of the Covid-19 pandemic.

The paper analyses undergraduate finance students' reflections on the impact of a virtual reality (VR) soft skills teaching intervention and their understanding of the influence of soft skills on their future work environment. The contribution of the research can be found in the self-developed VR soft skills videos, the reflections using the Pedler reflective framework and the findings that focus on the insights students gain through the VR teaching intervention. This leads to the research question: What is the impact of the VR soft skills teaching intervention on the insights of undergraduate finance students when confronted by work-place scenarios? The evaluation of any teaching intervention is important to ensure that learning took place. However, the development of soft skills cannot be assessed or evaluated in an immediate result. Once the students commence with their future work in practice, only then will one be able to evaluate the impact of the soft skills training.

The paper commences with a literature review focusing on reflective practices, the experiential learning theory and the value of VR in education. The section is followed by a description of the methodology used in developing and conducting the research, including the analyses performed. The findings are followed with a conclusion on the research question.

2. Literature review

Reflective practices were first described by Dewey in 1933 when he stated that reflection is making sense of hard to explain situtations. He suggested that posing questions to explore possible actions to take, is a process of learning (Dewey, 1933). Several years later Schon defined two types of reflections as "on-action" or retrospective reflections and "in-action" or "thinking on your feet" reflections (Schon, 1983). He argued that rehearsed interventions will assist practisioners to know how to read future situations. Reflecting is an ongoing process and therefore Fry and Kolb (1979) designed the reflective learning cycled framework that was simplified by Pedler, *et al* (2007). According to Figure 1, Pedler, *et al* (2007) confirmed the reflective cycled approach and that questions should be asked to reflect on the specific situation in order to grow in the learning process.

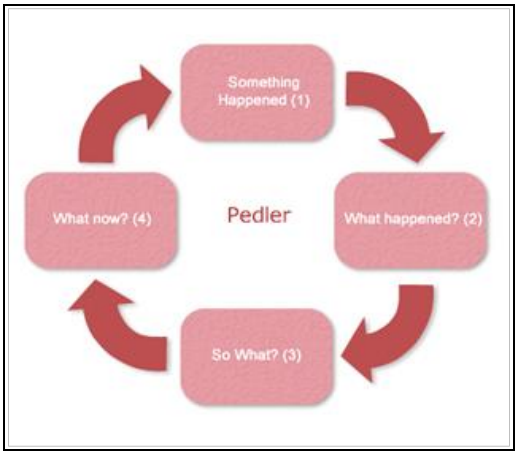

Figure 1. Pedler's reflective cycle framework. Source: Pedler, et al (2007)

Although later authors also contributed to the conversation, for example Jasper (2013), this study applied the Pedler reflective framework (Figure 1) to the reflections on the VR soft skills teaching intervention.

Reflection is a powerful tool, which was emphasized by Bloom when he created a framework for critical thinking in the 1950's *(Lasley, 2022)*. He stated that the second highest order of thinking is the concept of evaluating and used the idea of reflection as a verb to assist learners to evaluate. Reflections can thus further be used to introduce and stimulate critical thinking.

The application of VR in education is supported by the VR Education Model, stating that VR has the potential to transform the learning environment. The VR Education Model is applied on a scenario to engage students in an experience to create an equitable environment with no limitations *(Cooper & Thong, 2019)*. VR is thus used to create a teaching intervention for students to reflect on. Focusing on learning through experience is further confirmed by the experiential learning theory where time is allocated for reflection *(Hickman & Akdere, 2018)*.

In a study by *Niforatos et al. (2020)*, the use of a VR experience in the training of ethical dilemmas (soft skills) was explored. They concluded that VR enactment can foster ethical decision-making and may potentially be used in soft skills training. *Hickman and Akdere* (2018) confirmed the use of VR as an effective tool in financial education where a safe environment can be created for students to experience diverse soft skills training scenarios to improve learning and understanding.

Based on this premise, the paper explores the use of a VR soft skills teaching intervention in an undergraduate finance module in a developing country during the Covid pandemic.

3. Method

The research was set-up using five unique scenarios, presented as VR soft skills sessions, as part of the teaching intervention. A professional scriptwriter was employed to ensure the highest quality of the scripts. For the recording of each session, a producer and actors were involved and the footage was taken using a 360˚ / VR camera. Each of the five sessions were approximately 5 minutes long and addressed a different work-place scenario. The footage was edited and published as an unlisted video on the YouTube platform. The initial plan of the teaching intervention was to use cardboard VR headsets (made of durable plastic) with cellphones during the physical lectures in class where there is stable Wi-Fi access. However, during the Covid pandemic a revised plan was followed where Blackboard Collaborate (real-time video conferencing tool) was used as a platform to conduct online classes. The VR videos were then used in a 360˚ format.

Although 360˚ (or traditional) videos may deliver a similar effect, the VR teaching intervention provided an immersive experience where the student became part of the activities in the room. VR engages students in the teaching intervention and enhances the learning opportunity.

In line with the Pedler reflective framework (Figure 1), where stage 1 describes "something that happened", the VR soft skills teaching intervention was introduced. Session 1 represented an interview between a manager and potential clerk. The students were included in this session (as well as in the remaining 4 sessions) as an observer. Session 2 addressed a conflict situation between an intern and her client, where Session 3 created the scenario of an intern who made a poor decision leading to a stolen client file. The manager then had to reprimand the intern. In Session 4, a performance appraisal was conducted. The final session (Session 5) created a scenario of an ethical dilemma where a client offered the clerk a bribe to ignore an illegal transaction.

After watching the VR video, the students were divided into random groups (approximately 4-8 students per group) where they had to reflect on the session by answering three questions. The three questions represent stages 2-4 of the Pedler reflective framework (Figure 1). The question for stage 2 (What happened?) was: After watching the video, how will you respond to the question that was posted to the observer? In each scenario, a unique question was posed to the observer (or student) about what happened in the specific scenario. The reflection then continues with stage 3 (So what?) with the following question: Please use a few moments to reflect on the session. Think about what was done correctly in your opinion? To conclude the reflection (stage 4: What now?), the student were asked: Please reflect on what you would have done differently?

After the group reflections were completed, the students watched a feedback video compiled for each session individually, where a practitioner provided comment on the specific VR soft skills intervention as well as advice on how to improve soft skills going forward.

A total of 409 students took part in the reflective group work of Sessions 1 and 5. The reflections of the students were sanitized to ensure complete anonymity. Then the reflections were submitted to the software program Atlas ti where a thematic analysis was performed using the "word cloud" and "word list" functionality to identify the most common terms used and the reflections were coded for common themes. The reflections of each session were analyzed to gain an insight into the impact of the VR soft skills teaching intervention on the understanding of students regarding the influence of soft skills on their future work environment.

4. Findings

Once the reflections of Session 1 (interview scenario) and Session 5 (ethical dilemma scenario) were coded into themes, the most frequent themes identified were identified for each phase of the Pedler reflective framework.

4.1. Reflections on Session 1

The interview in Session 1 represents stage 1 (something happened) of the Pedler reflective framework (Figure 1). The thematic analysis of Session 1 (Figure 2) shows that students reflected in stages 2-4 of the Pedler reflective framework (Figure 1). Through their reflections, students developed a strategy of what they would do in future when in an interview scenario.

In stage 2 (what happened?), students identified that the interview had not gone well due to a number of reasons (unrealistic salary expectations, lack of preparation and research prior to the interview and unprofessional behavior from the interviewee). In stage 3 (so what?) students reflected and identified the behavior of the interviewee that went well (well dressed, punctual, confident, greeted the interviewer, enthusiastic and friendly). The students then reflected on stage 4 (what now?) and identified key areas to work on when faced with an interview scenario in future (prepare and research prior to the interview, having realistic salary expectations, set goals and a career plan, and act professionally in an interview).

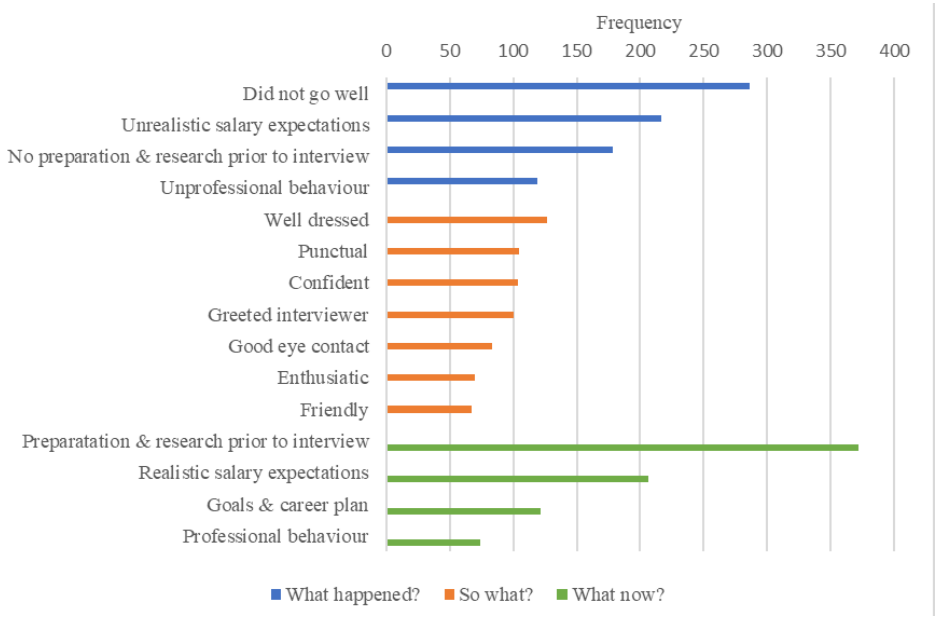

Figure 2. Reflections on Session 1

4.2. Reflections on Session 5

The ethical dilemma the students encountered in Session 5 represents stage 1 (something happened) of the Pedler reflective framework (Figure 1). The thematic analysis of Session 5 (Figure 3) shows that students reflected in stages 2-4 of the Pedler reflective framework (Figure 1). Through their reflections, students developed a strategy of what they would do in future when faced with an ethical dilemma.

In stage 2 (what happened?), students identified that the clerk had been offered a bribe which constituted unethical, illegal activity. They also identified that it was a reportable incident and that the Code of Professional Conduct, which applies to Accountants, was applicable in a scenario like the one they had just viewed. In stage 3 (so what?) students reflected and identified the behavior of the clerk that went well (she communicated her responsibility to report the matter to the client, she remained calm and acted in a professional manner, she identified the unethical issue and rejected the bribe, and she noted to the observer that client confidentiality was always important). The students then reflected on stage 4 (what now?) and identified key areas to work on when faced with an ethical dilemma in future. Students identified that they would notify a more senior member of staff or manager, they noted that they would have a responsibility to report the matter and that they should act immediately, and they noted that they would not accept a bribe.

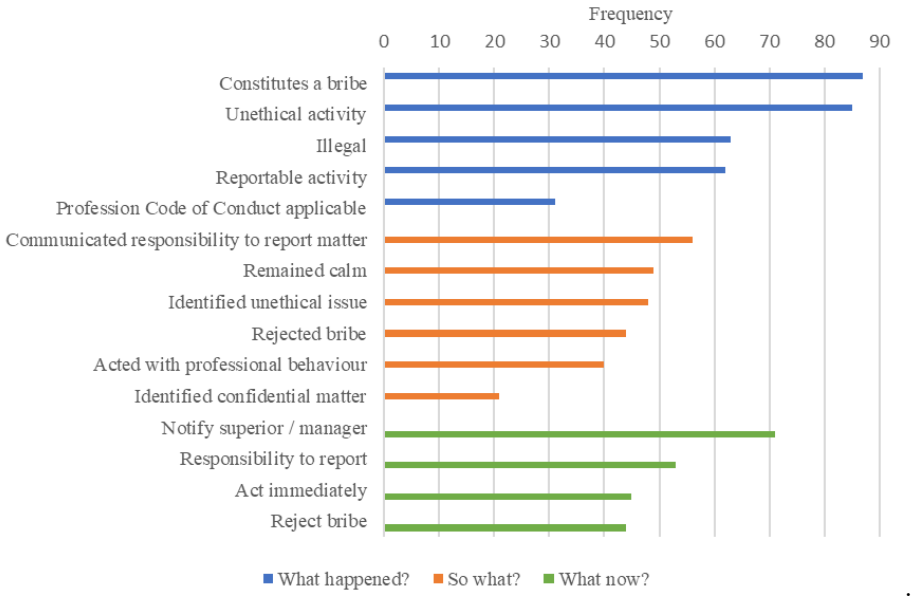

Figure 3. Reflections on Session 5

4.3. General reflections on the teaching interventions

When students were asked how they experienced the 5 sessions of the VR soft skills teaching intervention, they were positive about their experience and what they had learnt. Some of the comments the students made include the following:

- "It is nice to get a glimpse of the practical work environment!"
- "I really enjoyed this. Thank you very much!"
- "I really enjoyed the feedback session and found the experience insightful."
- "I think overall the soft skills sessions have been very valuable."
- "That was a really useful session, I think those skills are really important to know."
- "I learnt that it is important to act objectively despite your connection with the persons in the conflict of interest and the emotions you may feel in the situation."
- "We have learnt how to maintain our professional competence and behaviour despite being intimidated by an employee in a superior position."

Although the feedback from students did not specifically include negative comments regarding the actual teaching intervention, there were some frustrations encountered due to issues with connectivity during the sessions. This can be attributed to the fact that the teaching intervention took place online and not in a physical classroom with stable Wi-Fi as originally planned. Students were reliant on their own home networks, which are not always as stable as the Wi-Fi available on campus.

5. Conclusion

Based on the comments of the students, they believed that the learning experience had been effective in developing their soft skills for the work-place in future. The findings of the study show that the students who were exposed to the VR soft skills teaching intervention were able to retrospectively reflect effectively using the Pedler reflective framework (Figure 1). When exposed to a practical scenario that they might be encountered with in the work-place (stage 1: something happened), students were able to reflect and formulate what had happened in the scenario (stage 2: what happened?). Students were then able to identify the impact of what was going on in the scenario (stage 3: so what?) and formulate an action plan of what they would do in future if confronted with a similar scenario (stage 4: what now?). Assessing skills training remains a challenge and the current VR soft skills teaching intervention should merely be viewed as a stepping stone in the development of skills necessary in the future world of work. The VR soft skills teaching intervention is therefore an effective tool in developing the insights of undergraduate finance students when confronted by various work-place scenarios.

References

Cooper, G., & Thong, L. (2019). *Implementing virtual reality in the classroom: Envisaging possibilities in STEM education, an emerging field of enquiry.* Leiden: Brill.

Dewey, J. (1933). *How We Think: A Restatement of the Relation of Reflective Thinking to the Educative Process.* Boston, MA: D.C. Health & co publishers.

Fry, R., & Kolb, D. (1979). Experimental learning theory and learning experiences in liberal arts education. *New dimensions for experiential learning, 6*, 79-92.

Hickman, L., & Akdere, M. (2018). Developing Intercultural Competencies through Virtual Reality: Internet of Things Applications in Education and Learning. *2018 15th Learning and Technology Conference* (pp. 27-31). Jeddah, Kingdom of Saudi Arabia: IEEE.

Jasper, M. (2013). *Beginning reflective practice.* Australia: Cengage Learning.

Lasley, T. (2022). *Bloom's Taxanomy*. Retrieved from Britannica: https://www.britannica.com/topic/Blooms-taxonomy

Niforatos, E., Palma, A., Gluszny, R., Vourvopoulus, A., & Liarokapis, F. (2020). Would you do it? Enacting moral dilemmas in virtual reality for understanding ethical decision-making. *CHI 2020, Honolulu, USA*, 25-30.

Pedler, M., Burgoyne, J., & Boydell, T. (2007). *A manager's guide to self-development* (5th ed.). Maidenhead: McGraw-Hill.

Schon, D. (1983). *The reflective practisioner: How professional think in action.* New York: Basic Books.

Spencer, M. (2022, January 25). *Artificial Intelligence report*. Retrieved from Newsletter on LinkedIn: newsletters-noreply@linkedin.com

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14530

Professional Development Module in University: Building a sense of belonging for first-year students

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Abstract

Can a professional development module for first-year students help build a sense of belonging with their desired profession? In Munster Technological University (MTU) all first-year students must undertake a Creativity, Innovation and Teamwork (CIT) module. For each degree programme, this module is tailored to the needs of its students. The objective of this module for first-year Accounting students is to instill a sense of what it is to be accountants by building key skills and helping them envisage their pathways to becoming accountants. This paper introduces the teaching and learning techniques and assessment methods of the CIT module. It also presents Accounting students' opinions on their professional development from this module. Findings report development of some of the key skills required of accountants in the workplace and increased knowledge of the accounting profession, thus building first-year Accounting students' sense of belonging to their desired future profession.

Keywords: *professional development; accounting profession; belonging.*

1. Introduction

Having chosen a degree programme, first-year university students have already started to make choices about their future career. For some, first-year is about discovering future options, for others it is about confirming what they want to become. Some students will be happy with their choice, but others won't. First-year in university, referred to by Lizzio (2012) as the 'transition in' stage, has the highest attrition rates. This may be due to financial difficulties, lack of parental support or the number of semester hours (Fike and Fike 2008), but it may also be due to a lack of belonging with what they are studying (Noble *et al.* 2007; O'Keeffe 2013). While traditional modules tend to focus on delivering content and building students' knowledge, research shows that it is professional development education that increases students' likelihood of remaining on their degree programme (Noble *et al.* 2007; O'Keeffe 2013). Could it be that professional development, even as early as first-year, enhances students' sense of belonging with their chosen profession?

In Munster Technological University in Cork (Ireland), all first-year students undertake a mandatory module (in their first semester in university) called the Creativity, Innovation and Teamwork (CIT) module. While there is guidance as to the indicative content of this module, each department has autonomy to tailor this module to suit the needs of its students. In the Accounting and Information Systems Department, the CIT module focuses on professional development. After completing this module, students in the Accounting degree programme should have: 1) developed key skills that could be required of them as future professional accountants and 2) enhanced their knowledge of the accountancy profession.

This paper will present the teaching and learning techniques and assessments of this early professional development module. It will also report the findings of a survey of first-year Accounting students, before and after taking this module, showing the positive effects of this module on their skills-set and knowledge of their chosen career. By developing key skills and knowledge of the profession, the module gives students a taste of what being accountants is like right from the start of their time in university, thus helping them build a sense of belonging with their desired profession.

2. Teaching and learning the CIT module

There is a growing body of research in accounting education literature (Albrecht and Sack 2001; Kavanagh and Drennan 2008; Jackling and De Lange 2009; Wells *et al.* 2009; Yu *et al.* 2013) and in wider business education literature (Crebert *et al.* 2004; Buckley and El Amoud 2010; Sheridan and Linehan 2017) focusing on the skills required by employers of graduates. Kavanagh and Drennan (2008) and Jackling and De Lange (2009) report the importance of technical skills (such as key accounting skills and computer skills) and generic skills (such as written and oral communication skills, team skills and interpersonal skills) to

accounting graduates. Other contributors to accounting education literature refer to these as "hard" knowledge and "soft" skills (Andrews and Higson 2008, p.411). Hard knowledge relates to the content of the students' programme of study (often to particular modules) and the ability to apply that knowledge to business situations. Soft skills relate to other skills that are seen as "vital for graduate success" (Andrews and Higson 2008, p.415). Yu *et al.* (2013) identify "technology skills, teamwork, and oral communication" (p.1) as the skills needed by graduates to be better able to do the work in the workplace.

In the UK Riley and Simons (2016) found 79% of practitioners stating that written communication skills are considered in hiring entry-level accounting graduates. Tan and Laswad (2018) state that "a team player with a positive attitude and good communication skills appeared to be the most valued behavioural skill as perceived by employers" (p. 403). Conversations with accounting students at MTU after a six-month placement, confirm that students see written communication, teamwork, creation of presentations and presenting as some of the key skills required of trainee accountants. According to Siriwardane and Durden (2014), collaboration is required between accounting educators, practitioners and communication specialists to develop these skills in accounting graduates. The teaching and learning techniques and assessment methods of the CIT module reflect these valued skills, the desire for collaboration between academics, practitioners and specialists, and the need for students to build a sense of belonging with their future profession.

2.1. Teaching and Learning techniques in the CIT module

A variety of teaching and learning techniques were established for the CIT module. The aim was to ensure the development of students' key skills, improve collaboration between academics, practitioners and specialists and ensure students build a sense of belonging with the accounting profession. The teaching of this module is allocated three hours per week for one semester (15 weeks). This is divided each week into two hours in class and one hour in an IT lab. During this time, students get the opportunity to attend lectures, workshops with the Careers Department (to develop CV writing and presentation skills), a careers fair (to talk to accountancy bodies and potential employers), and a series of guest speakers (to learn about what accountants do in the workplace). They also get time each week to develop IT skills (Microsoft Word, Excel and PowerPoint) and partake in supervised team meetings/group work (to complete their assessments for this module).

2.2. Assessment methods of the CIT module

Accountants are often guided by the phrase "what gets measured gets done". This is definitely the case when devising assessments aimed at achieving the objectives of this module. There are three pieces of assessment for students in this module. Students must:

1) Present their desired career path in pairs using PowerPoint (worth 20%) in week 4. (10 minutes for each pairing to present their findings to the class)
2) Write an individual report on "What it is to be an accountant?" including preparation of a CV and reflection on one of the guest speakers (worth 30%) in week 11.
3) Prepare a poster and a presentation for a business plan for a new company in groups (of four or five) (worth 50%) in week 15.

Students are informed of these assessments at the beginning of the semester. Descriptive briefs and assessment rubrix are provided during the semester. The assessments examine the development of key skills (creating presentations, presenting, writing reports, and working in teams) and knowledge of the accounting profession, thus fulfilling the overriding aim of building a sense of belonging with their desired profession

3. Research Methodology

To determine whether the teaching/learning techniques and assessment methods of the CIT module achieve the desired outcomes, students were asked about their perceptions at two key points in time – before and after undertaking this module. In September 2019, 52 students commenced the Accounting degree in Munster Technological University. Questionnaires were used so that the researchers could quantify results (Creswell 2003; Hair *et al.* 2007) and compare results from the first and last weeks of the module. The questionnaire (using a 5-point Likert scale) was used to ascertain students' confidence levels (very poor, poor, good, very good, excellent) in six key areas before and after studying this module. The six key areas (ascertained by the researchers from accounting education literature and conversations with accounting students after completing work placement) were preparation of a written report, teamwork, creation of presentations, presentation skills, knowledge of what it takes to become accountants and knowledge of what it is to be accountants. 42 students responded to both questionnaires. The responses of these 42 students were used to compile the findings discussed in the next section.

4. Findings

This section presents the findings of the six key areas included in the questionnaire sent to students, as outlined in the previous section. In the questionnaire before taking this module, students reported feeling confident about writing reports and working in teams. These were skills they felt that they had already built during second-level education. These levels of confidence remained after completing this module. Other lecturers on the program reported low levels of report writing skills in this cohort, so a mismatch between expectations and perceived ability exists. While students were asked about their confidence levels at both stages, perhaps in the second questionnaire students should have been asked whether or not

these skills were enhanced because of this module. This is something the researchers wish to explore in more detail in the future.

With regard to presentation creation, prior to studying this module 33% of students reported a very poor or poor ability to create presentations. After studying this module this was reduced to less than 5%, with significant improvements in those considering themselves as very good or excellent (see Figure 1).

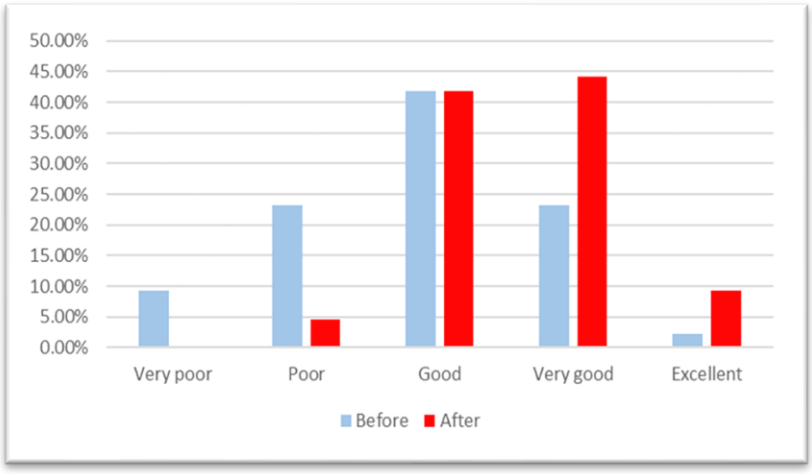

Figure 1: Confidence creating a presentation

Similarly, prior to studying this module almost 60% of students reported very poor or poor presentation skills. After studying this module almost 60% of students considered themselves good at presenting (see Figure 2).

Figure 2: Confidence in presenting

The next question asked students about their knowledge of how to become accountants. Prior to this module 12% of students reported a poor knowledge, and 52% reported a good knowledge, of what could be required of them to become accountants. After this module, this had improved, with almost 69% of students reporting having a very good or excellent knowledge of what could be required of them to become accountants (see Figure 3).

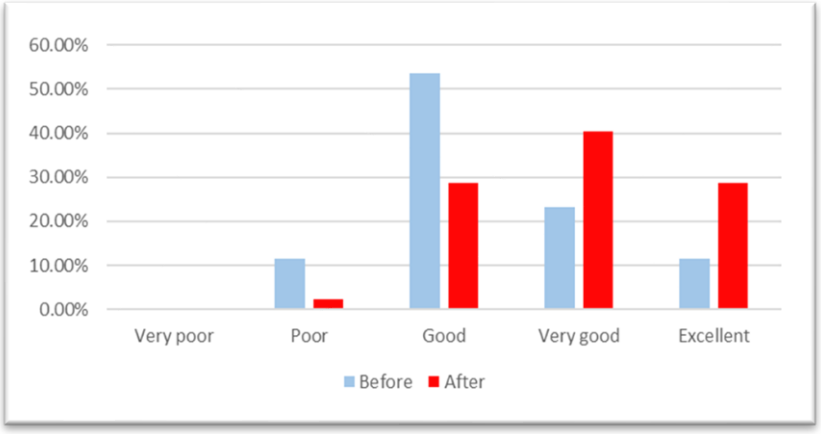

Figure 3: Knowledge of what you have to do to become accountants

Similar results were found when students were asked about their understanding of what it is to be accountants. Prior to this module 5% of students reported a poor knowledge, and 57% reported a good knowledge, of what it is to be accountant. After studying this module 67% of students reported a very good or excellent knowledge of what it is to be accountants (see Figure 4).

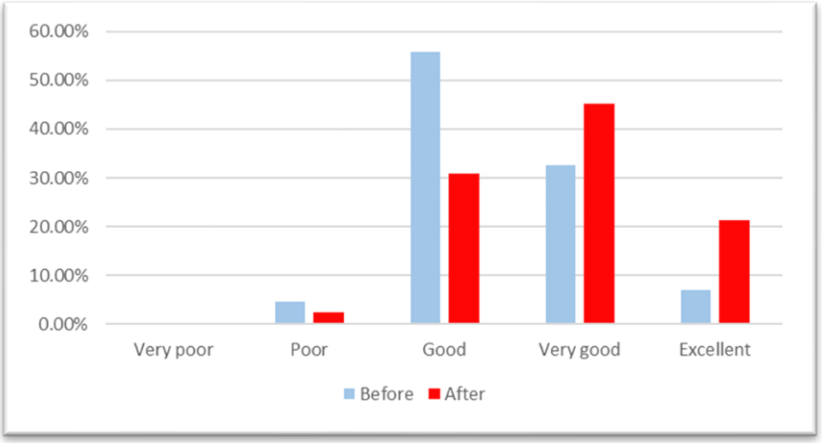

Figure 4: Knowledge of what it is to be accountants

For the teaching staff, these positive results are very encouraging indicators of the success of the module. However, further work is required to improve the confidence levels further.

5. Conclusion and further research

Early professional development gives students a closer idea of what they will find when they enter the workplace, right from when they begin their degree programme. The CIT module targeted at first-year accounting students aims to build first-year accounting students sense of belonging to the accounting profession. This is achieved by enhancing some of the key skills required of them in the labour market and giving them insight into what is ahead for them as accounting interns and graduates. The CIT module is also a way of improving the link between university education and employers.

The four skills that the CIT module aims to developed are report writing, teamwork, creating presentations, and presenting. Students reported improved confidence their abilities in all four of these skills. Even before taking this module, students reported being confident about their report writing and teamwork skills, and these levels of confidence remained after completing the professional development module. Confidence levels in creating a presentation and presenting were low before this module and improved significantly after undertaking this module. Even though students were asked to present twice during this module (week 4 and week 15), they still did not report increased confidence to very good or excellent levels. For future iterations of this module, it has been decided to provide more in-depth feedback to students after their first presentation. In doing so, areas of improvement will be highlighted and can be taken onboard for the second presentation. After the second (final) presentation, each student will be encouraged by feedback pointing out their strengths and areas in which they could improve.

As well as developing key skills, the CIT module also aims to give first-year accounting students insight into what could be ahead for them as accounting interns and graduates. This module provides students with knowledge about the accounting profession. Students' knowledge of what could be required of them to become accountants and knowledge of what it is to be accountants were enhanced significantly after taking this module. Improved skill-sets and knowledge of the profession and the possible pathways ahead help students to build a sense of belonging with their chosen profession. Future research is required to further explore if an enhanced sense of belonging is beneficial to students when applying for and undertaking placement during the degree programme, or when applying for graduate roles.

References

Albrecht, W. S. & Sack, R.S. (2001). The perilous future of Accounting education. *CPA Journal* March.

Andrews, J. & Higson, H. (2008). Graduate employability,'soft skills' versus 'hard'business knowledge: A European study. *Higher education in Europe* 33(4): pp. 411-422.

Buckley, J. & El Amoud, L. (2010). Undergraduate work placement programmes in Ireland: Issues and solutions. *13th Irish Academy of Management Conference*. Ireland.

Crebert, G., Bates, M., Bell, B., Patrick, C.J. & Cragnolini, V. (2004). Developing generic skills at university, during work placement and in employment: graduates' perc(eptions. *Higher Education Research & Development* 23 (2):pp. 147-165.

Creswell, J. W. (2003). *A framework for design*, California, Sage Publications Inc.

Fike, D. & Fike, R. (2008). Predictors of first-year student retention in the community college". *Community College Review* 36 (2), October 2008, pp. 68-88.

Hair, J. F. J., Money, A. H., Samouel, P. & Page, M. (2007). *Research methods for business students,* England, John Wiley and Sons Ltd.

Jackling, B., and De Lange, P. (2009). Do Accounting graduates' skills meet the expectations of Employers? A matter of convergence or divergence. *Accounting Education: An International Journal* 18 (4-5):pp. 369-385.

Kavanagh, M. H. & Drennan, L. (2008). What skills and attributes does an accounting graduate need? Evidence from student perceptions and employer expectations. *Accounting & Finance* 48 (2):pp. 279-300.

Lizzio, A. (2012). *Student lifecycle, transition and orientation*. Brisbane: Griffith University.

Noble, K., Flynn, N. T., Lee, J. D., & Hilton, D. (2007). Predicting successful college experiences: Evidence from a first-year retention program. *Journal of College Student Retention: Research, Theory & Practice* 9(1), pp. 39–60.

O'Keeffe, P. (2013). A sense of belonging: Improving student retention. *College Student Journal* 47 (4), 1 December 2013, pp. 605-613.

Riley, T. J. & Simons, K. A. (2016). The written communication skills that matter most for accountants. *Accounting Education* 25 (3):pp. 239-255.

Sheridan, I. & Linehan, M. (2017). Structures and processes to underpin enhanced engagement between Higher Education and enterprise. In *The world scientific reference on entrepreneurship: Volume 1: Entrepreneurial Universities - Technology and Knowledge Transfer*, edited by J. Cunningham, M. Guerrero and D. Urbano: World Scientific, pp. 57-84

Siriwardane, H. P. & Durden, C. H. (2014). The communication skills of Accountants: What we know and the gaps in our knowledge. *Accounting Education* 23 (2):pp. 119-134.

Tan, L. M. & Laswad, F. (2018). Professional skills required of accountants: what do job advertisements tell us? *Accounting Education* 27 (4):pp. 403-432.

Wells, P., Gerbic, P., Kranenburg, I. & Bygrave, J. (2009). Professional skills and capabilities of Accounting graduates: The New Zealand expectation gap? *Accounting Education* 18 (4/5):pp. 403-420.

Yu, S.C., Churyk, N.T. & Chang, A.C. (2013). Are students ready for their future accounting careers? Insights from observed perception gaps among employers, interns and alumni. *Global Perspectives on Accounting Education* 10:pp. 1-15.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14650

Learning logistics from MOOCs: an ample teaching cacophony

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Abstract

MOOC landscape is evolving, also boosted by distance-learning necessity of recent health crises. Logistics is an interdisciplinary area across business processes and functions, engineering, global views and sustainability. As lifelong learning appears a new norm and it is difficult for HEIs to provide a programme with both sufficient focus on foundational skills as well as topical expertise, students and practitioners can turn to MOOCs for complementary instruction. This study presents a data collected from 198 logistics-themed MOOCs across four major platforms (edX, Coursera, FutureLearn and Udemy) to evaluate the topical availability across main areas of direct logistics expertise. Regardless of relative abundance, the study suggests both thematic gaps and criticism of MOOC development priorities. The study allows to argue against feasibility of compiling a full online programme of MOOCs, lack of linkages and of coherent design. Within current paradigm, MOOCs shall remain complementary not a substitute to college programme experience.

Keywords: *Logistics knowledge areas, supply chain competences, MOOCs, future of higher education, lifelong learning.*

1. Introduction

While some online elements were supporting college teaching already in the beginning of the 21st century, a whole new era emerged roughly a decade ago with first MOOC (massive open online course) platforms of global ambition. MOOCs are mainly used for flexible self-development, but they can be, assuming fit in learning objectives, recognized by HEIs for academic credit (Sandeen, 2013). This study is observing the current state of available MOOCs in the topics of logistics and supply chain from the level of higher education. Logistics is an interdisciplinary area with roots in both engineering sciences as well as business and economics. Logistics mixes quantitative and qualitative perspectives and covers areas such as supply chain operations, technologies and IT, regulations and environmental impact. Logistics industry and its operating environment is rapidly changing and evolving and consequently the set of competencies of logistics workers must be aligned (Bisogni et al., 2021). Specialists in the field require broad functional skills, analytical skills and soft skills (such as time and conflict management and problem solving) (Wagner et al., 2019). Logistics curricula ought to include the subjects of relationship and trust building (Ballou, 2007). In an interconnected world, education should focus on developing especially soft skills (Munkácsi and Kazai-Ónodi, 2018). It has been suggested that logistics managers use business managerial, generic and behavioural competences in practice rather than direct expertise (Derwik et al., 2016). From the view of lifelong learning, sense-of-initiative and entrepreneurship competences have been seen as key factors (Kotzab et al., 2018). It is difficult to imagine a programme meeting all the expectations. As lifelong learning appears a new norm and programmes adjust focus to embrace more general and cross-functional skills, gaps in terms of topical expertise might ensue, which need to be filled later. This is where bite-sized MOOCs might play increasingly important role in the future.

One can speculate that after a decade of substantial MOOC development and rather loud marketing, major MOOC platforms would host enough content to thematically cover the entire spectrum of logistics. This study evaluates the topical availability of MOOCs across areas of logistics expertise. While undoubtedly soft skills play a major role in logistics, the development of such elements in MOOCs are difficult to identify without in-depth analysis falling outside the scope of this paper. The aim of the study is to understand how MOOCs cover the logistics field by matching MOOCs on the principal platforms available on the market with a categorization of the logistics-related disciplines.

In next segment, a few observations on the role of MOOCs in higher education are presented. Then study methodology is described, commenting briefly on the founding model of logistics knowledge areas and its modification, and then on aggregating a list of logistics MOOCs. Then the findings are presented and discussed from the viewpoints of students, logistics industry, MOOC platforms and HEIs, concluding with comments on viability of a full online programme of logistics built only on selection of current MOOCs.

2. Literature review

In the last decade, demand and offer for MOOCs have witnessed a striking upward trend. MOOCs represent an extremely flexible learning tool in line with the changing training needs of HE students. The value-added role of MOOCs both as complementary as well as integrated units go back almost a decade – MOOCs represent an excellent tool for universities to support hybrid or flipped classes but also for students to create a preliminary knowledge base or to deepen specific topics, for the recognition of prior learning, articulation and credit recognition (Sandeen, 2013).

Zhu et al. have analysed MOOC designer perspectives and found that many problems stem from too many students – meaningful grading can suffer, teachers cannot properly engage the audience, personalization and project-work starts to hurt. When volumes rule out meaningful individual grading, peer evaluation is used as alternative, but with mixed views. (Zhu et al., 2018). One clear obstacle appears to be student motivation and attrition – peer grading works only when peers actually sufficiently care. Furthermore, a common theme in MOOC design is being pressured for time – which might not allow to fully include relevant tech elements, not mentioning designing content with better pedagogical coherence. In summary, the paper presents broad criticism how a traditional university course can be superior to MOOC – not because MOOC could not be similar in performance, but because it is often hurried and at times approached almost as "minimum viable product" (Ibid.).

On a positive side, being involved in MOOC development can bring about substantial changes in academia not only in terms of digital capabilities but through engagement of transformative practices, as MOOCs can contribute to the diffusion of digital and transformative cultures within institutions. (León-Urrutia, 2019). However, the transformation assumes that top-down initiatives clearly support the transformation through stable strategic focus and avoiding intermittent and impulsive initiatives (Ibid.) In summary, MOOCs have huge potential, but reality constraints in design and in teaching are posing noteworthy obstacles. As MOOC design can be sometimes approached with an explicit intent to automate the teacher, there is a loss of notable human element. However, many shortcomings can be seen as direct consequence of that – missing to leverage the potential synergy between technology and human touch.

3. Methodology

Four MOOC platforms were included in the study: edX, Coursera, FutureLearn and Udemy. While there are multiple more around, their logistics-themed content appears secondary. Courses fitting various logistics-related keywords were included – *supply chain, operations, inventory, transport, purchasing, supplier, trade, mobility, vehicle, traffic*. Only English-language courses were included with a minimum of 3h content. While the smaller ones

perhaps ought not to be called "a course", they are still suitable for learner's self-development as well as additional contributors to blended learning. Data on certification price and access price (as the case of Udemy) was also recorded, but is not analysed in this study.

The resulting database included 198 elements as of January 2022: 67 from edX with average duration approx. 40h, 46 from Coursera (average 15h), 35 from FutureLearn (average 11h) and 50 from Udemy (average 7,5h direct video content). Hypothetically, if one were to undertake all of them, it would require between 4000-4500 hours of effort, which is close in volume to a full undergraduate programme. For this reason, the study does not involve quality evaluation of MOOCs identified. It is the intention of authors to later extend this study to involve quality evaluation through random sampling.

While the logistics content in MOOCS is abundant, if one would trust the search function of platforms, one could be led to believe of even larger content availability. However, when delving into search results one often meets only distantly related elements. Still, compared to 2020 state of logistics MOOCs (Niine et al., 2021), our database has grown significantly, and so content creation is active, with edX logistics-related titles more than doubling. Average course size has declined though, as total assumed learner effort is up approx. by 50%.

The model of logistics knowledge areas used as basis was constructed in 2014 for curricula evaluation purposes (Niine and Koppel, 2014). The original model has 20 sections. For this study, heavy consolidation was needed. Some sections were omitted due to foundational nature / lack of relevance for focal purpose (such as foundations of natural sciences, basics of strategy, human resources) – as in pursuit to be a logistician, one must not only learn matters directly of logistics. Other categories needed consolidating, because many courses were broad to encompass more than two. As a result, it was most meaningful to distinguish 6 categories: operations and supply chain management; purchasing and inventory; transport and warehousing operations; transport technologies; transport economics and mobility; and logistics and supply chain sustainability. Even so, some courses were related to two, as the line between mobility view, technology design view and sustainability is often impossible to draw. This is mainly due the multi-layer and multidimensional nature of sustainability, so no criticism to the MOOC industry in that regard. Similarly, purchasing is just a subset of supply chain management, kept separately to identify more functional-oriented focus.

The analysis of MOOCs against the categories had two phases: categorization and separate analysis of each segment. As limitation, some of the findings might be short-lived due to growth of MOOCs. The data comes from course titles which in some cases might not be fully representative of course content, which has not been studied in depth here. Finally, there is no categorical way of determining if a course is "a logistics course" – inclusion in the sample has been based on keywords, but still includes notable subjective element. Both type I and II errors are possible, while we attempted to be as strict as the six-component model instated.

4. Results

The overview of categorization is presented in Table 1. The authors are gladly willing to share the full database as it did not fit this paper due to formalities.

Table 1. Categorization and characteristics of logistics and supply chain MOOCs

Category	MOOCs	Sum of assumed learner effort	Platform with most titles
Operations and supply chain management	101	2100 h	Similar across all 4 platforms
Purchasing and inventory	28	330 h	Coursera, Udemy
Transport and warehousing operations	10	130 h	Udemy
Transport technologies	26	750 h	edX
Transport economics and mobility	15	270 h	edX
Sustainable logistics and supply chain	26	570 h	edX
Industry / field-specific topics	4	30 h	N / A

Source: Authors' study.

Technological innovation and automation is a theme well-suited for MOOCs both for topical relevance as well as marketability. Material on electric vehicles and self-driving is also abundant. The modern and future technology element is perhaps the most well covered aspect of logistics across the board. This also reflects why such a study is meaningful to run especially on logistics topics – the topical tech innovation also drives teaching innovation. Another rich area is supply chain management with views across functions and companies.

As broader observation, it appears many course names are designed to attract attention. This suggests marketing intent on two levels: both strategic topic choice as well as tactical "buzzwords for popularity". For example, big data analytics and blockchain are relevant future technologies, but they also tend to be overrepresented in our data. It could be called a double-echo effect, as both content creators and platforms are in most cases rather heavily incentivized to attract large student volumes. Likewise, while sustainability is a critical area of expertise, its presence in the course title appears to be somewhat forced in some cases.

This marketing-focus has also a proposed downside of less desire to develop courses that "appear boring", regardless of practical relevance. Our data suggests that topics such as mode-specific transport law or detailed physical characteristics of cargo handling are rather notably underrepresented, not to say missing. A broader pattern emerges, as strangely the main area seemingly presenting noteworthy gaps lies in the core of operational and vocational

logistics – transport arrangements and transport service economics. Udemy is the platform known for material with direct industry practitioner focus and is in this case true to that promise by presenting some titles to provide at least modest attention. While there is some more of such material packaged into broader courses, a remaining issue is that they are not sufficiently visible. When a prospective student needs a quick introduction to, say, maritime insurance, one can be discouraged to undertake a 50-hour "international logistics" course, with still a chance that a course with a general title might struggle to provide sufficiently deep insights. It appears a possible explanation that most of the transport area (not just legal aspects) is just "not hot". As an anecdote, when one enters keyword "shipping" into Coursera, one of the top results is "A life of happiness and fulfilment" with over 430 000 students. Not aiming to disregard Greek philosophy and Buddhism, the point here is not what is present (the linkage is still a mystery) but what is not. There is a little too much popularity focus across MOOCs in general and relatively less attention on providing optimal value for logistics practitioners. One can speculate that one of the root problems might be that demand-driven industry relevance is sometimes not sufficiently embedded in the MOOC design.

5. Conclusion and discussion

Firstly, for industry the findings are encouraging – the availability of online courses is wide. While such "bite-sized" learning cannot (and are not meant to) replace customized company training sessions, they can be used to complement HR training plans and provide strong support to life-long learning with only some topical gaps. The study did not evaluate the quality of logistics MOOCs, but major content validity risks are not apparent. One ought to note the diverse pedagogical methodology of MOOCs ranging from just a bundle of video clips to more properly simulating conventional course experience with groupwork, case-solving, projects and feedback. Some closer inspection is necessary before making commitments. While MOOCs are sometimes frowned upon due to low completion rates, we would not treat it as a quality issue, but in probably most cases a motivational issue.

Similarly, for students, practitioners or just enthusiasts of logistics the results are promising, given some expectation management. We recommend to treat MOOCs as self-motivational discovery rather than direct contribution to becoming a professional in a systematic manner. While some MOOCs can be recognized by vocational or academic programme-studies, one should not see MOOCs as replacement of a full academic diploma-track. MOOCs on a platform business model are mostly designed one block at a time. There are course bundles with various labels, but even then MOOCs tend to lack the systematic planning of a programme experience one could expect from a professional college or faculty. This is not mainly the question of "face-to-face versus online", as it might have been perceived pre-pandemic, but a question of fragmentation. The landscape on logistics courses is rich but much more of a cacophony than a symphony. The disorderly growth of MOOCs appears

similar to urban development where the lack of coordinated top-down approach results in high fragmentation which is clearly unoptimal from broader angle. Similarly, one cannot get a strong college programme from just a hastily tied bundle of courses without efforts to design proper sequencing and linkages and account for student body characteristics. A strong programme should aim for a layer of top-down development existing in cooperation with course-level improvements. All in all, it is not that MOOCs cannot in principle serve as Lego-blocks for diploma, as we argue they can. It is mainly the matter of how they are designed and developed and for what particular purpose. The criticism in terms of time pressure seems to be another major obstacle (Zhu et al. 2018).

It is quite viable to build a micro degree of MOOCs, assuming authorship by one school or a small set of academic content creators in concert. Anything substantially larger would require more than linear increase in effort. Logically, the options are either: A) a major project from a small set of universities, B) a "weaving and patching" task across large variety of Lego-blocks, C) dedicated synchronized effort of a central team. While all options are technically and economically feasible, option A can be discouraged by "the middle man question". Pandemic has shown that universities can operate semi-online also individually with overcoming some of the problems initially feared. While only a minority of programmes would continue online post-pandemic in short-term (whether to launch such is a question of local strategy), we speculate there is now a wide-spread understanding of value proposition for students in online teaching, including quality assurance and thoughtful pedagogical design philosophy. While a platform might well serve as coordinator and catalyst of cooperation, particular value-adding roles of such third-party providers seem debatable.

Option B is what this paper argues against – the Lego-blocks are more than enough heterogeneous that building meaningful linkages for synergized experience assumes a coordination effort perhaps better spent in building an entire programme from scratch. This leads to option C. Somewhat similar to movies produced by Netflix, one could see future MOOC platforms with enough resources building their own packages akin to a curriculum, systematic programme experience and, where applicable, third-party certification. Whether this realizes, remains to be seen, but such widespread adoption appears doubtful.

For traditional universities, this presents new opportunities. Less than a decade ago, online enthusiasts were predicting the downfall of traditional academia with new models proving their superiority. However, the core of the future higher education model might not be outside academia after all. Whether the online-imbued academia becomes "a new paradigm" or just a slight evolutionary side path of teaching, is up to speculation. But it does seem that pandemic has done the academia (along with numerous scars) also a long-term favour by nudging us closer to discovering value in online teaching (as well as its limits).

In developing better future education, one does not need to think only in competitive but in complementary terms. Educational diversity is a value dimension on its own, so the piecemeal philosophy of MOOCs is highly relevant, especially considering self-conscious lifelong learning. MOOCs can and should be integrated where they add value. Good MOOCs deserve more recognition than they have today, especially in terms of "common good". Building upon interconnectedness is the optimal way forward.

References

Ballou, R. H. (2007). The evolution and future of logistics and supply chain management. *European Business Review*, 19(4), 332–348. doi: 10.1108/09555340710760152

Bisogni G.P., Brdulak, H., Cantoni, F., Niine, T., & Zsifkovitz H. (2021). The Role of European Logistics Association 2020 Standards in facing modern industry expectations and logistic managers competencies. *International Journal of Value Chain Management*, 12(2), 171-198. doi: 10.1504/IJVCM.2021.116401

Derwik, P., Hellström, D., & Karlsson, S. (2016). Manager competences in logistics and supply chain practice. *Journal of Business Research*, 69(11), 4820-4825. doi: 10.1016/j.jbusres.2016.04.037

Kotzab, H., Teller, C., Bourlakis, M., & Wünsche, S. (2018). Key competences of logistics and SCM professionals – the lifelong learning perspective. *Supply Chain Management: An International Journal*, 23(1), 50-64. doi: 10.1108/SCM-02-2017-0079

Munkácsi, A., & Kazai-Ónodi, A. (2018). Challenges and methods of the 21st century in logistics education. In: Karlovitz, T. J. (Ed.) *Some Recent Research from Economics and Business Studies.* International Research Institute, Komárno, pp. 211-222.

Niine, T., & Koppel, O. (2014). Competence in Logistics – Designing a Meta-Model of Logistics Knowledge Areas. In Katalinic B. (Ed.), *DAAAM International Scientific Book 2014*, pp. 543-556, Vienna, Austria. doi: 10.2507/daaam.scibook.2014.43

Niine T., Cantoni F., & Córdova M. (2021). MOOCs in Logistics – Preliminary Data on University Curricula Coverage. In: Auer M. E., Rüütmann T. (Eds.) *Educating Engineers for Future Industrial Revolutions*. Springer, Cham. doi: 10.1007/978-3-030-68198-2_54

Sandeen, C. (2013). Integrating MOOCs into traditional higher education: The emerging "MOOC 3.0" era. *Change: The Magazine of Higher Learning*, 45(6), 34-39. doi: 10.1080/00091383.2013.842103

Urrutia, M. L. (2019). MOOCs and competencies for Higher Education transformation: an activity theory analysis. Doctoral thesis. University of Southampton, Faculty of Engineering and Physical Science.

Wagner, C., Sancho–Esper, F., & Rodriguez–Sanchez, C. (2019). Skill and knowledge requirements of entry-level logistics and supply chain management professionals: A comparative study of Ireland and Spain. *Journal of Education for Business*, 95(1), 23-36. doi: 10.1080/08832323.2019.1596870

Zhu, M., Bonk, C. J., & Sari, A. R. (2018). Instructor experiences designing MOOCs in higher education: Pedagogical, resource, and logistical considerations and challenges. *Online Learning Journal*, 22(4), 203-241. doi: 10.24059/olj.v22i4.1495

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14672

Dealing with Uncertainty – Experiencing Real Life in Class

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Abstract

It is likely that our Computer Science graduates will be confronted with software which has been growing over a long period of time. In order to master resulting challenges in their later professional lives, students need to be able to deal with the inherent uncertainty of legacy software systems. Observations show that many students are bad at dealing with uncertainty. Therefore, it is important to address the competence of dealing with uncertainty in teaching.

In this article, we describe our experiences with addressing this important competence in teaching of a module on Software Archaeology.

The basis is to establish a teaching and learning environment that creates uncertainty within lab sessions. We achieved this by using a project from industrial practice. This, however, also induces uncertainties regarding the teaching and assessment processes.

We conclude that further methods need to be developed to address this competence with respect to teaching and assessment.

Keywords: *Higher cognitive abilities; uncertainty, software maintenance and evolution; sustainable software.*

1. Motivation

The training of our students in software development and software engineering requires dealing with a large number of abstract concepts and formal language constructs that can be combined with each other in almost any way. We have observed that we tend to focus strongly on the competence levels of understanding and application of constructs. Although we usually formulate learning objectives for our courses also at higher competence levels according to Bloom's revised taxonomy of learning objectives (Anderson et al., 2001), important learnings related to higher levels of competency are often neglected.

An example of such a neglected skill is the ability to deal with uncertainty. Many of our teaching examples and practical tasks in the first semesters are based on crystal-clear requirements, so as not to allow uncertainties to arise. This results from large freshmen cohorts where feedback has to be produced in an efficient manner. We also try not to make ourselves vulnerable in the evaluation by keeping the space for discussions as small as possible. This leads to a stronger schoolification which is not the goal of higher education. Also in practice, software developers are often faced with unclear requirements and old undocumented legacy software. Such environments bring up uncertainties, they have to deal with.

2. Objectives

Based on these findings, we want to adapt our teaching and address the deficits mentioned in advanced courses. The above points can be integrated into teaching by providing the students with an extensive existing codebase. The less such a project is in compliance with the classical quality standards, the more we have to work like archaeologists would put it: “To draw knowledge from what has been created by humans in ancient times” (Sinn, 2000). Starting from such a metaphorical allusion, Hunt and Thomas raised the term software archaeology already in 2002 (Hunt & Thomas, 2002).

In this article, we use the example of a module on software archaeology to describe our experience with these important topics in the field of software engineering.

3. Literature

Software maintenance is definitely mentioned in standard curricula. It is often considered as a sub-discipline of software engineering but rarely seen as a separate module; see e. g. (ACM, 2016).

In 2003, van Deursen et al. state in a workshop contribution for Program Comprehension: “Students learn how to write new programs but they are not taught how to read and change existing and large ones” (Deursen et al., 2003).

Both Smith and Pinto follow the approach to teach maintenance and evolution by using existing open source projects (Smith et al., 2014, Pinto, 2017). We extend this field to software archaeology by a retrospective architecture and requirements analysis.

Overoye and Storm (Overoye & Storm, 2015) collected evidence that students can benefit from experiencing uncertainty and from having the opportunity to overcome it. They claim, however, that "it is the process underlying the change from uncertainty to certainty that leads to deeper understanding and better memory for the to-be-learned information".

4. Course Design

The module on Software Archaeology is designed as an elective subject with five ECTS for the bachelor's degree programs in Computer Science as well as Information Systems and Management. It is designed for two hours per week each: lecturing and lab time. Assessment is done in two-parts: a graded study paper and a graded oral exam.

Due to Covid-19, the course had to take place completely online in the summer semester 2021. We had the opportunity to teach the module in pair-teaching mode (Zehetmeier et al., 2018).

4.1. Learning objectives

We formulated the following learning objectives based on the competencies that are required for the given tasks:

- You analyze existing code to understand it and
  - to draw conclusions about the intention of the original developers
  - to identify requirements so that they can be used as a basis for refactorings or a re-implementation
- You document the knowledge gained using suitable tools.
- You apply reverse engineering techniques systematically and purposefully.
- You apply refactoring techniques systematically and purposefully.
- You analyze control flow theoretically and based on existing initial data.
- You will design, implement and execute tests for legacy code.
- You discuss procedures and results in your lab group and in plenary.

4.2. Project used within the module

The focus of the course should be an existing project that serves as a guideline for a substantial discussion within a semester. According to Smith et al. (Smith et al., 2014) we formulated criteria for such a project in advance:

- The project must be sufficiently large and complex so that no group of students tries to carry out a complete re-implementation on a single weekend.
- The project must have technical debts.
- The project must deal with various external systems and interfaces.
- The project should not come from an academic context.

In this respect, projects from the open source environment could be considered, as well as projects from practice. Unlike described in (Pinto et al., 2017) we just didn't want an Open Source community, that could be contacted as a fallback in case of difficulties. The change of one of the authors to industry opened up the possibility of working on several projects from the professional context that meet the requirements. We chose a historically grown, approximately twelve-year-old project realized in ColdFusion. The software is still in productive use. The scope is about 30,000 lines of code. The software deals with several external systems and interfaces, is largely undocumented, has no tests, and brings various more technical debts with it.

4.3. Topics and Tasks

The existing software should be analyzed in the first two thirds of the semester with the goal of creating an architecture documentation based on the arc42 template (Starke et al., 2019). This includes a description of the requirements that can be extracted ex-post from the software. In addition to a support for maintenance work, the documentation can provide a basis for the upcoming reimplementation of the system. Finally, a modern user interface should be designed so that the benefits of archaeological work become visible.

The module is comprised of the following thematic blocks:

Glossary In addition to setting up the project, the first block included creation of a glossary. The task was to continuously expand the glossary with knowledge gained over time.

Extraction of an API documentation This task required the creation of a documentation of the project's (pre-REST) HTTP-API including a description of the chosen approach to this task in a wiki. The concrete design of this documentation was left to the students.

Interface description and cross-cutting concerns Creating the arc42 template and to fill it with glossary and API documentation was the third task. Additionally, stakeholders, boundary conditions and context had to be identified, as well as any cross-cutting concerns and external interfaces of the system "as far as possible".

Documentation of the database In this step, the relationships between the existing database tables had to be analyzed and documented by reverse engineering.

Runtime view After having thoroughly dealt with the static view of the application, the students should determine dynamic views. Individual API backend functions had to be described on an adequate high level of abstraction.

Documentation of requirements An ex-post extraction of the requirements was considered as the basis for a later re-implementation of the application.

GUI At the end of the semester, students should propose a redesign based on the knowledge acquired during the semester.

5. Observations and Reflection

When designing the course, it was important to us that the project contains many uncertainties. The historically grown software also confronted us lecturers with a considerable amount of uncertainty. The complete range of functionality and structure had not fully opened up to us either.

During the preparation of the individual lectures as well as in the retrospective, we repeatedly discussed various statements, work results, and also the behavior of students. Two findings appear worth a special discussion at this point: assignments that appear vague, simply because they do not state volume of work required, and how to deal with the resulting uncertainty.

5.1. Dealing with tasks that are vague with respect to quantity

The tasks were vague with respect to volume as even we lecturers had to build hypotheses and verify them in a critical discussion.

Example: ”Describe external interfaces as far as possible”. Already the lack of a quantitative statement created a feeling of uncertainty. Therefore, the students repeatedly demanded quantitative statements, such as how much they have to do to pass the module. We couldn't determine the exact number of external interfaces ourselves. Thus, we explained that we put emphasis on the students’ solution approach in the final grading.

During the semester we kept asking ourselves the question whether we needed to know the project better, in order to make such quantitative statements. However, we repeatedly came to the conclusion that it is precisely the lack of knowledge that brings the project close to a real situation enabling all possibilities of learning by uncertainty (Overoye & Storm, 2015). The evaluation at the end of the semester revealed a very heterogeneous picture among the students with regard to their ability to deal with the occurring uncertainties:

"The course is very realistic, which in my opinion increases the relevance of its content. That's exactly why I personally think the course is very interesting."

"The tasks were not posed well and there was a lot of discussion about what exactly had to be done."

How do we create sufficient certainty for the students despite the naturally vague work assignments, so that they are not in a constant state of vagueness with regard to their grades?

5.2. Impact of uncertainty on quality of results

A comparison of a task's level of uncertainty and the quality of results confirms our hypothesis that the quality of results decreases with increasing uncertainty:

Task Glossary: high degree of uncertainty, poor overall rating. At the beginning of the semester, the assignment to create a glossary offered a high degree of certainty to the students: Some terms from the context of the project have been addressed in the course. But we rapidly reduced the number of explicit hints towards which terms to add to the glossary. Students underestimated the importance of terms from the technical context of the application and neglected expanding the glossary. Overall, the resulting glossaries were of inferior quality. Students did not sufficiently differentiate which terms are important and which are not. Many glossaries were merely lists of acronyms.

Task API documentation: low level of uncertainty, good overall rating. Students did not face a high amount of uncertainty during the creation of the API documentation. The task could also be solved through diligence. The students' results were consistently rated very well.

Task Interfaces: medium degree of uncertainty, medium overall rating. One task towards the arc42 documentation was the identification and description of the external interfaces. Here we did not make a quantitative statement on how many interfaces exist and thus need to be identified. The students faced a degree of uncertainty since they had to decide for themselves when to finish their research. The rating of this task is mediocre. We suspect that the positive trend results from the good search mechanisms and the use of standardized interfaces (e.g. HTTP requests).

Requirements: high degree of uncertainty, poor overall rating. Students had major problems with a description of the requirements for the software functions they had to analyze. To imagine which requirements are the basis for the functions and to describe them in the context of the system was difficult for all groups. The number of questions were also at a peak during this exercise. Despite numerous discussions, the task could only be completed with a rather poor overall result.

The evaluation results show the existing uncertainty among students:

”Project from reality, even if it's not nice to work with ColdFusion”

”[...] the project with Lufthansa was somehow only suitable to a limited extent, since many challenges/tasks could only be solved by guesswork”

“The confusing code and bad coding style make analyzing the project laborious. This may be an accurate representation of reality, but it is motivating not to work out the lab assignments beyond the minimum.”

There was a very heterogeneous mix of students, independent of their semester. Some can deal with the uncertainty of the task – others can not. As a result, we lecturers have to specifically teach how to deal with uncertainties.

If you teach how to deal with uncertainties, you should assess these competences according to the principle of constructive alignment (Biggs, 1996). But how do we assess the competence of dealing with uncertainties? What are the criteria for objectively measuring the competence and how to communicate the assessment criteria transparently?

6. Discussion and Outlook

In this article we presented our observations on dealing with uncertainties in class on Software Archaeology. An important experience is that a grown extensive external project that was developed without clear quality standards, offers good conditions for this approach. The company cooperation has proven to be helpful in this context: the industrial project does not come from the professor’s ”weird world of thoughts”, which makes the students perceive legitimacy, credibility and authenticity. With this project we were able to provide a task with a large space of possible solutions.

Nevertheless, our students tend to push for clear answers or process descriptions that they can internalize for the exam or use in their study paper. If we resist to provide this, they feel great uncertainty. Here a dilemma arises for the lecturers: if they give too much and too detailed feedback too early, students adapt work results to a solution, lecturers have in mind – a result that is to be avoided. From the student's point of view the lack of early feedback takes away their opportunity to improve grades during the semester, even though we were willing to accept any reasonable solution with well argumented derivation.

Encouragement to continue on the approach chosen, appreciation for work results, and discussing the pros and cons of approaches and artifacts, help dealing with uncertainty in the project. On the other hand, artificially creating certainty does not foster the ability to last uncertainties now and in future professional life.

Supporting students in such a course where higher cognitive skills are addressed exceeds the usual time budget for a course significantly. We are missing efficient forms of supporting our students. This should be the next step in research about this competence.

In summary, several questions arise from this article: Which other methods are suitable for integrating uncertainty into teaching? And how can we objectively assess these skills so that the assessment criteria can be communicated? This could be a factor to lower the uncertainty regarding the exam performance. The students could then focus on the uncertainty the project context brings with it.

References

ACM (2016). Computer Engineering Curricula 2016 – Curriculum Guidelines for Undergraduate Degree Programs in Computer Engineering. Tech. Rep., Assoc. for Comp. Machinery (ACM)/ IEEE Comp. Society

Anderson, Lorin W.; Krathwohl, David R.; Airasian, Peter W.; Cruikshank, Kathleen A.; Mayer, Richard E.; Pintrich, Paul R.; Raths, James; Wittrock, Merlin C., Hrsg. (2001). A Taxonomy for Learning, Teaching, and Assessing. A Revision of Bloom's Taxonomy of Educational Objectives. Longman, New York, 1. ed.

Biggs, Jhn (1996). Enhancing teaching through constructive alignment. Higher education, 32(3):347–364.

van Deursen, A.; Favre, J.-M.; Koschke, R.; Rilling, J. (2003). Experiences in teaching software evolution and program comprehension. In: 11th IEEE International Workshop on Program Comprehension, 2003. S. 283–284.

Hunt, Andy; Thomas, Dave (2002). Software Archaeology. IEEE Software, 19(2): 20–22.

Overoye, A. L., Storm, B. C. (2015). Harnessing the Power of Uncertainty to enhance Learning. Translational Issues in Psychological Sciences, 1(2), 140-148. doi: 10.1037/tp20000022.

Pinto, Gustavo Henrique Lima; Filho, Fernando Figueira; Steinmacher, Igor; Gerosa, Marco Aurelio (2017). Training Software Engineers Using Open-Source Software: The Professors' Perspective. In: 2017 IEEE 30th Conference on Software Engineering Education and Training (CSEE&T). S. 117–121.

Starke, Gernot; Simons, Michael; Zorner, Stefan; Müller, Ralf D. (2019). arc42 by Example: Software architecture documentation in practice. Packt Publishing, Birmingham.

Sinn, Ulrich (2000). Einführung in die klassische Archäologie. C. H. Beck.

Smith, Thérèse Mary; McCartney, Robert; Gokhale, Swapna S.; Kaczmarczyk, Lisa C. (2014). Selecting Open Source Software Projects to Teach Software Engineering. In: Proceedings of the 45th ACM Technical Symposium on Computer Science Education. SIGCSE '14, Association for Computing Machinery, New York, NY, USA, S. 397–402.

Zehetmeier, Daniela; Böttcher, Axel; Brüggemann-Klein, Anne. (2018). Designing Lectures as a Team and Teaching in Pairs. in Proc. 4th International Conference on Higher Education Advances (HEAd'18), Valencia. 873—880

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14386

Collaborative Design and Build Activity in a CS1 Course: A Practical Experience Report

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Abstract

Shaping students' mind to structure and solve problem, in an Introduction to Programming course for first year students, takes time, leading some students to get demotivated before they actually master this new skill. This paper reports on a Collaborative Design and Build activity dedicated to reinforce students' interest and improve their skills by sequentially solving problems in teams, through a real-life inspired scenario. Two sessions of the activity were organized during the semester. This paper carefully describes the activity design. It also presents and discusses results showing that students' productions got more accurate across the sessions, leading many participants to outperform in solving problems in the final exam.

Keywords: *Collaborative Learning; Role Taking; First Year Students; Computational Thinking; Active Pedagogy; Clustering.*

1. Introduction

A main objective of our course "Introduction to Programming" (usually referred to as "CS1") consists in teaching to first year Computer Science students how to design a solution before actually building it. Many students find that reflection phase (called "Design Phase") hard, abstract, and tedious. In practice, as soon as they are working on their own, students tend to rush or even skip the design to directly jump to the implementation (perceived as more funny). That leads to a poor solution they patch afterwards, resulting in a final shaky solution. To tackle it, we need to assist more closely the students during the Design Phase, to emphase its importance (Harackiewicz, 2016) and "unlock" their understanding. This paper describes a Collaborative activity, incorporated in our CS1 course, relying on Role Taking (included in Collaborative Learning) (Strijbos & Weinberger, 2010). The activity highlights the purpose of the Design Phase and gives students co-ownership. It is hold for groups of six students whose goal is solving three problems, by first designing their solution, in a limited amount of time. For a given problem, the resolution draws on an assembly-line process, following the concept of Assembly Line Education ("ALE") experimented in the Medicine Faculty in University of Florida where it has been demonstrated that this teaching mode increases interest and sparks students (Rosario et al., 2020). By acting so, the students need to give their best since they are laying the foundations for other teams. Moreover, they get instantaneous feedback from each others, making them aware of their deficiencies in their ability to design a solution. This *Collaborative Design and Build activity* (abbreviated here as "CDB") was also set out to be as close as possible to a real professional scenario in order to bring more sense to the solution design process and stimulate students (Bédard & Béchard, 2009). Eventually, it is aimed to see students producing higher quality solutions, relying on the vision that interest energizes learning (Hidi, 2000).

2. Context of the CS1 course

From a content perspective, the course alternates between specific C programming concepts and a problem-solving methodology, inspired by the idea "Thinking before Implementing" (Razzouk & Shute, 2012). It consists in learning the students to handle complex problems by first designing their solution (through the *Design Phase)* so that, eventually, implementing it (through the *Building Phase*) gets straightforward. The Design Phase relies on Computational Thinking concepts (Rodríguez del Rey et al., 2020) and includes two sequential steps:

1. *Problem Analysis*. It consists in defining the problem through input and output and, then, decomposing it into several subproblems easier to handle than the original one.
2. *Graphical Reasoning* It consists in graphically representing the iterative process associated to a given subproblem so that this graphic will support the code (Liénardy et al., 2020).

Then, the Building Phase comes, made up of the last step :

3. *Coding*. It consists in writing the code (in C programming language) based on the two previous steps and testing it with respect to the initial problem.

In practice, during traditional sessions where students resolve exercises, in isolation to each others, they often find hard, tedious and useless to go through this process for easy problems. But as soon as problems get more complex, they are not able to utilize properly the methodology and their final solution gets very poor due to a too superficial Design Phase. This phenomenon has been periodically observed in recent years, in particular during the MidTerm evaluation (that is the first certificative assessment the students have to take).

To tackle this recurrent trend, the *Collaborative Design and Build Activity* (i.e., CDB) was created and proposed twice to the students, in order to emphase the importance of the Design Phase and make them involved and rigorous across this process. Fig. 1 depicts when the two CDB sessions were organized with respect to other usual class activities and evaluations. More precisely, this figure shows that the course is made up of theoretical and practical sessions (where only the ones related to the problem-solving methodology are highlighted). Moreover, a MidTerm evaluation is organised, following similar conditions than the final Exam, with a strong emphasis on our methodology (both Design and Building Phases).

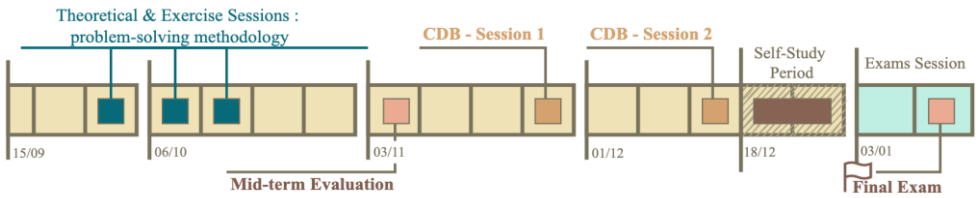


Figure 1. Inclusion of the CDB activity in the CS1 course organization.

3. Organisation of the CDB Activity

The CDB activity has been set up for a mid-size group (around 50 participants) and could afford until 100 participants with two supervisors. Here, 50 students participated to the first CDB session while only 25 took part in the second one. 23 students took part in both sessions.

The right side of Fig. 2 ("Classroom Configuration") shows that the CDB activity is experimented by *Groups* of six students, each Group being split in three *Teams* (two students per Team). The goal of each Group is to solve three problems in a limited amount of time. The left part of Fig. 2 illustrates how the three problems are getting progressively solved in parallel over time, following the three steps of the methodology taught in the course.

This conception is inspired by real professional life as, in large-scale development projects, the three steps of the methodology are performed by different computer scientist teams.

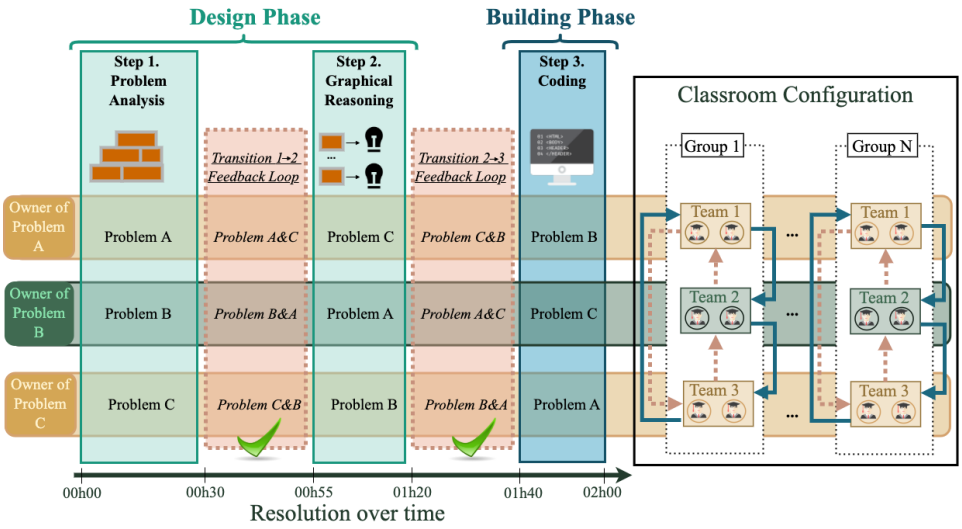


Figure 2. Teaching Scenario Organization.

Going into more detail, at the beginning, each Team receives and gets responsible of one problem. For a given problem, the three steps are sequentially addressed, each Team being busy, turn-by-turn, with a specific one. At the end of each step, each Team work moves to the next Team, clockwise, in the same way in every Group, as shown by the plain arrows.

For every step transition, a validation period is dedicated to allow the students to read the production provided by the previous Team and, if needed, report a feedback to them, as depicted by the dashed arrows. The motivation behind this is to limit the impact of a "poor quality work" on the next productions that are based on the previous ones. This feedback is supported by a validation form listing the criteria the production should meet to be a good ground for the next step. Once filled, this validation form can be returned to the previous Team who should adapt their work based on the comments in the form.

Once the Coding step is over, every Team checks if the final code related to the problem they were the owner of correctly answers the initial question. Then, the three Teams join together and share their conclusion. Finally, they pick one solution that was not working (if there is any) and identify the various error sources. This last investigation work is supported by a dedicated template listing the main requirements the solution should have met. This template is kept flexible, allowing students to easily add specific observations.

4. Method

Data was collected to evaluate the impact of the CDB activity on the students' perception and performance. In particular, it is aimed to see how much students' learning got supported through Collaboration, with a dedicated focus on their performance on the Design Phase.

4.1. Perception Data

An anonymous survey was administered to students at the end of each CDB session. Both surveys included open-ended and Likert scale questions, asking how they felt during the activity, what they learnt, which difficulties they encountered, and how communication went.

4.2. Performance Data

For each CDB session, all students' productions were collected and labeled by their University identifier in order to be analysed afterwards. In this way, the list of participants to each session could be derived. We consider in our performance analysis the students who took part in at least one session. Moreover, the level of each pair of participants (i.e., each Team) is qualified by rating their production through a score value that is mapped to a cluster.

Figure 3. Mapping from their score to a cluster.

As shown in Fig. 3, the absents get a score of -1 for discriminating poor performance and not taking part in the CDB activity. The remaining clusters are assigned to students based on score intervals that are evenly space sample from 0 to 5. A score of 0 means that the Team has performed a poor job, while a score of 5 means the production is correct. To compute the score, some typical mistakes are defined and each of them is mapped to a gravity factor. The largest the factor, the most serious the mistake and the more penalized the students if they fall into it. Those errors are categorized as syntax error or semantic error. This classification is relevant when the second and the third steps are assessed since they rely on some primary work from other Teams. That means that the correctness of those last steps might be badly impacted by the previous Teams, independently from any lack of knowledge and skills from the current Team. Under that concern, if the input coming from the previous Team is qualified as too poor, only the syntax errors are assessed to derive the score.

5. Results and Discussion

5.1. Students' Perception

To the question *"Did you like the activity ? Why ?",* roughly 88% of the participants in the first session answered positively, with 39% of them spontaneously plebisciting the fact that this was a group activity and 16% this was a real life inspired activity. Fig. 4. also shows learning outcomes of the CDB activity, according to participants. A large panel of aspects came up, especially at the end of the first session since it was completely new to them. However, after the second one, many students felt they learnt more about the methodology itself (mainly the 2 first steps)**.** This last observation shows the importance of repeating the CDB activity throughout the semester in order to really bring improvements in their ability to handle the Design Phase. This inference was enforced by the participants themselves. At the end of the second session, from the statement *"The quality of the work you got from other teams improved compared to the first session.* ", 63% of them agreed or even strongly agreed.

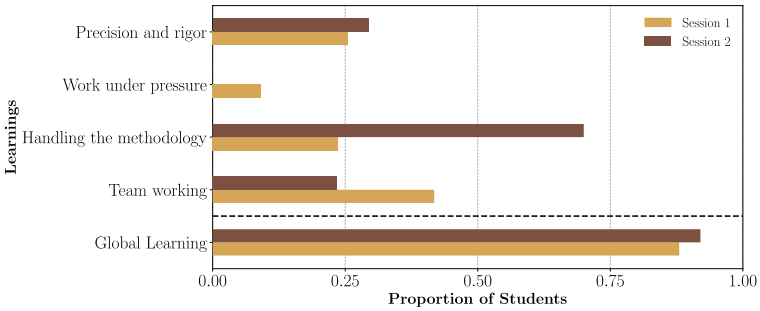


Figure 4. How much and what students have learnt in particular during the CDB activity (Answers to : "Have you learnt something in the CDB session? If so, what in particular?").

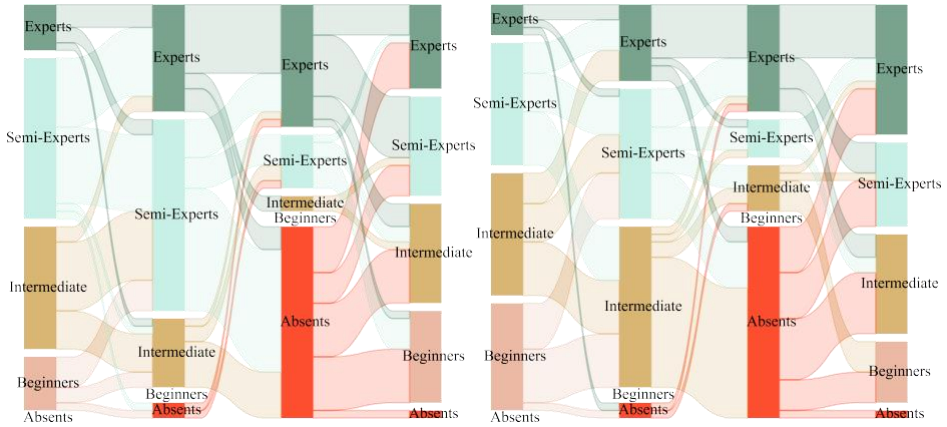
5.2. Students' Performance

We focus here on the performance over the Design Phase, targeted to be promoted by the CDB. Then, more broadly, the resulting performance on the Building Phase is given as well.

In order to qualify the impact of the CDB activity on students' performance, two end references framing the two CDB sessions are defined : the MidTerm and the Exam. For all those four activities, the students were assessed based on the same criteria. However, some intrinsic differences remained, leading to overestimate the students' performance during the CDB sessions compared to the evaluations. In particular, during the CDB sessions, there was (*i*) less stress, the CDB activity having been introduced as a formative exercise; (*ii*) the opportunity to roll backward thanks to the feedback reported by other Teams; (*iii*) more time to handle each step; (*iv*) collaboration, which can be considered as both reinforcement and

additional difficulty to handle, depending on the soft-skills and the knowledge of each student; (*v*) a focus on the methodology, while the evaluations also cover (many) other topics.

Fig. 5 illustrates the distribution and evolution of the participants over the various clusters. In particular, Fig. 5a provides the mean results over the whole Design Phase. It shows that many participants improved from the MidTerm to Session 1. More precisely, we computed that 52% of them moved from one cluster to an upper one. Then, 20% of the participants got even better in Session 2, half of them growing from Semi-Experts to Experts. However, a large rate of Absents is also observed for Session 2. A likely reason is that the CDB sessions ran (too) late over the semester (as shown in Fig. 1), since it got organized at the same time as the idea rolled forward. In Session 2, all the time budget dedicated to the course activities



5a. For the Design Phase (Step 1+ Step2). *5b. For Graphical Reasoning (Step 2).*
Figure 5. Distribution and evolution of the participants across clusters over the activities.

was consumed. Moreover, the session was not promoted enough, leading many students to prefer starting their studying period earlier, rather than taking part in another CDB session.

With respect to the Exam, one can notice that both the Experts and Beginners clusters grew compared to the MidTerm. To catch what is behind the larger proportion of Beginners, we have considered separately the 2 steps of the Design Phase. Taking that detailed perspective, we could link that performance decrease to the Analysis step that was addressed slightly differently in the exam, which disrupted some students. However, the Graphical Reasoning Step (roughly independent from the Analysis one here) got successfully handled by many students. More precisely, from Fig. 5b (complemented by the corresponding computated percentage), we can see that the proportion of Semi-Experts joined to the Experts rose (by 40%) from the MidTerm to the Exam while the proportion of Beginners dropped (by 43%). That improvement was likely boosted by the CDB, in accordance with the observation that Collaborative learning can lead to better development of ideas and concepts through sketch drawing (helping students in sharing the same representation) (Komis et al., 2002).

Finally, shifting to the Building Phase, we notice that the group of Experts and Semi-Experts grew from 3 to 23 participants from the MidTerm to the Exam. Again, it enforces the idea the CDB activity is a good springboard to make students embracing the Design Phase.

6. Perspective and Conclusion

From this first experience, CDB appeared to be a cross-skilling exercise, learning students to handle intra and inter-team communication, be precise and rigorous, and improve their problem-solving skill. During both sessions, students were stimulated by working on a real-life scenario where they needed to give their best to avoid penalizing the others in performing their own task. This dependence also gave the opportunity to put in place feedback loops, learning students to provide feedbacks and adapt from them. Besides those positive aspects, we believe the CDB activity could be better tuned. In particular, it should be better articulated with the rest of the course, e.g., the first session should come prior to the MidTerm and any session should be better advised to ensure students' participation. Moreover, the first CDB session could be made mandatory, so as to make students realizing early enough the interest of the Design Phase.

More generally, we believe Collaborative Learning and Assembly Line Education (both encapsulated in a real-life scenario) have the potential to make the difference in students' engagement and performance.

References

Bédard, D., Béchard, J.-P. (2009). Innover dans l'Enseignement Supérieur. *Presses Universitaires de France.*

Harackiewicz, J. M., Smith, J. L., & Priniski, S. J. (2016). Interest Matters: The Importance of Promoting Interest in Education. *Policy Insights from the Behavioral and Brain Sciences*, 3(2), 220–227. doi: 10.1177/2372732216655542

Hidi, S. , Harackiewicz, J. M. (2000). Motivating the Academically Unmotivated: A Critical Issue for the 21st Century. *Review of Educational Research Summer*, (70)2, 151-179. doi: 10.3102/00346543070002151

Komis, V., Avouris, N., Fidas, C. (2002). Computer-supported collaborative concept mapping: Study of synchronous peer interaction. *Journal of Education and Information Technologies*, 7(2), 169-188. *doi: 10.1023/A:1020309927987*

Liénardy, S., Leduc, L., Verpoorten, D., Donnet, B. (2020). CAFÉ: Automatic Correction and Feedback of Programming Challenges for a CS1 Course. *22nd Australasian Computing Education Conference (ACE),* 95-104. doi : 10.1145/3373165.3373176

Razzouk, R., Shute, V. (2012). Why is Design Thinking and Why Is It Important ? *Review of Educational Research*, 82(3), 330-348. doi: 10.3102/0034654312457429

Rodríguez del Rey, Y. A., Nissandra Cawanga Cambinda, I., Deco, C., Bender, C., Avello-Martinez, R., Villalba-Condori, K. O. (2020). Developing Computational Thinking with a Module of Solved Problems. *Computer Applications in Engineering Education*, 29(3), 506-516. doi: 10.1002/cae.22214

Rosario, J., Lebowitz, D., Webb, A. L., Ganti, L., Vera, A., Macintosh, T., Walker, A., Rubeor, J. (2020). Assembly Line Education: A Novel Educational Technique for Today's Learners. Cureus, 12(2). doi: 10.7759/cureus.7065

Strijbos, J.W., & Weinberger, A. (2010). Emerging and scripted roles in computer supported collaborative learning. *Computers Human Behavior*, 26(4), 491-494. doi : 10.1016/j.chb.2009.08.006

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14587

Supporting Developers in Creating Web Apps for Education via an App Development Framework

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Abstract

As more educational activities are conducted online, the need for interactive applications (apps) that can effectively support educators in their practice is increasing. These apps are often created by web developers or by researchers, educators, and even students with programming experience. While a large body of work has focused on incorporating these apps into educational contexts, fewer studies have focused on their development. In this paper, we first present the design and implementation of an app development framework aimed at supporting developers in creating apps for education. We then report the results of a study comprising interviews with 12 developers who used the framework. Our findings highlight that while the creation of web apps for education can be facilitated by a purely software-based app development framework, effectively exploiting such a framework requires domain knowledge that could be acquired through in-depth documentation, tutorials, and collaboration between developers and educators.

Keywords: *App development framework; apps for education; online learning; developer support; interactive apps; digital education.*

1. Introduction

As more educational activities move to online learning scenarios, the need for adequate tools to support these scenarios is becoming more pertinent. However, developing these tools requires programming skills, which can be a limitation for teachers and researchers in education looking to incorporate custom tools into their practice. In this paper, we present the design of an open-source development framework aimed at supporting the creation of web applications (apps) for education. This framework was used by 20 developers to create over 35 apps that were deployed in an online learning environment. To evaluate our framework, we conducted a qualitative study comprising semi-structured interviews with 12 developers who used the framework. Results from these interviews were analyzed using thematic analysis, shedding light on the (i) technical, (ii) educational, and (iii) open-source aspects of our framework, as well as on how to make app development for education more accessible. Our results point toward the need for collaboration between developers, researchers in education, and educators, which could be facilitated by our framework.

2. Background and Related Work

Educational design approaches, frameworks, and software proposed in the literature often focus on the production of learning content (Puggioni et al., 2020) or the design and development of tools supporting learning activities (Hohenwarter, 2002). Furthermore, frameworks supporting software development for education generally target specific platforms or subject matter. On the one hand, some learning management systems (e.g., Moodle) support the development and integration of custom plugins (Moore & Churchward, 2010). These plugins, however, are tightly coupled with the content hosted on the respective platform and cannot be deployed externally without custom software, such as an LTI adapter (IMS Global Learning Consortium, 2019). On the other hand, some online simulation providers, such as the PhET Interactive Simulations project (Perkins et al., 2006), provide access to their development frameworks but are specifically tailored for certain subjects.

Our goal is to provide an open-source, platform-agnostic, software development framework that can be harnessed to create apps aimed at supporting online learning across academic disciplines. This approach is best aligned with the H5P project (h5p.org), which supports the creation of reusable interactive HTML content. Nevertheless, while H5P is widely used in education (Amali et al., 2019), it targets publishing platforms in general and is designed primarily for content creators, not developers. Our framework exclusively targets educational contexts and is designed for developers working on creating web apps for such contexts. Furthermore—to the best of our knowledge—no study has focused on gathering feedback from developers on their experience creating apps for education. In this paper, we address these gaps by presenting the design and evaluation of our app development framework.

3. Design

Our app development framework is designed following a headless and decoupled architecture similar to that of the popular Gatsby framework (Gatsby, 2022). Gatsby is a JavaScript framework for creating and deploying websites. It allows developers to use a command-line interface (CLI) to create websites based on templates, some of which are featured in a public repository. Developers can then build on those templates and deploy their websites to their own infrastructure or to one provided by Gatsby. Our design adopts and adapts this strategy to online education platforms. In this section, we present the five core components of our framework: (i) context, (ii) application programming interface (API), (iii) templates, (iv) CLI, and (v) repository.

3.1. Context

Our app development framework is primarily designed for apps that are incorporated into an online learning context, which we refer to as running in *contextual mode*. Specifically, apps are loaded by calling the URL where the app is hosted, either in an iframe (if embedded directly in a learning activity) or as a standalone web page (if opened as a separate link). To inform an app of its context, the URL includes a query string that contains its unique ID within the learning platform, as well as the IDs of the activity that it is a part of (i.e., its context) and of the user that is interacting with it. The query string also informs the app whether it is running within the platform's teacher or student interface and provides the endpoint that the app needs to call to access the platform's API. Apps can then render role-specific views or components, such as a settings panel that is only available to teachers. If this context is missing, apps can fall back to running in *standalone mode* (i.e., without support from an online learning platform). Standalone mode is particularly useful for apps that do not require user-generated data (e.g., simulations) or to perform demos.

3.2. Application Programming Interface (API)

Apps running in contextual mode are aimed at communicating with online learning platforms and therefore need access to data hosted by these platforms, such as learning resources and activity traces. Access to this data is often made possible via APIs. While each platform has its own API, our goal was to identify the core data required to support educational apps and design our API specifications accordingly. To do this, we created a public API that exposed endpoints for the app to (i) get information about the user that is currently logged in, (ii) get a list of learners that have interacted with the app or with the lesson in which the app is embedded, (iii) read and update its configuration, which is visible to all learners (e.g., an app providing an online programming environment could be configured for Python or JavaScript), (iv) create, read, update, and delete its own resources, which include user-generated learning outputs, and (v) create, read, and delete activity traces generated by users

while interacting with the app. These endpoints are loosely based on the—now deprecated—OpenSocial standard, which defined a social API specification that was adopted by some open education platforms (Gillet et al., 2013). Once our API was set in place, apps could exploit it to get access to the content they required to run.

3.3. Templates

While it is possible to develop an app for our framework from scratch, templates allow developers to maximize code reusability and focus on app- and use-case-specific code. Templates are code repositories that serve as a starting point for the development of an app. While we provide default templates, developers can create custom templates, either from scratch or by building on our default templates. This reduces the amount of boilerplate that developers need to write in order to create apps. That is, templates allow for the basic structure for a particular set of apps to be only written once. The structures provided by templates can facilitate many development tasks, including enforcing code style, setting up development and testing frameworks, providing design components, and abstracting the API through ready-made functions that pre-establish the link between the app and the platform(s) it will be hosted on. Furthermore, templates can be generated in various frontend development languages (e.g., JavaScript, TypeScript, Elm) and frameworks (e.g., React, Angular, Vue) to attract a wider community of developers. Our default templates are written in JavaScript and cover both the React and Angular frameworks. These templates encapsulate the core structure of an app targeted at our online learning platform, including—on top of the aforementioned development tasks—privacy and role-aware data access and visualization modes, frontend state management, an open-source license, and compatibility with an offline desktop environment.

3.4. Command Line Interface (CLI)

To make it straightforward to get started with a template, we created a CLI that guides developers through the process of bootstrapping an app. The CLI's `new` command prompts developers for information concerning the template that they want to use, the name for their app, and optional IDs required for access to our API and deployment to our infrastructure. The CLI can also be used to test an app locally, package it as a compressed file, deploy it to our infrastructure, and publish a new version. These commands harness lower-level utilities (e.g., `git`, `npm`, `aws`) and custom shell scripts, abstracting this logic from the developer.

3.5. Open Educational App Repository

A final component of our design is the app repository. While the code for the apps could be hosted in any source code repository (e.g., GitHub, GitLab), these repositories are not specifically aimed at education. To allow educators to more easily discover and use apps built with our framework, we created a repository of open educational resources that could host

these apps and provide information about them in a way that is accessible to non-technical users. Our design followed the approach used by other app repositories such as Go-Lab (de Jong et al., 2014), whereby educators can quickly search for, filter, and test apps that are relevant to their practice.

4. Applications

Over 35 apps have been created and published in our open repository. These apps range from virtual labs targeting physics education, to learning analytics visualizations for both teachers and students, to interactive chatbot interfaces. Figure 1 illustrates four examples of apps that were created using our app development framework. *Code* (top left) allows students to write and execute Python code in the browser (Farah et al., 2020). *Sticky Notes* (top right) enables collaborative design thinking and brainstorming. *Global Model* (bottom right) helps students visualize the effects of global warming. Finally, *Light Pollution Simulator* (bottom left) aims at raising awareness of the effects of light pollution on the night sky (Gomes et al., 2019).

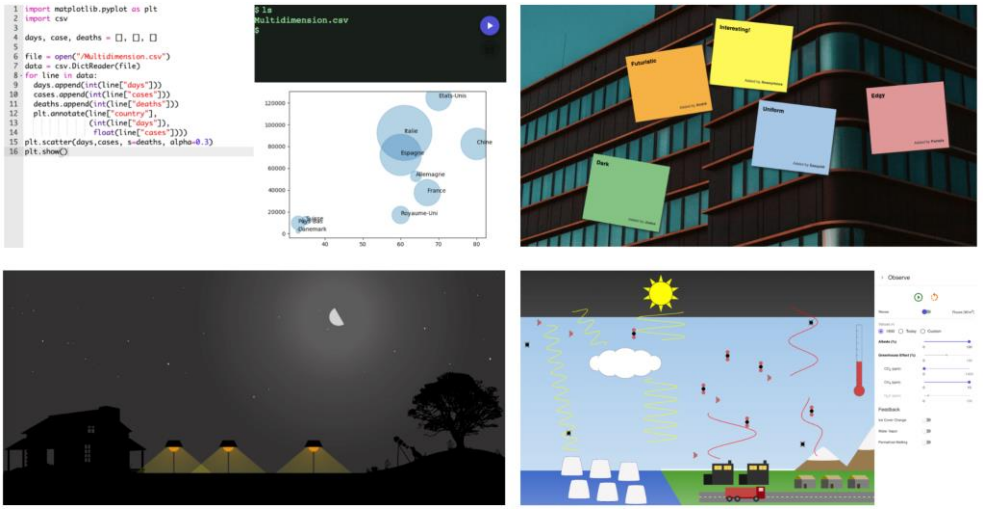

Figure 1. Four example apps (clockwise from top left): Code *for Python programming,* Sticky Notes *for design thinking,* Global Model *for climate change awareness, and* Light Pollution Simulator *to visualize light pollution.*

5. Evaluation

Our evaluation addressed the following research question: *How did our app development framework facilitate the creation of apps for education?* Specifically, we focus on three aspects: (i) *technical*, (ii) *educational*, and (iii) *open-source*.

5.1. Methodology

Our qualitative analysis consisted of semi-structured interviews, given their applicability to small-scale research (Drever, 1995). Interviews lasted approximately 30 minutes, took place using an online video conferencing tool, and were loosely guided by 15 questions covering four topics: (i) developer background, (ii) experience with the app development framework, (iii) educational context, and (iv) importance of open-source code. Following the total population purposive sampling method, we contacted all developers who were identified as having worked with our app development framework. A total of 13 developers agreed to participate and were interviewed in January and February 2022. One interview was excluded from our analysis due to technical issues with the transcript. We analyzed our qualitative data using thematic analysis, performing line-by-line coding on the interview transcripts to identify emergent themes with respect to the three aspects of our study.

5.2. Results

Concerning the technical aspect, all 12 developers were overall positive about the support received by the framework, although five developers expressed that they found it challenging to get started due to their lack of experience either with JavaScript (two developers) or React (three developers). Five developers noted that the boilerplate provided by the default template was helpful, while nine developers alluded to the consistent and adequate structure of the code. Eight developers highlighted the need for more technical support, with five developers suggesting the creation of video tutorials. These tutorials were suggested as a way to explain what was included in the template (two developers) and to help developers create a sample app (two developers). Four developers also noted the need for more templates to support other technology stacks (one developer), keep the code up-to-date with current standards (three developers), and make parts of the code optional (one developer).

Concerning the educational aspect, all developers were overall positive about the framework's impact on helping create apps for education, with six developers noting that the framework's support for learning analytics was an important feature. Nevertheless, five developers reported that understanding the educational context and nomenclature of the framework was challenging. To address this challenge, four developers highlighted the importance of collaboration between developers and educators. Two developers specifically suggested incorporating requirements elicitation and validation processes into the framework. The importance of collaboration is best illustrated by a quote from one of the developers, who mentioned that "*one of the challenges is that very often it's not really about the code and how skilled the coders are… it's more [about] the teachers and the teachers who know the [subject matter] and who know how the students will receive [the app] and what they will find challenging and what they will find interesting… I'm not a teacher, so I wouldn't have that knowledge. I don't know the [subject matter]… maybe I could learn it, but*

I'm not going to learn it in a way that someone who's been teaching it for 5-10 years knows it, and also [knows the] students".

Finally, concerning the open-source aspect, all 12 developers were positive about the fact that the framework encouraged open-source. Reasons put forth for the importance of open-source included (i) not reinventing the wheel (two developers), (ii) making knowledge and examples accessible (seven developers), and (iii) building a community (three developers).

6. Discussion

The results of our evaluation show that on the one hand, developers found our framework useful in terms of the technical advantages it provided through convenient boilerplate, the ease of use of the CLI, and the consistent structure of the code. On the other hand, the framework failed to fully support developers in understanding the educational aspects involved in the development of apps aimed at learning contexts. The need to better support and encourage collaboration between the different stakeholders in education is aligned with work by Tavares et al. (2020), who proposed a participatory design process to bring together researchers in education and end-users of educational mobile apps. Indeed, our findings suggest that collaboration should also be established between software developers, researchers in education, and educators. This collaboration could be facilitated by the development framework, which could include educational aspects in its documentation and tutorials, incorporate an automated validation process, provide a library of reusable components that are strongly linked to pedagogical interfaces, and follow nomenclature defined through a participatory design process involving both developers and educators.

7. Conclusion

In this paper, we presented the design and evaluation of an app development framework aimed at supporting developers in creating apps for educational contexts. Our results suggest that developers would benefit from support from experts in education, which could be facilitated by the app development framework. Nevertheless, our evaluation has some limitations worth noting. First, while the sample size is appropriate for a qualitative study using semi-structured interviews, it would be useful to complement these findings with a larger sample size, along with a quantitative analysis of the actual usage of the framework. Second, our app development framework allows apps to be deployed in standalone or contextual mode. However, contextual mode currently only supports the Graasp online learning platform (Gillet et al., 2022). To increase portability, contextual mode should be compatible with multiple platforms. In future work, we aim to address these limitations and incorporate the feedback received into the next iteration of our framework.

References

Amali, L. N., Kadir, N. T., & Latief, M. (2019). Development of E-learning Content with H5P and iSpring Features. *Journal of Physics: Conference Series*, 1387(1), 012019. doi: 10.1088/1742-6596/1387/1/012019

de Jong, T., Sotiriou, S., & Gillet, D. (2014). Innovations in STEM Education: The Go-Lab Federation of Online Labs. *Smart Learning Environments*, 1(1), 3. doi: 10.1186/s40561-014-0003-6

Drever, E. (1995). *Using Semi-Structured Interviews in Small-Scale Research: A Teacher's Guide*. Edinburgh: The Scottish Council for Research in Education.

Farah, J. C., Moro, A., Bergram, K., Purohit, A. K., Gillet, D., & Holzer, A. (2020). Bringing Computational Thinking to non-STEM Undergraduates through an Integrated Notebook Application. *Proceedings of the Impact Papers at the 15th European Conference on Technology-Enhanced Learning (EC-TEL 2020)*, 14.

Gatsby (4.7). (2022). [Computer Software]. Gatsby. gatsbyjs.com

Gillet, D., de Jong, T., Sotirou, S., & Salzmann, C. (2013). Personalised Learning Spaces and Federated Online Labs for STEM Education at School. *2013 IEEE Global Engineering Education Conference (EDUCON)*, 769–773. doi: 10.1109/EduCon.2013.6530194

Gillet, D., Vonèche-Cardia, I., Farah, J. C., Phan Hoang, K. L., & Rodríguez-Triana, M. J. (2022). Integrated Model for Comprehensive Digital Education Platforms. *2022 IEEE Global Engineering Education Conference (EDUCON)*, 1586–1592.

Gomes, N. R. C., Farah, J. C., Doran, R., & Gillet, D. (2019), A Light Pollution Simulator. *European Planetary Science Congress - Division for Planetary Science Joint Meeting (EPSC-DPS 2019)*, 1838.

Hohenwarter, M. (2002). *GeoGebra - ein Softwaresystem für dynamische Geometrie und Algebra der Ebene*. Universität Salzburg.

Learning Tools Interoperability Core Specification (1.3). (2019). IMS Global Learning Consortium, Inc. imsglobal.org/spec/lti/v1p3

Moore, J. & Churchward, M. (2010). *Moodle 1.9 Multimedia Extension Development: Customize and Extend Moodle by Using its Robust Plugin Systems*. Birmingham: Packt Publishing Ltd.

Perkins, K., Adams, W., Dubson, M., Finkelstein, N., Reid, S., Wieman, C., & LeMaster, R. (2006). PhET: Interactive Simulations for Teaching and Learning Physics. *The Physics Teacher*, 44(1), 18–23. doi: 10.1119/1.2150754

Puggioni, M. P., Frontoni, E., Paolanti, M., Pierdicca, R., Malinverni, E. S., & Sasso, M. (2020). A Content Creation Tool for AR/VR Applications in Education: The ScoolAR Framework. In L. T. De Paolis & P. Bourdot (Eds.), *Augmented Reality, Virtual Reality, and Computer Graphics*, 12243, 205–219. doi: 10.1007/978-3-030-58468-9_16

Tavares, R., Vieira, R. M., & Pedro, L. (2020). A Participatory Framework Proposal for Guiding Researchers through an Educational Mobile App Development. *Research in Learning Technology*, 28. doi: 10.25304/rlt.v28.2370

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14568

Improving Learning Quality in CS Education during the COVID-19 Pandemic

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Abstract

Teaching introductory computer science (CS101) to first year engineering students during a pandemic provides a challenge that can be met with different measures. In this paper we give an analysis of how the course setup evolved during the pandemic, which changes we decided to make in terms of group size and offering additional learning opportunities. It is detailed and compared how an oral summative assessment and a newly introduced written midterm exam influence the final grades of the course and students' contentment. We conclude by discussing the exam results and comparing them over several years and describing what we see as a future proof setup for online and face-to-face teaching.

Keywords: *COVID19; computer science education; midterm; summative assessment; hybrid teaching.*

1. Introduction

Students who began their university studies during the worldwide COVID-19 pandemic were facing severe challenges due to the restrictions. Partly, the restrictions were in place before they even started their studies at the university during their graduation period at school or while working in regular jobs. Since March 2020 and still in the following year professional and educational settings were characterized by strict social distancing and remote learning situations world wide, see Crick et al. (2021).

First year students begin a new chapter of life when entering the university campus – often life long friendships start during the first weeks, study groups form and the new social activities are formative for this period of life. In autumn 2020 it was clear that larger groups of students weren't allowed in the classroom due to the risk of infection at our university. The continued social distancing prevented a normal start for the first year students. Furthermore, a sense of belonging, i.e. feeling as an accepted member of an academic community (see Hehir et al., 2021), is supportive for the learning outcome as well as important for creating equitable and inclusive learning environments.

Riese and Kann (2021) conclude in their study about computer science major students during the pandemic that students needed more help with structure due to the social restrictions and preferred traditional lecture to online formats. First year students often need to establish structure in their study organization. Flynn-Wilson and Reynolds (2021) confirm this observation by a study among students over four semesters comparing virtual, hybrid and face-to-face teaching: students develop their online learning capabilities over time. A similar effect described by Lorås, Haugset and Trætteberg (2021) shows large differences between students managing their online learning, and outlines a greater ability gap among the student group. Finally, according to a study by Gherhes et al. (2021) more than 40 % of the students prefer a return to face-to-face learning after the end of the pandemic.

On the other hand, Katalnikova et al. (2021) describe in detail that students generally prefer online classes to face-to-face teaching while lecturers favour the traditional lecture in the classroom to online teaching. One should not deny the benefit of technological advance with online teaching methods available offering also more flexibility for both students and teachers. However, especially for first years students the authors consider the interaction in the classroom as well as the social structure that regular lessons offer as important. Learning is a social-emotional activity and the higher intensity of university studies also can be fostered by the direct face-to-face contact between professors and students. The first semester course *Introduction to Computer Science* (CS101) was therefore planned with the highest possible percentage of face-to-face lectures.

2. Teaching Setup during the Pandemic Years

The CS101 course at our engineering faculty with typically about 70 students, taught in one large group before the pandemic years, was divided in two groups in October 2020. However, the number of students was still too large to be taught face-to-face in lecture halls. As there are three time slots for the lecture per week, the groups were further subdivided into three small groups. A weekly plan is shown in Table 1. While one group was present in the lecture hall, the two other groups joined the lecture via a videoconferencing system online. This guaranteed the required distance between the students in the lecture hall and allowed every student to participate face-to-face once a week. A similar teaching setup is described by Hunter, Haynes and Kim (2021) and is further referred to as hybrid teaching (HT).

Table 1. Dividing the student group 2020 into small subgroups for face-to-face lectures.

Total Number of Students	Lecturer Group	Students in classroom	Teaching Days Face-to-Face	Teaching Days remote
75	A	A1: 14	Monday	Thursday, Friday
	37 Students	A2: 9	Thursday	Monday, Friday
		A3 14	Friday	Monday, Thursday
	B	B1: 9	Monday	Thursday, Friday
	38 Students	B2: 17	Thursday	Monday, Friday
		B3: 12	Friday	Monday, Thursday

In the autumn of 2021 the group of CS101 was again divided into two groups, one for each lecturer, but further subdivision wasn't necessary as students and lecturers were required to wear masks, and the majority of the students and lecturers were vaccinated. Similar to the previous year students could take part via video conferencing system and additionally recordings of each lecture were made available to the students.

Table 2 shows the different course setups from before the pandemic and during 2020 and 2021. The general layout of the course remained similar to the previous years: five exercises that were to be prepared by the students before discussing them in class, a test exam was conducted at the end of the course and alongside a Q&A session was offered.

In 2020, students in the lecture hall had the opportunity to collect points: Points were given for correct answers to revision questions at the beginning of each lecture and for active participation in problem solving during the exercise discussion in class. The points were added to the points in the final exam at the end of the semester as a "safety cushion" for the students. This summative oral assessment allowed a maximum improvement of one grade

and the students could not worsen their grade by not participating. Exercises respectively the test exam were arranged in a way that each face-to-face group could attend two sessions. Due to the small group size the lecturers could ensure that students are called in equal measure and there was an upper limit to the number of points that could be collected per lecture.

Due to the larger groups in 2021 we decided to use the revision questions for activation of the students at the beginning of each lecture but switched from giving points for answers to an actual written midterm (MT) exam, see Table 2. It consisted of three problems similar to the ones in the final exam, mainly calculations. To motivate students to prepare for the written midterm exam they had to reach at least 25 % of the total number of points to count for the final grade. Students received the graded midterm exam to enable them to revise their mistakes and use the midterm to study. This way they also had knowledge about the size of their "safety cushion" for the final exam. Both, the midterm exam as well as the oral assessment in the year before, were voluntary but strongly encouraged by the lecturers.

Table 2. Course setups before and during pandemic years 2020 and 2021.

Year	Before Pandemic	2020	2021
Number of students in classroom per lecture	75	max. 17	max. 36
List of questions	Done informally by students for exam prep	Oral answers used for summative assessment	Used for revision in classroom only
Written midterm exam	None	None	After six weeks: 30 min.
5 Excercises	Yes	Yes	Yes
Test exam + Q & A	Yes	Yes	Yes
Possibilty to follow via video conference	No	Yes	Yes
Lectures recorded	No	No	Yes

3. Methodology and Analysis

3.1 Course Evaluation Methodology

A variety of measures were used to evaluate the different course setups. In the following, we will refer to the oral summative assessment and the written midterm both as MT results or MT exams. We analyzed points reached per student for both – the MT results and the final exam. For better comparison of the points reached we used a relative scale from zero to 100

percent. The percentage of the points of the final exam are calculated without adding the MT points. The goal was to draw conclusions about a correlation between a successful MT exam to a better learning outcome in the final test. Therefore, we plot for each student the points of the MT exam and the points for the final exam in a diagram for each year, see Figure 1 and Figure 2.

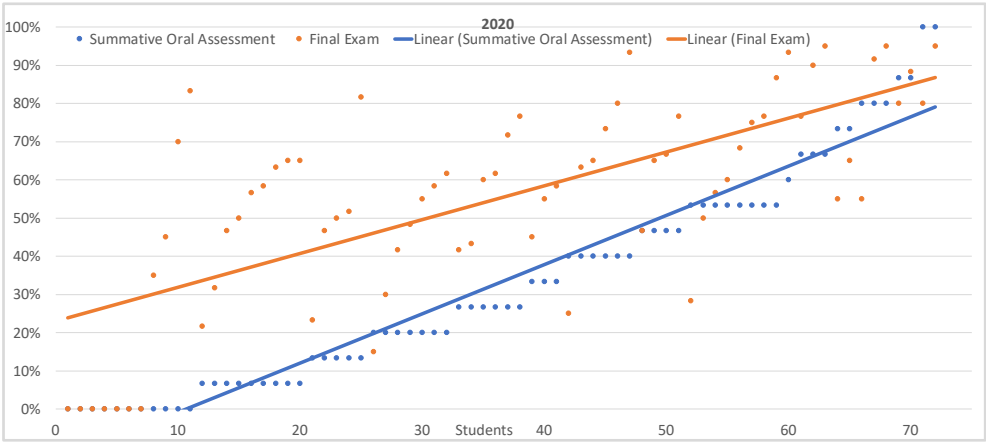

Figure 1: Results of the oral summative assessment and the final exam sorted from lowest to highest for 2020

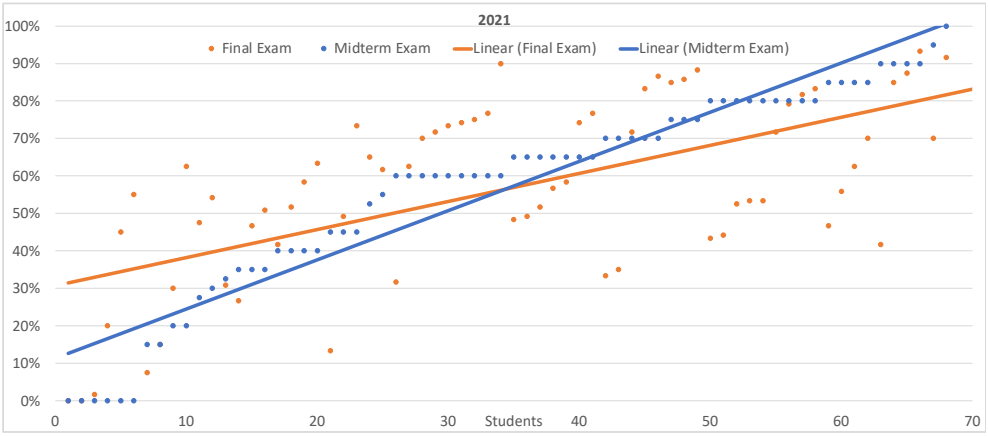

Figure 2: Results of the written midterm and the final exam sorted from lowest to hightest for 2021

The average grades were calculated for the final exams with and without the points accumulated through MT exams. Table 3 shows additionally the pass rate of the courses over four years. The oral assessment was taken at least once by 83 % of the students and about 40 % took part regularly in 2020. The attendance of the MT was 88 % in 2021.

For the comparison of the courses a regular student evaluation is performed for each course plus additional specific questions with respect to the summative assessment and the students' experience with hybrid teaching and pure online teaching as in parallel courses taken by the same students. The survey uses a five point Likert scale. As the student evaluation was scheduled after the final exam, the return rate was quite low: 34 students (23 %). 86 % of the students, who participated in the evaluation, passed the final exam.

3.2 Analysis

Figure 1 and Figure 2 show the correlation of the MT results and the final exam. The data points in both figures are sorted firstly from low to high results of the MT and secondly in ascending order of the final exam results. Comparing Figure 1 and 2 it becomes evident that the effect of the written midterm (Figure 1) is higher on the final grade compared to the oral assessment (Figure 2). This can be drawn from the smaller distance between the linear regression lines in 2021 compared to 2020.

Figure 1 shows that the summative oral assessement has a positive effect on the results of the final exam. The effect is larger the higher the MT points are. This can be concluded from the linear approximation lines being closer together where students had higher points. The first eleven students did not take part in the oral assessment, still two of them had reasonable exam results. Students who got at least 50 % in the summative assessment also passed the final exam and finally, the students with the highest points were the ones getting very good grades in the final exam. In Figure 2 the linear approximation lines of the grades intersect at close to 60 % of the points. The first six students did not take part in the midterm exam but one of them still just about passed the final exam. The students who reached 60 % in the MT exam achieved good grades (> 70 %) in the final exam. Surprisingly we can observe that some students with high MT results did not receive matching results in their final tests.

Table 3 Overview of the received average grades and pass rates of the last four years.

Year	2016	2018	2020	2021
Final Grade [1.0 = best, 5.0 = failed]	3.8	3.7	3.4	3.3
Final Grade with Midterm	-	-	3.4	3.1
Average Grade of Midterm Exam	-	-	3.0	3.1
Percentage of Students passing the exam	63%	64%	76%	82%

As it can be seen from Table 3 the final grades improve about 0.4 compared to the course given before the pandemic. The average grade of the final exam in 2021 is also 0.1 points better than the year before with the oral examination. In the second line of the table the average grade including the MT points improves by 0.3 from 2020 to 2021. It can be noted

that the percentage of the students passing the exam increases by more than ten percent from the course before the pandemic and another six percent from 2020 to 2021.

Table 4. Evaluation results.

Question	(fully) agree	neutral	(fully) disagree
Q1: HT as teaching method was motivating and stimulating?	77 %	18 %	5 %
Q2: Online teaching as teaching method was motivating and stimulating?	59 %	27 %	14 %
Q3: Has the opportunity to collect points had a positive effect on your learning success?	59 %	27 %	14 %
Q4:Would you like to be able to collect points for future courses that can be counted towards your exam?	90 %	5 %	5 %

The students‘ evaluation results shown in Table 4 are ambiguous with respect to HT, feedback received was from “being glad for face-to-face teaching, I’d do anything to get out of my student digs” to “I prefer the flexibility of online teaching and video recordings.” Compared to pure online teaching (OT), 18 % of the students found HT more motivating and stimulating, compare Q1 & Q2. On the other hand, the students evaluated their own learning success in grades as 2.0 for HT and with 1.9 slightly better for OT. CS101 is the first mandatory course at our faculty with a summative assessment. 90 % of the students agreed or fully agreed (Q4) that they would like to collect points in other courses as well. About 60 % of the students stated that the summative assessment had a positive impact on the learning success (Q3).

4. Discussion and Conclusions

A catalog of revision questions is greatly appreciated by students and a valid measure for collecting points as a summative oral assessment for small groups (less than 15 people). This holds true for online and face-to-face teaching. Our students confirmed this in other subjects that were taught in small groups as well. In larger groups the appreciation for the questions remains but grading is quite difficult with respect to equal treatment and proper tracking of the answers, and therefore consuming too much time during the lecture. In the evaluation of the class most students gave the feedback that the questions helped them prepare for exam while some stated that they didn’t like to interrupt other students or wanted to give answers in front of the whole class.

Figure 1 and Figure 2 show that the effect of the oral assessment is less effective towards a higher final grade than the written MT exam. However, the MT results as shown in Figure 2 reflect just the first six weeks, whereas the oral assessment lasted the whole semester. Thus, collecting more points in the oral assessments requires students to stick further to the lecture objectives. This explains a lower variance for students with superior oral assessment results.

Students gladly took the incentive of collecting points during the trimester to accumulate better final grade as shown by the above 80 % participation at the MT exams and with a strong result in the evaluation. On the contraty Figure 2 shows: the higher the MT grade, the safer the students must have felt to pass the final exam. Students confirmed after the course that they felt safe due to the MT exam and prioritized other subjects in the examination phase.

From before the pandemic years to the lecture given quite a number of factors were changed: The size of the groups, teaching in parallel with two lecturers, the introduction of the summative oral assessment, the written MT exam and hybrid teaching. We found that despite difficult circumstances (pandemic) the average grade of the class improved (see Table 3). We still attribute the improved average grades mainly to the MT exams and revision questions as this was the oral and written feedback from students during the evaluation of the class. Future work may include a more specific analysis of the correlation of detailed problems in the midterm and final exam and a comparison between CS101 and other classes taught to the same group of students at the same time.

References

Crick, T., Knight, C., Watermeyer, R. and Goodall, J. 2021. The International Impact of COVID-19 and "Emergency Remote Teaching" on Computer Science Education Practitioners. *2021 IEEE Global Engineering Education Conference (EDUCON)*, 2021.

Flynn-Wilson, L., Reynolds, KE. 2021. Student Responses to Virtual Synchronous, Hybrid, and Face-to-Face Teaching/Learning. Int. J. of Technol. in Education. 2021;4(1) 46-56.

Gherhes,V., Stoian, C.E., Farcasiu, M.A., Stanici, M. 2021. E-Learning vs. Face-To-Face Learning: Analyzing Students' Preferences and Behaviors. Sustainability 2021, 13, 4381, doi: 10.3390/su13084381

Hehir, E., Zeller, M., Luckhurst, J. and Chandler T., 2021. Developing student connectedness under remote learning using digital resources: A systematic review. *Educ Inf Technol* **26,** 6531–6548 (2021), doi: 10.1007/s10639-021-10577-1

Hunter, W., Haynes, M. and Kim, J. 2021. Dual Teaching: Simultaneous Remote and In-Person Learning During COVID. In Proc. of the 22nd Annual Conf. on Information Technol. Education (SIGITE '21), Snowbird Resort, Utah (US), Oct. 6-9, pp. 111–116

Katalnikova, S., Zagulova, D., Prokofjeva, N., Špakova, A., Ziborova, V., Averin, A. 2021. Forced distance learning in Covid-19: peculiarities of the position of lecturers, students of IT and humanitarian specialties. 7th Int. Conf. on Higher Education Advances (HEAd'21), June 22-23, Valencia, Spain, doi: 10.4995/HEAd21.2021.13057

Lorås, M., Haugset, B. and Trætteberg H. 2021. The Importance of the Campus - A Study on the Effects of the COVID-19 Pandemic in a CS2 Course. IEEE Global Engineering Educ. Conf. (EDUCON), 2021, pp. 160-169, doi: 10.1109/EDUCON46332.2021.9453910.

Riese, E. and Kann, V. 2021. Computer Science Majors' Experiences of Their Distance Education Caused by the COVID-19 Pandemic. IEEE Global Engineering Educ. Conf. (EDUCON), 2021, pp. 393-397, doi: 10.1109/EDUCON46332.2021.9454105.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14217

Challenges of Knowledge Component Modeling: A Software Engineering Case Study

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Abstract

To improve instruction, educators require greater visibility into the learning gains of individual students and the ability to adapt to resolve any learning gaps. A prerequisite to achieving such instruction is decomposing knowledge into small components that function as gradual steps for the learner's journey. However, decomposing a knowledge domain is not trivial, as instructors must overcome many practical challenges along the way.

We report on our experience of knowledge component modeling for the clean code analysis and refactoring domain. We describe our method and list four challenges encountered during modeling and our solution for them. The resulting knowledge component inventory is a secondary contribution of the paper. These results can assist educators in planning and executing knowledge component modeling to refine their instruction and produce more significant learning gains in their students.

Keywords: *knowledge component; intelligent tutoring systems; KLI; cognitive task analysis; clean code; refactoring.*

1. Introduction

Ideal instruction causes robust learning (Koedinger et al., 2012) for the whole audience, with the minimum required time, while engaging and motivating each student to continue learning (Honebein & Reigeluth, 2020). Such a feat seems practically impossible, as most classrooms have dozens or hundreds of students with different prior knowledge, interests, and affective states when the instruction is being delivered (Aleven et al., 2016). This problem is one of visibility and scale (Baker et al., 2022). It is difficult for an educator delivering the lecture to understand the learning gains obtained by an individual student through passive observation. Even with perfect visibility of the students' learning gaps, the educator cannot adapt their instruction for each student, as the number of students far outweighs the number of educators.

Contemporary learning theories coupled with digital technologies provide a scalable way to achieve visibility into individual students' learning gaps and gains (Koedinger et al., 2012; Ritter et al., 2019; Baker et al., 2022). Adaptive e-learning tools, such as intelligent tutoring systems (ITSs), interleave instruction with assessments to ensure a student achieves mastery of a unit (i.e., the expected learning gains) before moving on to the next one. To be effective, ITSs require educators to decompose the domain model (i.e., the taught subject matter) into chunks known as knowledge components (KCs) (Koedinger et al., 2012; Pelánek, 2020).

Even without an ITS, there is value in decomposing a unit into its KCs, communicating them, and monitoring their learning (Koedinger et al., 2012). Educators can focus their instruction and assessments to target one concept at a time by explicitly defining them, reducing students' working memory load (Sweller, 2020). KCs have been used as a basis for systematic methods that refine instruction, leading to more significant learning outcomes (Gusukuma et al., 2018). However, many practical challenges are involved in modeling KCs, some previously reported (Aleven & Koedinger, 2013; Pelánek, 2020).

We conducted KC modeling for an undergraduate software engineering course by following the method proposed by Gusukuma et al. (2018). We utilized the method to develop KCs, instructional, and assessment items for a set of units concerned with clean code analysis and refactoring. In this paper, we report on our experience and identify a set of challenges and our solutions to them as the paper's primary contribution. These results may help educators of all subject matters improve their instruction and overcome the challenges inherent in KC modeling. We also present part of the resulting KC inventory for the clean code analysis and refactoring domains as secondary contributions of the paper that software engineering educators can directly use.

The rest of the paper is organized as follows. Section 2 describes the related work in which we anchor our contribution. Section 3 presents the method we followed while creating our KCs and presents the resulting set of KCs. Section 4 discusses the identified challenges in

KC modeling. Here we outline our solutions to the challenges and present open issues that remain unsolved. Finally, Section 5 concludes the paper and lists ideas for further work.

2. Related Work

Here we briefly discuss the knowledge-learning-instruction framework (KLI) developed by Koedinger et al. (2012), which defines the baseline conceptual model of our work. We then explore previously defined challenges in KC modeling, which we expand upon in Section 4.

2.1. Knowledge Component Conceptual Model

Koedinger et al. (2012) developed a framework that specifies three taxonomies - kinds of knowledge, learning processes, instructional choices, and the dependencies between them. The framework defines four concepts that interact to cause and assess learning gains:

- Instructional events (IEs) are observable variations in the learning environment that facilitate learning by introducing new knowledge or providing a different perspective on familiar knowledge. Examples of IEs include a statement of fact, an example of a concept, a case study, or an illustrative metaphor.
- Assessment events (AEs) are observable variations in the learning environment that require a submission from the student to infer their mastery of the related knowledge components. Examples of AEs include multiple-response questions, algebra problems, or programming exercises. AEs can be instructional when they provide feedback for submissions, and most ITSs offer such AEs.
- Learning events (LEs) cause unobservable processes that change cognitive and brain states. The student's existing knowledge influences LEs, and LEs create new or refine existing knowledge components.
- Knowledge components (KCs) define an acquired unit of cognitive function or mental structure inferred from performance on a set of related assessment events. The KLI framework defines the KC as a broad term for describing pieces of cognition or knowledge, including facts, concepts, misconceptions, or skills.

KCs vary in granularity and present a hierarchical structure (e.g., to master the broader skill of solving basic arithmetic equations, the student needs to master the addition, subtraction, multiplication, and division KCs). Other relations among KCs exist, such as prerequisite relationships (Pelánek, 2021). When decomposing a unit into its KCs, learning engineers should consider the expected understanding (i.e., KC mastery) that students should have at the start of the unit and build upon that.

Given a set of KCs, each student starts with zero mastery for each KC in the set. When a student makes a submission for an AE, they are graded based on their performance (the correctness of the submission and possibly the time it took them to complete it) (Koedinger

et al., 2012). Tracking a student's mastery reduces over-practice (i.e., when a student masters a KC, additional AEs are redundant) and under-practice (i.e., when a student has not mastered a KC, they need additional IEs and AEs to help them develop the mastery).

2.2. Knowledge Component Modeling Challenges

The fundamental challenge of creating a KC model for a domain is determining which KCs correctly map to the student's cognition, evidenced by the model's ability to accurately predict student performance across tasks and time (Aleven & Koedinger, 2013).

To illustrate, we consider a set of knowledge components related to arithmetic addition: (1) Add two single-digit numbers, where the result does not exceed 10. (2) Add any two single-digit numbers. (3) Add two numbers where the result does not exceed 100. (4) Add any two numbers. (5) Add multiple numbers.

Given that a student achieves mastery for the listed KCs, how can we be sure that they have mastered arithmetic addition in general? How can we ensure that the KC set does not include redundant items (e.g., is the third KC necessary, or does mastery of the second KC guarantee mastery of the third)? Given enough students and AEs, Aleven and Koedinger (2013) discuss combining human expertise and statistical analysis to determine better KC models.

Pelánek (2020) reports a set of challenges for KC modeling related to the practical limitations of the activity. A typical domain model for a course can count hundreds of KCs and dozens of IEs and AEs for each KC. Given the ambiguity of KCs discussed by Aleven and Koedinger (2013), creating, managing, and incrementally improving such a collection of items is a considerable practical challenge. Pelánek (2020) offers a list of recommendations to overcome these challenges, including tips for determining KC granularity, reducing possible relationships between elements (e.g., limiting each IE and AE to a single KC; focusing only on the hierarchy relationship in KCs), and automating the creation of AEs where possible.

3. KC Modeling Case Study

Here we outline our case study, including the method we used to perform KC modeling and the achieved results.

We employed KC modeling for a 3rd-year undergraduate *Software specification and modeling* course. The original course was developed without awareness of the KLI framework. The instruction and assessments have been developed without a formal process, relying on informed experience.

We targeted units related to the topic of clean code analysis and refactoring (Martin, 2009; Fowler, 2018), a set of skills whose goal is to produce higher-quality code, making the software more maintainable. For these units, we employed the method for refining instruction

proposed by Gusukuma et al. (2018) and based on the systematic design of instruction (Dick et al., 2015). Here we describe only the steps of the method relevant for our KC modeling.

3.1. Defining the set of KCs

Following Gusukuma et al. (2018), we *identified a set of instructional goals*, including:

- "Assign meaningful names to identifiers in code" entails analyzing the existing code and new requirements and determining a set of words that appropriately describe the targeted identifier.
- "Create clean functions" entails understanding the various aspects that contribute to a function's cleanliness and how to combine them into the codebase.

Next, we *identified common misconceptions* by examining our interaction with previous students and their coding assignments collected as part of a controlled experiment we conducted (Luburić et al., 2022). This analysis resulted in a list of mislearned skills, which served as valuable input for the next activity.

For *instructional analysis*, we examined each instructional goal and defined the expected students' baseline knowledge. In KLI terms, we declared all KCs for which we expected existing mastery from the students (e.g., either from the previous unit of our course or the previous courses). Next, we performed cognitive task analysis (Clark et al., 2007) by analyzing existing course materials and related literature (e.g., Martin (2009) and Fowler (2018)) and interviewing our subject matter experts. Through these activities, we derived the knowledge and skills we expected students to develop to accomplish the instructional goal. We then mapped the identified misconceptions from the previous steps to the instructional goal. Guided by the revised Bloom's taxonomy (Anderson & Krathwohl, 2001), we developed the initial KC inventory over several iterations of brainstorming and review. While performing instructional analysis, we ran into several challenges and dilemmas, which we elaborate on in Section 4.

3.2. The KC inventory

We list our KC inventory as a secondary contribution of the paper as supplementary material[1]. The table lists KCs for two units from the clean code analysis and refactoring domain, relevant for all major programming paradigms (i.e., procedural, object-oriented, and functional). Following the recommendations made by Pelánek (2020), we simplify the relationships between KCs and only include the hierarchy relationship (denoted by the Parent KC Id column).

[1] Because we plan to further refine our instruction over the coming years, we maintain an online page that hosts the up-to-date KC inventory (https://github.com/Clean-CaDET/tutor/wiki/Sample-Knowledge-Components).

4. Discussion

Here we expand the work presented by Aleven and Koedinger (2013) and Pelánek (2020). Guided by our experience, we define a set of challenges and solutions for KC modeling.

4.1. Discovering unnecessary KCs

Researchers strive to create fine-grained KCs in their experiments to build a perfect knowledge map of a domain. However, expanding the KC inventory increases maintenance efforts for educators (Pelánek, 2020). In practical terms, it is challenging to determine if additional KCs justify their maintenance cost when they increase learning gains for a small percentile of students. Furthermore, requiring students to complete AEs for these extra (and possibly redundant) KCs can result in over-practice, violating the goal of minimizing instructional time (Koedinger et al., 2012; Honebein & Reigeluth, 2020).

After our brainstorming sessions, we produced KCs that we subsequently excluded from the final inventory. We reviewed each KC and removed it from the inventory if neither of the following conditions was met:

- The students' prior coding assignments contained errors that resulted from mislearning the examined KC, signaling that the KC is important and should be explicitly addressed.
- Our course materials had segments that directly targeted the examined KC, indicating that the students might have achieved mastery because of these materials.

Through this approach, we removed two KCs from the inventory and integrated their knowledge into the higher-level KC (N01 and F03 in the supplementary material).

4.2. Discovering hidden KCs

Some KCs, especially those at a higher level of granularity (Pelánek, 2020), are simple to identify. Basic intuition coupled with a few brainstorming sessions can reveal many skills and subskills for the initial KC inventory. However, many non-intuitive KCs often remain hidden, including integrative KCs (Koedinger et al., 2012) and other non-obvious skills.

Identifying misconceptions helps discover hidden KCs (Gusukuma et al., 2018). We supplemented this approach by examining coarse-grained KCs for which the students' have trouble achieving mastery (i.e., many students required many AEs before reaching the mastery threshold). Once we determined problematic KCs, we applied cognitive task analysis (Clark et al., 2007) to discover three additional KCs (i.e., N04, F04, and F07 in the supplementary material).

Notably, it is not essential to identify all hidden KCs. As discussed in Section 4.1, this can lead to maintainability and over-practice issues.

4.3. Discovering insufficient AEs

AEs help determine the student's KC mastery, provided they properly target the KC. Koedinger et al., 2012 identified the issue of AEs that do not examine if the KC is developed at the appropriate level of abstraction (and is instead overspecialized). Pelánek (2020) recommends creating enough AEs for each KC (i.e., several dozen) to combat this issue.

We found that these guidelines require a significant upfront investment that is wasted if the issues described in Section 4.1 or 4.2 occur (i.e., discarding a KC might discard most of its AEs). Instead, we created five to eight AEs of varying difficulty for each KC. Our goal is to expand the AE set when we encounter overspecialization in students' thinking or discover problematic AEs (e.g., an AE for which most students make an incorrect first submission).

4.4. Discovering poor IEs

An adequately defined KC might have AEs that correctly assess the students' mastery. However, without clear feedback and instructional resources to examine, students might continuously fail to achieve the required level of mastery. Therefore, another issue might arise from poorly constructed IEs that do not produce the expected LEs.

To mitigate this issue, we designed a feedback loop where students can grade and comment on the quality of our instructional materials. Considering that KCs are small chunks of knowledge, we require frequent feedback from the students and therefore design the feedback control to allow swift input from the student (i.e., grade IEs for a KC on a scale of 1 to 3).

5. Conclusion

To improve instruction, educators require greater visibility into the learning gains of individual students and the ability to adapt to resolve any learning gaps. A prerequisite to achieving such instruction is decomposing knowledge into small KCs that function as gradual steps for the learner's journey. Each step (i.e., KC) is supported by IEs that overcome learning gaps and AEs that test learning gains.

Decomposing a knowledge domain into KCs is not trivial, as instructors must overcome many practical challenges along the way. In this paper, we report on our experience of KC modeling for the clean code analysis and refactoring domain. We describe our method and list four challenges for KC modeling and our solution to them, expanding on previous work in the field. The results can assist educators in refining their instruction and producing more significant learning gains in their students. We provide a KC inventory as a secondary contribution, useful to software engineering educators. Further work entails performing KC modeling for course units and refining the KC, IE, and AE inventory over the coming years.

References

Aleven, V., & Koedinger, K. R. (2013). Knowledge component (KC) approaches to learner modeling. *Design Recommendations for Intelligent Tutoring Systems*, 1, 165-182.

Aleven, V., McLaughlin, E. A., Glenn, R. A., & Koedinger, K. R. (2016). Instruction based on adaptive learning technologies. *Handbook of research on learning and instruction*, 2, 522-560.

Anderson, L. W., & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives*. Longman.

Baker, R. S., Boser, U., & Snow, E. L. (2022). Learning Engineering: A View on Where the Field is at, Where it's Going, and the Research Needed.

Clark, R. E., Feldon, D., van Merriënboer, J., Yates, K, and Early, S. (2007). Cognitive Task Analysis. In Spector, J. M., Merrill, M. D., van Merriënboer, J. J. G., & Driscoll, M. P. (Eds.) *Handbook of research on educational communications and technology (3rd ed.)*. Mahwah, NJ: Lawrence Erlbaum Associates.

Dick, W., Carey, L. & Carey, J.O. (2015). *The Systematic Design of Instruction*. Boston, MA: Pearson.

Fowler, M. (2018). *Refactoring: improving the design of existing code*. Addison-Wesley Professional.

Gusukuma, L., Bart, A. C., Kafura, D., Ernst, J., & Cennamo, K. (2018, February). Instructional design+ knowledge components: A systematic method for refining instruction. In *Proceedings of the 49th ACM Technical Symposium on Computer Science Education* (pp. 338-343).

Honebein, P. C., & Reigeluth, C. M. (2020). The instructional theory framework appears lost. Isn't it time we find it again?. *Revista de Educación a Distancia*, 64(20), 1-24.

Koedinger, K. R., Corbett, A. T., & Perfetti, C. (2012). The Knowledge-Learning-Instruction framework: Bridging the science-practice chasm to enhance robust student learning. *Cognitive science*, 36(5), 757-798.

Luburić, N., Vidaković, D., Slivka, J., Prokić, S., Grujić, K. G., Kovačević, A., & Sladić, G. (2022). Clean Code Tutoring: Makings of a Foundation. In *CSEDU*. In press.

Martin, R. C. (2009). *Clean code: a handbook of agile software craftsmanship*. Pearson Education.

Pelánek, R. (2020). Managing items and knowledge components: domain modeling in practice. *Educational Technology Research and Development*, 68(1), 529-550.

Pelánek, R., 2021. Adaptive, Intelligent, and Personalized: Navigating the Terminological Maze Behind Educational Technology. *International Journal of Artificial Intelligence in Education*, pp.1-23.

Ritter, F. E., Tehranchi, F., & Oury, J. D. (2019). ACT-R: A cognitive architecture for modeling cognition. *Wiley Interdisciplinary Reviews: Cognitive Science*, 10(3), e1488.

Sweller, J. (2020). Cognitive load theory and educational technology. *Educational Technology Research and Development*, 68(1), 1-16.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14594

Distance learning experiences at the University of Guadalajara, Mexico. Towards a hybrid model

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Abstract

The recent health crisis caused by the SARS-CoV-2 virus, known as the COVID-19 virus, disrupted essential areas of the economy and led to the implementation of new forms of teaching and learning in education. At the University of Guadalajara (UDG), Jalisco, Mexico, practical distance learning tools were adapted, and teaching staff was trained to use them; however, areas of opportunity were left visible beyond the work of universities. With the data resulting from a survey of students at the University Center for Economic and Administrative Sciences (CUCEA), we concluded that the strategy implemented by the university was successful; however, the outcome of the learning process was not wholly successful there were significant shortcomings.

Keywords: *Distance learning; hybrid learning; e-learning; virtual education.*

1. Introduction

The total closure of schools, institutes, and universities throughout Mexico caused by the COVID-19 pandemic forced education at all levels to be virtual or distance learning, as the entire population's health was put at risk. This strategy, implemented in March 2020, resulted in the confinement of 40.7 million people, including students, teachers, and administrative staff, of which 5.3 million people correspond to the higher education level, and giving continuity to education through technological environments (Concheiro, 2020).

The above has led homes to become classrooms, and there was the need to acquire computer equipment or mobile devices that allowed connection and internet service when unavailable. Education became totally online, and teachers also had to adapt to these needs. The situation was that not everything flowed as desired; there were delays in the execution of educational programs, there was confusion, discouragement, and in many cases, school desertion.

This paper focuses on presenting the educational policy and actions carried out by higher education institutions, in this case, the University of Guadalajara (UDG), particularly in undergraduate programs offered at the University Center for Economic and Administrative Sciences (CUCEA), regarding distance learning and the challenges faced by students and teachers. The latter finally led to applying a hybrid learning system based on the educational experience implemented.

2. Educational system in Mexico

Education was traditionally face-to-face with other learning environments such as Blended Learning or combined learning in Mexico. This last situation has been more frequent in European countries and has had acceptance among the student community due to the flexibility, access, and teaching-learning processes based on continuous models and not rigid and disciplinary as is the face-to-face (Simon, et al., 2018).

Performance of primary and secondary students remains low about "reading comprehension, written expression, and mathematics" (Gómez, 2017, p.156). In the pandemic context, lags that were already there have worsened since the closure of schools, the economic situation of families, access to education in a virtual environment, capabilities and skills to adapt to the new scenario. All of the above constitute factors that will eventually affect the development of human capital and well-being (World Bank, 2020).

On their behalf, United Nations Educational, Scientific and Cultural Organization (UNESCO, 2020) has reported significant adverse effects on education derived from the

COVID-19 pandemic. Confinement has generated additional problems, such as domestic violence, poor nutrition, unstable family economy, stress, and anxiety, to name a few.

Historically, Mexico does not have the required higher education coverage for its total population. Terminal efficiency has also contributed to the lack of higher educational levels in its people and the existence of other problems related to the social relevance of academic programs at the higher level (Malagón, 2003; ANUIES, 2018).

Therefore, education in Mexico has sought to rely on synchronous, asynchronous, distance, and online virtual learning tools to provide continuity to the educational process and conclude educational programs in the best possible way, with quality and without affecting learning.

In the University context, potentially efficient learning support tools known as Learning Management System (LMS) have been adapted. As its name says, our online learning management systems work in a virtual environment, such as Google Classroom, Cisco Webex, Zoom, Teams, etc. However, this form of disruptive education or change of teaching and learning model from face-to-face to virtual has had essential effects on both students and teachers to incorporate this change and continue with their thematic content and not affect the ultimate goal of learning.

2.1. Classroom vs. virtual education and the hybrid model.

In Mexico, face-to-face education has been the predominant public and private education mode at all levels. Virtual education and remote or distance education were only options for those who, by choice or necessity, had access to this type of learning and for which there are educational programs in specific areas of knowledge.

There was a disruptive change in education by the pandemic where everyone, without exception, had to continue with academic instruction in virtual environments. With the help of an internet connection, through social networks, email, mobile telephony, or instant messaging, such as WhatsApp, Facebook, Telegram, or others, through a television connection has given continuity at all educational levels, mainly in basic education, in the Mexican context.

Under this scenario, virtual education, also known as online education, requires an Internet connection, highlighting the students' socioeconomic problems. Some of them could not pay for Internet service or did not have an electronic device to connect; if they owned, one had to share it with other household members, which generated tension and, ultimately, school dropout.

Therefore, the strategy of the governments in coordination with the Universities consisted of implementing support programs for the student community of free internet connections so

that they could continue with their studies or the loan of computer equipment to be able to connect.

2.2. Actions adopted by the UDG in response to the pandemic

At the beginning of the pandemic, the UDG formed a health board in conjunction with the Jalisco government to monitor the evolution of the number of infected people and inform society about the appropriate actions to prevent and contain contagions.

At the same time, the UDG, as a member of the National Association of Universities and Institutions of Higher Education (ANUIES), signed the National Agreement for Unity in Higher Education in the face of the health emergency caused by COVID-19. With this, they committed to safeguarding society's health to continue their educational work online, prioritizing socioeconomically disadvantaged students (ANUIES, 2020).

Under this scenario in the UDG, from March 17, 2020, until February 8, 2022, middle and higher education (undergraduate and graduate) classes were carried out in the virtual modality. In addition, it was established teachers and administrative or support staff over 60 years with a compromised health condition or pregnant women should not report to their workplaces.

2.3. Actions adopted by the CUCEA in response to the pandemic

Administrative processes and procedures were adapted to be offered primarily online and in digital formats, except for those strictly necessary to be carried out in person.

A particular training program was developed for academics and students in hybrid and online modalities with a perspective of educational inclusion to reinforce students' learning during the pandemic.

The following is a list of the equity and inclusion actions undertaken at CUCEA:

1. Face-to-face access to laboratories for vulnerable groups: oriented to students who manifest problems with internet access or mobile devices and situations of family violence had access to the use of laboratories for their online classes.
2. Scholarships for mothers and fathers: to provide access to the daycare system for their children.
3. Priority in the class schedule: organization of flexible class schedules.
4. Tutoring: monitoring and accompanying academic performance of vulnerable groups, school trajectories, academic and administrative processes.
5. Job opportunities: online catalog.
6. Culture of Peace Program: psychological support (face-to-face and virtual).
7. Protect yourself and enjoy: sexual prevention program.
8. Subtitles in webinars: support the community with hearing impairment.

9. Emotional and legal support for complaints.
10. Computer equipment donation campaign.
11. Internet: support for sim cards with internet access.

Finally, classrooms and specific spaces were provided for teachers to teach their classes online from the campus if necessary. In addition, services were provided to design and develop conferences, seminars, master classes, and virtual workshops to support students' learning.

2.4. Educational setting, design, and evaluation

First-year students received face-to-face tours and induction sessions for comprehensive instruction and school services as part of a welcome to the new stage of their academic education and got to know the dynamics of our university community.

The first semester of 2021 has been developed online, under a hybrid model, to respond to academic priorities and, at the same time, ensure the health of the people who make up the university community.

Undergraduate and graduate teaching activities were developed at a distance (online), using virtual learning platforms and didactic support tools during the regular hours of each class (as in the traditional model). It was recommended to use the institutional Moodle and Google Classroom platforms associated with institutional emails and contact students through those emails.

Each professor was free to choose the platform and didactics that suited best. Those teachers who used Google Classroom shared didactic material, videos and presentations (their own or from other authors), homework, evaluations (two or three, on average, throughout the semester), and made video calls (through Google Meet or Zoom) to conduct their class.

During the semester, evaluations of student development and academic achievement were carried out in order to obtain information that will allow us to adapt our activities and take measures to address the educational lag.

3. Methodology

The analysis was based on a survey of undergraduate students of the CUCEA of the UDG, elaborated through the Google Forms tool, applied in February 2021, to know the perception of their academic performance and of their professors. Therefore, the data are cross-sectional, and descriptive statistical analysis is used. A total of 435 valid questionnaires were received from students of different careers and semesters of the CUCEA.

The survey was structured in 4 sections as follows:

1. Online learning
2. Internet connection and technological resources
3. Virtual modality use and teacher performance
4. Educational platform used

4. Results

Female participation was 72%, and male participation was 28%. The average age was around 20 years old, and the great majority were students of Accounting and Gastronomic Business Management, respectively. The students' responses are presented below (Table 1), organized by axis.

Table 1. Results grouped by section

Section	Result
Online learning	Most of them said they had never taken a course in this modality before.
Internet connection and technological resources	The majority (97.9%) had internet at home, but not good quality. Of these, 31.3% said they share it with another household member. The device they connected to classes was mostly laptop (61.6%), followed by their cell phone (26.4%); desktop computer only 9%, while a minority connected via an electronic tablet, 3%.
Use in the virtual model and teacher performance	In this question, one out of every three respondents (33.1%) mentioned that they had not found the modality promising, as there were more homework assignments. However, slightly more than half (56.6%) stated that their grades were not affected in the virtual modality. Of the respondents, 43.7% felt feedback from their professors is poor, 37.7% felt their professors do better in the face-to-face modality, and 21.8% thought they require training for the virtual modality. Only 18.9% of the respondents perceived that teacher is trained to use virtual educational platforms; 21.6% mentioned that online classes were a disaster.
Educational platform used	The platforms mostly used were Classroom, Meet, email (institutional and personal), Zoom, and Moodle.

Source: Authors' elaboration

5. Conclusions

Change face-to-face to online model has represented a significant issue in the educational sector, where students and professors have had to adapt technology use. However, Internet quality often did not allow asynchronous connection with teachers, meaning students have also faced the self-learning challenge.

On the other hand, it is highlighted e-learning brought some benefits for students, such as a lower economic investment for their transportation to educational centers, time-saving, and practicality of reviewing their teachers' recordings after classes and searching for other educational resources in a self-taught manner.

Survey results confirm a range of possibilities when introducing a hybrid educational model, where face-to-face and virtuality are allowed. The student's perception of a better performance of their professors in the face-to-face environment has been one of the motivations for implementing the hybrid model currently being developed on campus, where the use of educational platforms to guide learning continues and combines with face-to-face sessions.

References

ANUIES (2020). Acuerdo Nacional por la Unidad en la Educación Superior frente a la emergencia sanitaria provocada por el COVID-19. Available at: https://web.anuies.mx/files/Acuerdo_Nacional_Frente_al_COVID_19.pdf.

ANUIES (2018) Visión y acción 2030 Propuesta de la ANUIES para renovar la educación superior en México Diseño y concertación de políticas públicas para impulsar el cambio institucional. Available at: http://www.anuies.mx/media/docs/avisos/pdf/VISION_Y_ACCION_2030.pdf

Concheiro Bórquez, L. (2020). Responses of Public Institutions of Higher Education in Mexico to face the COVID-19 crisis. Mexico: Subsecretaría de Educación Superior, Secretaría de Educación Pública. Retrieved from: http://www.anuies.mx/media/docs/avisos/pdf/200417115709VF_ACCIONES_SES_COVID_19_ANUIES.pdf

Gómez, C. M. (2017). Overview of the Mexican education system from a public policy perspective. Innovación Educativa, Vol. 17, number 74, pp. 143-163.

Malagón, P. L. (2003). Relevance in higher education: elements for its understanding. Revista ANUIES, No. 127, Vol. 32, pp. 113-134.

Simon, P.J., Benedí, G.C., Blanché, V.C., Bosch, D. M., Torrado, F.M.. (2018). Quantitative and qualitative analysis of blended learning in the Catalan university system. RIED. Revista Iberoamericana de Educación a Distancia, 21(1), 113-133. https://doi.org/10.5944/ried.21.1.18773

UNESCO. (2020). Global Coalition for Education. Compiled on 10/14/2020 from https://es.unesco.org/covid19/globaleducationcoalition

World Bank. (2020). COVID-19: Impact on education and public policy response. Executive summary. Available at: https://pubdocs.worldbank.org/en/143771590756983343/Covid-19-Education-Summary-esp.pdf

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14531

From face-to-face environments to distance learning universities: the transition period of first-year students

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Abstract

The sudden transition from face-to-face into distance learning activities in higher education during the Covid-19 pandemic has highlighted the need to improve student induction and transition into distance learning settings. This study explores the experiences of first-year students at a distance learning university. Semi-structured interviews were conducted with students, aged 18-19, who transitioned from a face-to-face environment (school, college or another university) to distance-learning higher education. Thematic analysis yielded themes related to students' early perceptions on distance-learning, experiences with learning and assessment, and social interactions. Noteworthy findings include students' early misconceptions of distance-learning, distance-learning as a shelter for students with mental health issues, views on hybrid learning and continuous assessment, and approaches to socialising. Insights from this study have implications for how universities with new and existing distance learning practices design their induction and support programmes to facilitate student transition and enhance the first-year student experience.

Keywords: *Distance-learning; learning experiences; first-year students; university induction; Covid-19; early perceptions.*

1. Introduction

The transition from school/college to university is a period in which individuals experience changes in various aspects of their lives. For young students, this can be especially stressful, as they are the protagonists of changes that affect the way they learn, their relationships and habits (Aristeidou, 2021; Parker et al., 2004). For instance, Rickinson and Rutherford (1995) identified that an abrupt change in the learning environment can generate anxiety in students especially when they leave a controlled environment like school and go to university and are treated as independent adults responsible for their learning. A survey by Cook and Lecky (1999), assessing attitudes to learning and expectations of university life of incoming students, found that students with A-levels (qualifications offered by schools and colleges focusing on academic subjects) consider themselves unprepared for higher education regarding study skills, private reading, time management, note taking, IT competence and team/project work. Research by Lowe and Cook (2003) with 691 first-year students identified that they did not feel prepared for university, whilst Hassel and Ridout (2018) discovered students struggle with the pace of learning and workload in higher education.

For students enrolling in a distance university course, further uncertainties may arise about the learning approach, socialisation in a virtual environment, assessments, and the presence of educators (Krasilnikov & Smirnova, 2017). However, the transition of students from school/college (or even a university with face-to-face learning) to distance learning has not yet been extensively investigated. The Covid-19 pandemic forced universities to rethink and adapt courses to a distance learning model and researchers have begun to investigate the topic. Previous works have identified actions such as conducting inductions, creating collaborative spaces and guidelines that could smooth out this transition period. For instance, Winnard and Elliott (2012) identified that induction can minimise feelings of isolation, bring students closer to their tutors and support staff, and also get them acclimatised to the VLE. In addition, Foley and Marr (2019) suggested the creation of extracurricular and collaborative activities in the distance-learning environment so that students can get to know each other and get closer to the educator. Lowe and Cook (2003) suggested the creation of guidelines to design support spaces.

This interview study addresses the research question (RQ): *"What are distance learning first-year university students' experiences on their transition from school to university, learning and assessment, and social interactions?"* We conducted 12 interviews with first-year students, aged 18-19, at The Open University (OU), a UK-based university with an open entry system and a long tradition of distance learning. Findings from this research contribute to identifying the anxiety faced by younger students and suggest improvements for an ongoing induction. Our insights can be useful for improving the university and learning experiences of students who transition from a traditional learning environment (school or university) into a distance learning one.

2. Methods

We conducted semi-structured interviews with 12 first-year students, aged 18-19, across faculties at the OU. This study is part of a larger research project, which invited students to join a survey and, optionally, a follow up interview. Several findings from the, mainly quantitative, survey are reported elsewhere (e.g., Aristeidou, 2021). Ethical approval was obtained from the university ethics committee, and participation was voluntary.

2.1. Data collection

The interview protocol was created and piloted with two volunteers from the OU's Student Association prior to the start of the study. The interview involved questions related to the overall project's RQ, i.e., transition from school to university, learning and assessment experiences, and social interactions. The interviews were carried out online between March-April 2021. At the point of the interview, students had studied at least five months with the university and already submitted their first formative assignment**.** The 12 participating interviewees were eight females and four male students, three with declared disabilities and nine without, ten with A Levels and two without. These statistics are representative of the university's demographics. Interviews were recorded, transcribed, and anonymised.

2.2. Data analyis

Deductive and inductive approaches (Miles & Huberman, 1994) were followed to thematically analyse the interview data on nVivo. Some initial themes were pre-constructed, based on the project's research question (e.g., social interactions), while others were identified during the analysis (e.g., Covid-19 effects). Sub-themes and codes were set and identified by Author C after analysing a small number of transcripts; they were then verified and modified where necessary by Author B to ensure inter-rater reliability. The IRR was calculated according to Miles and Huberman (1994) by dividing the number of times both coders agreed by the total number of times coding was possible. The inter-rater percentage agreement reached 76%, which is considered acceptable. The two coders resolved disagreements by merging codes with similar meaning into a single theme, and creating a first version of the codebook. Author C analysed two more interviews, reaching an inter-rater agreement of 82% with the initial codebook, and some minor changes were made. The high percentage agreements are most likely due to all three authors being part of the larger project, having previous discussions and shared understanding. This work focuses on four themes, as these are specifically representative of first-year students, rather than the entire university population. These themes focus on students' early perceptions, learning and assessment, and social interactions.

3. Findings

Findings are structured according to three themes of analysis and data are presented and discussed by providing an account of participants' voices. Students' statements are illustrated by quotes, representing the perspectives of larger groups of interview participants.

3.1. Students' early perceptions

Pre-enrolment and early experiences are highlighted by all the students. In their narrations, they convey their initial perceptions on distance learning, their feelings towards this new 'trip', flexibility and accountability. A principal misconception in students' narrations was that learning activities would be completely digital, without further support, live tutorials, assigned tutors, interactive tasks or social activities. Several students expressed their positive surprise when they discovered that online learning was not 'boring', support levels were 'high' and "they were not left to their own devices in a way that feels like they are isolated".

Mixed emotions were expressed in relation to their enrolment in distance learning. Students felt 'relief' and 'worry'. Of the former, a surprisingly large number communicated experiences of bullying or extremely stressful situations in face-to-face settings and how these have been eliminated in distance-learning.

"I can't deal with like classroom environments because multiple reasons because of bullying and I had a teacher at school who basically said I was going to fail at everything in life. So it brings up anxiety." [Student 4]

However, as the literature suggests elsewhere (e.g., Krasilnikov & Smirnova, 2017), several students were also worried about their social lives and whether they would be able to develop new friendships: "I was like Oh, I'm going to be all by myself, studying with a bunch of people spread around the country." [Student 1]

Concerning their initial impressions of distance learning in the very first months, students discussed their feelings towards the setting's flexibility and being accountable for their studies. They commented on how previously their teachers were responsible to "gather all the learning resources for them", and "remind them of their responsibilities", and others expressed their satisfaction with the fact that they could now "prioritise their tasks", "not having someone telling them what to do", "not having a teacher shouting at them 'you haven't done this work'", and "doing things at their own pace". Students also added that being accountable for their studies allows them to gain skills such as "balancing their workload and work-life responsibilities".

Finally, students compared their university life to those of face-to-face universities, which they had either attended previously themselves or where their friends currently study. Students commented on the "limited support levels" of a particular university, or explained

that they “dislike commuting” and “spending unproductive time on campus”. As expected, the Covid-19 pandemic has also affected students’ university choices, with nearly all students explaining that “they were not going anywhere anyway”, “The OU is already adapted to distance learning” or even highlighting that face-to-face universities “just do what they are doing already, but putting it online”.

3.2 Learning and Assessment

The interview discussion focused on how they engage with learning and assessment in distance-learning settings. It involved students’ illustration of the available resources and material, how they engage with their tutors and tutorials, and their assessment experiences. Students highlighted their satisfaction on the multimedia aspect of online learning, focusing on the availability and variety of online resources, such as “having video clips to watch”, “having things to listen”, “a lot more online activities” and “not having to walk to the library, as everything is on my computer”. Interestingly, receiving physical books to complement or use as alternatives to online material was a positive surprise for students. The interviewees welcomed this unexpected resource, adding that they "like having a book to be able to write on" and this "really helped with the online learning in that it wasn't all on a screen”.

“I thought it was going to be a little bit boring, looking online and reading a bit and then writing an essay and submitting it, but there’s videos, you’ve got your tutorials, […] like there’s audio files and everything in the module. You can use the materials either like in physical form or online, depending on how you learn.” [Student 1]

The interviewees also discussed the role of tutor and the importance of tutorials and tutor groups (small groups supported by a tutor). Students emphasised the value of having a dedicated tutor to support them “because you are kind of on your own doing it so having someone is really nice”. Positive impressions noted how tutors can be contacted via email or phonecall, without having to visit their office, and how quickly most of the tutors respond online. Interviewees then examined differences between school and their current tutors. On the one hand, commenting that schoolteachers helped them feel confident by providing higher levels of guidance in their studies and on the other hand criticising “spoon-fed” approaches to learning. Other differences between the two settings were outlined, such as being trusted to complete your tasks and having to read through the material yourself.

Interviewees also described the role of tutor groups on forums, in engaging them with a small group of students and receiving support to course-related questions. They explained that engaging with tutor(s) and other students can be expanded via tutorials, in which you can receive extra support (such as handouts) discuss the material, and access other viewpoints:

Compared to other distance-learning aspects, assessment was reported to be the most challenging to manage. Several students highlighted the fact that schoolteachers would

ensure they were prepared for assessment, providing them with detailed guidance via smaller tasks and examples. However, even the students who reported feeling challenged by the absence of that guidance, agreed that the continuous assessment and feedback aspect of their distance-learning studies along with their flexible learning schedule allowed them to improve their academic and work-life balance skills.

“I think the assessments are really good because the fact that it is continuous over the thing and you know you are kind of doing a few chapters then getting feedback, and it is not just feedback on the topic but also how you are writing up your work and how you are communicating it, and that kind of constant feedback is much more helpful than do a whole year’s worth of working and then just do an assessment.” [Student 6]

3.3 Interactions

Means and challenges of interaction in distance-learning education, as well as a sense of belonging were main topics discussed by the respondents. Students mentioned a number of ‘university official’ means by which they can interact with their tutors and fellow students, such as course discussion forums and tutor groups, university clubs, and videoconferencing software (e.g., Skype, Adobe Connect). However, they also discussed how student-initiated social network groups (mainly WhatsApp, Facebook) enhance communication with fellow students. The latter was linked to challenges in interaction that, as expected, students were facing. These challenges, as perceived by students, were mainly linked to socialising for fun rather than study purposes. One of the challenges that nearly all of the interviewees reported was identifying people closer to their age for socialising, as distance-learning universities usually accommodate people of older ages.

“[...] I was probably one of the youngest people on my course so a lot of them were older, they were in kind of work, they had families, they had children, you know, so I didn't feel like I really kind of related to the people on my course.” [Student 2]

Some of the students reported feeling part of an academic community and enjoying "having discussions with people about the OU". Further, students described enhancing their sense of belonging by buying university branded products and following official social media stories. However, others explained that they do not feel integrated into a community, with the main reasons relating to social differences (such as age and personal circumstances) as well as a difficulty in connecting with people without more direct interactions.

“If you're not hearing someone's voice or seeing someone's face I think for me I struggle to build up that sense of community because they're just names onscreen whereas I guess if you did a kind of like, like a Skype or whatever like Adobe whatever it's called, Connect and if you could see people and talk to people…”. [Student 2]

Finally, others explained that they never aimed to be part of a university community, as they prefer to focus on studies and "go to university and do the work".

4. Discussion

This study explored the experiences of first-year students at a distance-learning university, during the Covid-19 pandemic, via semi-structured interviews. The main themes identified were students' early perceptions, experiences with learning and assessment, and interactions.

The evidence from this study supports previous research (Krasilnikov & Smirnova, 2017) suggesting that the transition from school/college to university can be more challenging for students in a distance-learning university. This study indicates that further to transitioning to a less controlled environment (that requires advanced study skills) distance-learning students are also expected to conform to new ways of learning and interacting. This is particularly evident in our study, which while deductlively exploring students' experiences on transition uncovered themes revelant, but less visible, to their transition (e.g., challenges with new ways of assessment). These themes identified how conforming with these new ways of online learning and interaction can be part of students' transition challenges. Interestingly many students prior to joining distance-learning have misconceptions as to what it involves. This finding can provide evidence for distance-learning universities planning their 'open days' and induction activities, to include a better 'snapshot' of how life as a distance-learning student can be. Another noteworthy result was that distance-learning has been perceived as a 'shelter' for students with mental health issues or those who faced bullying in face-to-face settings. Whilst the most intriguing result was that, compared to previous research (e.g., Hassel & Ridout, 2018), many of the students welcomed the challenge of independent learning, the chance to be responsible for their own learning and the opportunity to develop work-life balance skills. However, these reflections were directly linked to how learning and support was structured at the particular university. Further to students' initial misconceptions, perceptions, and motivations for joining, it was interesting to see how the Covid-19 pandemic affected respondents in different ways – with some opting in for a distance-learning university considering it as the 'safe' and 'smart' choice.

First-year distance learning students, overall, appear to be satisfied with the resources and support in the particular distance-learning settings. This is a direct result of the wide range of available offline and online resources, and tutor support. Curiously, while students knowingly registered for distance-learning, they highlighted the importance of having the option of offline resources, too. Further, this study stresses students' challenges with assessment in distance-learning, without the 'security' of the schoolteacher who approves their readiness. Surprisingly many students welcomed this responsibility, whilst others longed for this 'security'. This finding points to the need for more guided assessment (for

instance, assessment examples and pilots) for students with lower levels of confidence. The study validates previous findings on difficulties in socialising in distance-learning settings (Krasilnikov & Smirnova, 2017), and provides some tools for improving social interactions. Furthermore, our findings extend our knowledge of social interaction in distance learning universities by revealing how age differences can intensify difficulties in socialising, but they also reveal that not all students desire the same level of interaction with their peers. It appears that some, while studying flexibly, make time for out-of-university activities and interactions.

These insights add to the literature on first-year students' transitions from school/college to university, and in particular to distance-learning. Our findings can inform pre-induction and induction programmes as well as policies, to improve students' experiences and reduce first-year drop-out rates. This work can be useful to both distance-learning universities and traditional institutions that have switched to distance-learning due to the pandemic.

References

Aristeidou, M. (2021). First-year university students in distance learning: Motivations and early experiences. In *procedings of the 16th European Conference on Technology Enhanced Learning, Technology-Enhanced Learning for a Free, Safe, and Sustainable World* (pp.110-121). Cham: Lecture Notes in Computer Science, Springer.

Brooker, A., Brooker, S., & Lawrence, J. (2017). First year students' perceptions of their difficulties. *Student Success, 8(1),* 49–63.

Cook, A. & Leckey, J. (1999). Do expectations meet reality? A survey of changes in first year student opinion. *Journal of Further and Higher Education, 23*, 157–171.

Foley, K. & Marr, L. (2019). Scaffolding extracurricular online events to support distance learning university students. *Journal of Interactive Media in Education,* 1, 17.

Hassel, S. & Ridout, N. (2018). An investigation of first-year students' and lecturers' expectations of university education. *Frontiers in Psychology*, 8, 2218.

Krasilnikov, A. & Smirnova, A. (2017). Online social adaptation of first-year students and their academic performance. *Computers & Education, 113*, 327–338.

Lowe, H. & Cook, A. (2003). Mind the gap: Are students prepared for higher education? *Journal of Further and Higher Education. 27,* 53–76.

Miles, M. & Huberman, A. M. (1994). Qualitative data analysis : An expanded sourcebook. Thousand Oaks, CA: Sage.

Parker, J.D.A., Summerfeldt, L.J., Hogan, M.J., & Majeski, S.A. (2004). Emotional intelligence and academic success: Examining the transition from high school to university. *Personality and Individual Differences*. 36, 163–172.

Rickinson, B. & Rutherford, D. (1995) Increasing undergraduate student retention rates. *British Journal of Guidance and Counselling*, 23, 161–172.

Winnard, Y., Elliott, V. (2012). The freshers' week experience in a VLE: Can it be achieved? *European Journal of Open, Distance and E-Learning*. 2. – ARRO AQ1 - *Anglia Ruskin Research Online.*

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14205

Development of Ontologies in Different Domains for a Test Generation Environment

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Abstract
The purpose of the proposed article is to present the creation of ontologies for automatic generation of test questions from the Test Generation Environment, which was created as part of the Virtual Education Space. The ontologies presented in the article are in different fields and can be helpful to students in their exams or for self-study. The three ontologies are in the fields of botany, literature and history of Bulgaria, and architecture of Revival houses. The article presents examples of automatically generated questions for each of them.

Keywords: *ontology; VES; e-testing , e-learning, TGE.*

1. Introduction

One of the main tasks of e-learning environments is to provide e-testing services. They are needed to facilitate trainers and trainees in taking exams, preparing for exams, and self-assessment. There are a wide variety of systems offering similar services that are widely used. Such is the system Moodle (Moodle Community, 2022) (Modular Object-Oriented Dynamic Learning Environment), which is a modular, dynamic, object-oriented and free learning environment. The "Quiz" model in Moodle allows training to create different types of tests. Other examples of known test-supported systems are OLAT (Online Learning and Training) (OLAT, 2022) and OpenOLAT (Open Online Learning and Training) (OpenOLAT, 2022). Here again the tests can be automatic, but prior preparation is required, including inventing/ providing the parts of the test, the elements of the tasks, and the questions. In (Zeileis, 2014) is demonstrated the ability to automatically generate exams for the academic discipline of statistics with the environment R. Analysis of algorithms for compiling tests are presented in (Kostadinova, 2019). The authors offer information on various test systems. They focus on compiling the tests themselves, but providing the questions needed for these tests is still a task of the teacher.

The Virtual Education Space (VES) is being developed as a successor of the DeLC e-learning environment (Stoyanov, 2010, 2012, 2016) in the "Distributed eLearning Center" Lab of the University of Plovdiv “Paisii Hilendarski”. The space provides electronic teaching material and electronic services including support of the internationally accepted standards SCORM 2004 (SCORM 2004) and QTI 2.1 (QTI 2.1). One of the services offered by VES is the Test Generation Environment-TGE (Stancheva, 2017). The architecture of the environment is a multi-agent system that performs two main tasks generating and verifying tests. The specificity of the environment and the proposed architecture is that the questions in the tests are generated and checked automatically by two operational agents created for this purpose – Questioner Agent and Assessment Agent (Stancheva, 2016). For the purpose of automatically generating and checking questions, both agents use an ontology. The TGE environment was created to use the UMLOntology (Stoyanova-Doycheva, 2021), which contains knowledge of the UML language specification. One of the main tasks we set ourselves was to use the created architecture of the environment to automatically generate questions in other areas. For this purpose, we continued to create ontologies for the needs of this environment. The main goal of the article is to present three ontologies in three different areas, which we have created for the purpose of training in plant growing (botany), literature and history of Bulgaria, and architecture of Revival houses. On the one hand, ontologies are created with a structure that presents knowledge in the specific field, and on the other hand, they can be used to automatically generate questions. Learners will be able to use the question-generating environment, both to test their knowledge in these three areas and to do test-based self-study.

2. Structure of ontologies and test generation in TGE

2.1. Structure of GenBankOntology

GenBankOntology contains the classification of plants according to the taxonomy presented in (Stoyanov, 2019). Its main structure was developed under a project for maintenance of plant genetic resources in the gene bank of the IRGR in Sadovo (Stoyanova-Doycheva, 2020). The ontology can be used for training in botany. Some of the classes in the ontology hierarchy are presented in Figure 1. Owing to the strict hierarchy between the ontology classes, when adding an instance of a plant species, subspecies, or variety, the ontology immediately obtains all the other characteristics from the taxonomy such as genus, subfamily, family, and order. This makes it easier to maintain the ontology in the future, where these connections will be made automatically when new instances are added. The ontology currently has over 500 classes and over 2400 axioms.

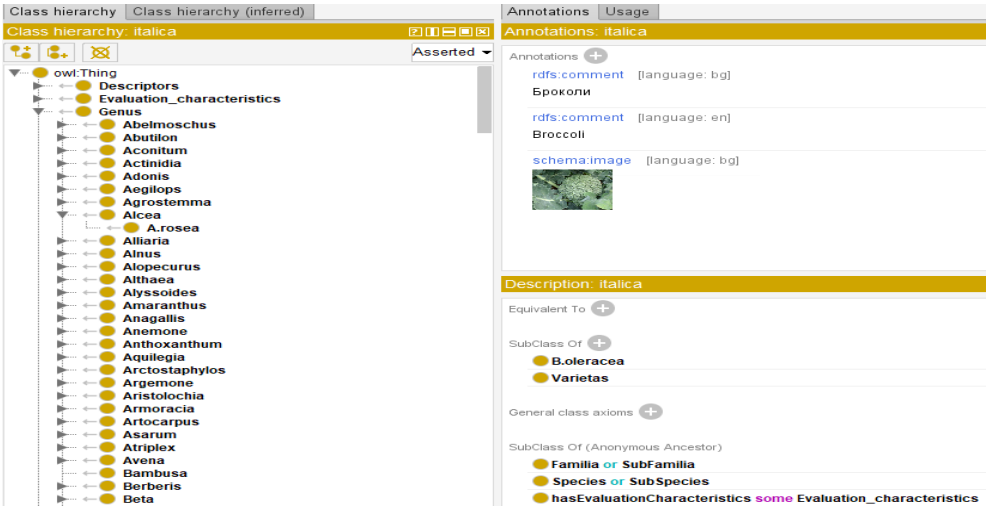

Figure 1. Part of the class hierarchy in GenBankOntology.

For the purposes of automated question generation, some additional annotations have been added to the created ontology. This is necessary because the questions in the TGE are generated on the basis of templates that use axioms in the ontology and annotations, which help to syntactically correct the generation of the questions. The additional annotations that have been added to the ontology are related to ObjectProperties – the connections between the concepts. In GenBankOntology, there are only two annotations (has evaluation characteristics and is evaluation characteristic) and they link an identity with its evaluation characteristics, such as where a plant can be found, where its seeds are stored, what its fruits are, what its resistance to diseases is, and others. Each identity of a species has its own evaluation characteristics, and each evaluation characteristic is determined by specific values

through DataProperties in the ontology. Figure 2 presents additional annotations for GenBankOntology's ObjectProperties.

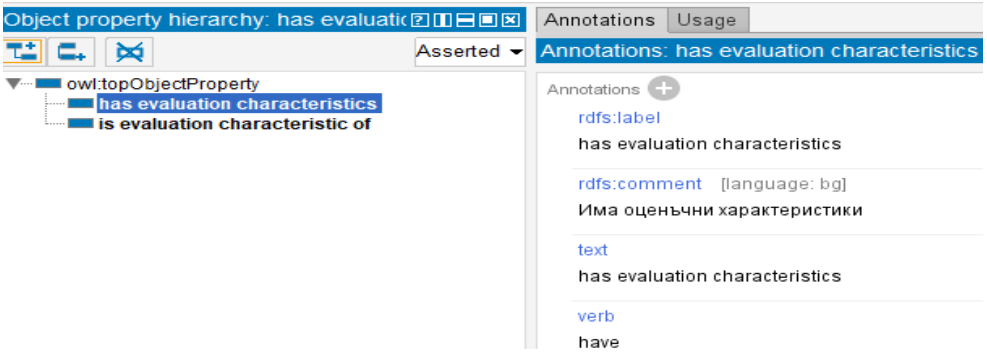

Figure 2. Anotation for ObjectProperties in GenBankOntology.

The main axioms in GenBankOntology are SubClassOf, DisjointClass, and ObjectPropertyRange. The most widely used axiom is SubClassOf – 1142 axioms. With them, generating questions in TGE is easier because agents can use the concepts in the ontology directly. Let us consider such an axiom from the ontology and the question generated by it.

```
<SubClassOf>
    <Class IRI="#Poaceae"/>
    <Class IRI="#Familia"/>
</SubClassOf>
<DisjointClasses>
     <Class IRI="#Genus"/>
     <Class IRI="#Varietas"/>
    <Class IRI="#Ordo"/>
</DisjointClasses>
```

Figure 3. SubCalssOf and DisjointClass axioms.

The axiom represents that the class *Poaceae* is a subclass of the *Familia* class. The closed question generated by the system can be seen in Figure 4.

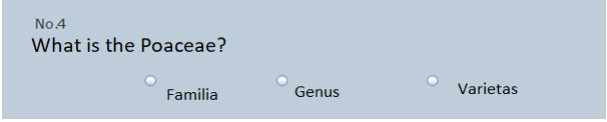

Figure 4. A multiple choice question generated in TGE.

To generate the wrong answers to the question, the Question Generation Agent uses the DisjointClass axiom for the *Familia* class. Each of the axioms in the ontology can be used to generate a question, and in GenBankOntology there are over 2400 axioms, which makes the variety of questions great.

2.2. Structure of BulgarianLiteratureAndHistoryOntology

BulgarianLiteratureAndHistoryOntology contains a classification of the notable personalities who have studied and worked at the First Bulgarian High School, established by Naiden Gerov in 1850. Its successor is today's Humanitarian High School "St. St. Cyril and Methodius" in Plovdiv. The created ontology (Figure 5) can be used in extracurricular forms of education in the field of Bulgarian literature and history.

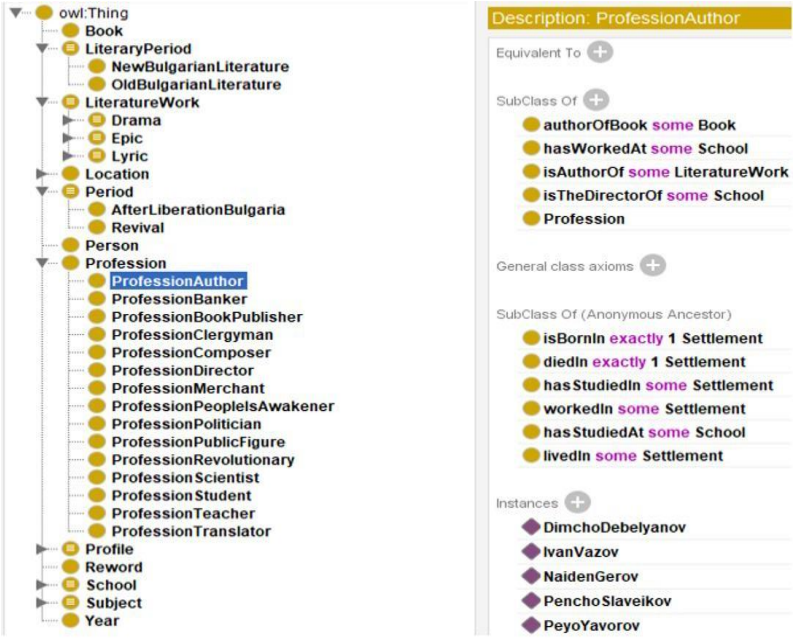

Figure 5. Part of the class hierarchy in BulgarianLiteratureAndHistoryOntology

By adding a new person as an individual, it can be concluded whether he is a graduate of the school or a teacher in it, whether he is a book author, revolutionary, politician, public figure, etc., according to the classes created and their limitations. If an individual is the author of a book, it is possible to find out during which literary period the book was created, which books were written by him and which of the literary genres the work belongs to.

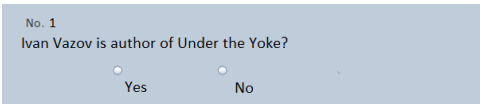

Figure 6. A question generated for isAuthorOf

The ObjectProperties isAuthorOf connects the classes ProfessionAuthor and LiteratureWork. A question generated for this ObjectProperty is presented in Figure 6.

2.3. Structure of RevivalHousesOntology

RevivalHousesOntology contains information about the Bulgarian residential architecture in and around the period of the Bulgarian Revival (Madanska, S., Bilyanov, S., Stoyanova-Doycheva, A., Stoyanov, S., 2021). The development describing the houses consists of seven ontologies. The division of the ontology into subsets is according to the CCO standard (Baca, M., Harpring, P., Lanzi E., McRae, L., Whiteside, A., 2006) and in view of scalability. *Agents.owl* includes information about the personalities who played a role in the buildings – owners (past and present), builders, restorers, organizations, as well as the registration as a cultural value in the relevant institutions. *Locations.owl* contains location - geographical, administrative, cadastral, and coordinate. *Ontology Subjects* includes data for the period. *Ontology Objects* contains the characteristics of a standard house, and *Materials* describes building materials and techniques. *Functionalities.owl* contains rooms according to different geographical and dialectal features. *The OldHouses ontology* includes IRI of elements from the above-mentioned ontologies and characteristic features of the Revival house – the typological groups of houses on the territory of Bulgaria are discussed in it; they are described in detail and their individuals are added, for example, the "Pangalova house" (Figure 7).

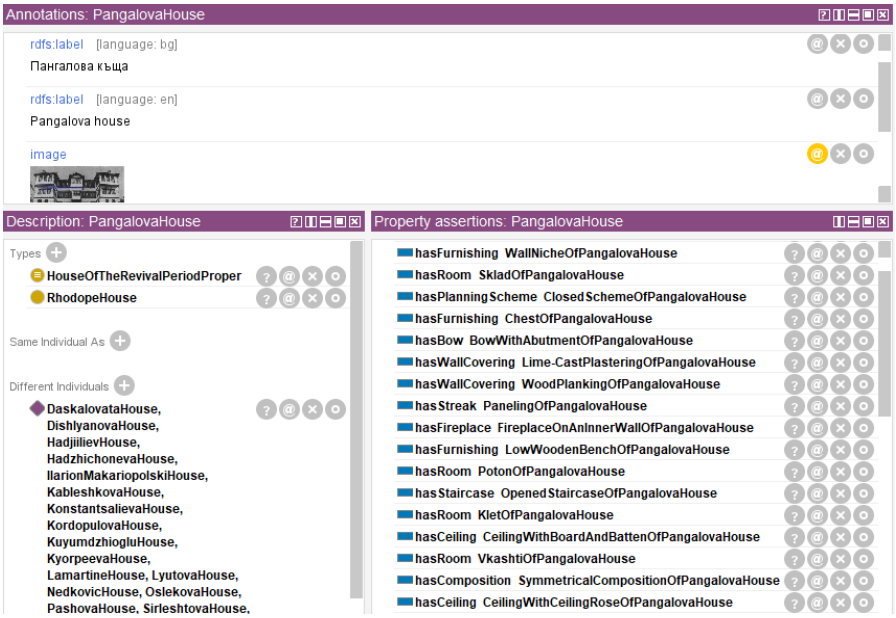

Figure 7. Individual description of the "Pangalova house"

The ontology can be used for training in schools and universities in the field of architecture and art, for tests related to the determination of a Revival house to a specific Typological group of houses and the period of its construction; architectural features and varieties of bearing and non-bearing elements, and others.

Figure 8 presents a segment of axioms: for the subclasses of the class BulgarianRevivalHouse, which are "disjoint" with each other in order to unambiguously define and identify a house afterwards, and a characteristic of the class HouseOfTheRevivalPeriodProper, that there is a closed or opened scheme.

```
<ObjectUnionOf>
  <ObjectSomeValuesFrom>
      <ObjectProperty IRI="#hasPlanningScheme"/>
      <Class abbreviatedIRI="objects:ClosedScheme"/>
  </ObjectSomeValuesFrom>
  <ObjectSomeValuesFrom>
       <ObjectProperty IRI="#hasPlanningScheme"/>
       <Class abbreviatedIRI="objects:OpenedScheme"/>
  </ObjectSomeValuesFrom>
</ObjectUnionOf>
```

Figure 8. Axioms for the SubClasses of the "BulgarianRevivalHouse" and the "HouseOfTheRevivalPeriodProper"

The generated guestion from this axiom is presented in Figure 9 – in this case, the TGE takes only one ObjectValue of the ObjectUnionOf Axiom to generate a question. Currently, *RevivalHousesOntology* includes 613 classes and 7724 logical axioms.

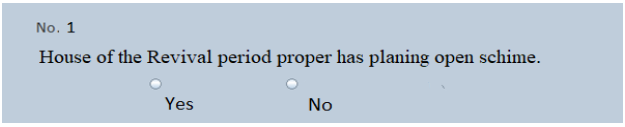

Figure 9. A generated question for the hasPlaning Schima object property

3. Conclusions

Creating ontologies in order to be used by the Test Generation Environment supports the exam process of students and helps them to study in different fields. When testing the environment with knowledge of the new ontologies, no problems arising from their use were noticed. The environment performs its functionalities as expected and there are no differences in performance and results due to the change in the knowledge base. But it should be noted that adding meta-knowledge to ontologies in order to be able to generate and check questions automatically takes a lot of time.

Statistics on the work of TGE have been collected. Major problems regarding its use have been defined and eliminated. The most common criticism from students is that the generated tests are in English and not in Bulgarian. For this purpose, ontologies developed in Bulgarian and adding meta-knowledge to them are needed. The algorithm for generating questions also needs to be changed due to the grammatical differences between the two languages. For this

future purpose, the proposed ontologies in the article are developed in two languages – English and Bulgarian.

Acknowledgement

The research is supported by the project КП-06Н36/2 2019-2022 “Competition for financial support of basic research projects – 2019” of the National Scientific Fund of the Ministry of Education and Science in Bulgaria and the research is partly supported by the project FP21-FMI-002 “Intelligent innovative ICT in research in mathematics, informatics and pedagogy in education" of the Scientific Fund of the University of Plovdiv “Paisii Hilendarski”.

References

Baca, M., Harpring, P., Lanzi E., McRae, L., Whiteside, A. (2006). Cataloging Cultural Objects. A Guide to Describing Cultural Works and Their Images. Chicago, United States of America: *American Library Association* (ALA). http://vraweb.org/wp content/uploads/2020/04/CatalogingCulturalObjectsFullv2.pdf

Kostadinova, I., Rasheva-Yordanova, K., & Garvanova, M. (2019). Analysis of Algorithms for Generating Test Questions in E-Testing Systems. 10.21125/edulearn.2019.0498.

Madanska, S., Bilyanov, S., Stoyanova-Doycheva, A., Stoyanov, S. (2021), Ontological Presentation of Bulgarian Revival Residential Architecture. Digital Presentation and Preservation of Cultural and Scientific Heritage. Vol. 11, Sofia, Bulgaria: Institute of Mathematics and Informatics – BAS, 2021, pp. 67-76, ISSN 1314-4006 (Print), eISSN 2535-0366 (Online)

Moodle Community. (2022). https://moodle.org/, retrieved on 18.01.2022

OLAT. (2022). https://olat.org/, retrieved on 18.01.2022

OpenOLAT. (2022). https://www.openolat.com/, retrieved on 18.01.2022

QTI 2.1. (2022). https://www.imsglobal.org/question/index.html, retrived on 18.01.2022

SCORM 2004. (2022). https://scorm.com/scorm-explained/technical-scorm/scorm-2004-overview-for-developers/?utm_source=google&utm_medium=natural_search

Stancheva, N., Stoyanova-Doycheva, A., Stoyanov, S., Popchev, I., Ivanova, V. (2017). An Environment for Automatic Test Generation, *Cybernetics and Information Technologies*, Volume 17, ISSN (Online) 1314-4081, DOI: https://doi.org/10.1515/cait-2017-0025

Stancheva, N., Stoyanova-Doycheva, A., Popchev, I., & Stoyanov, S. (2016). Automatic generation of test questions using ontologies, 2016 IEEE 8th International Conference on Intelligent Systems, IS 2016 – Proceedings, 7 November 2016, Article number 7737395, Pages 741-746, ISBN: 978-150901353-1, DOI: 10.1109/IS.2016.7737395

Stoyanova-Doycheva, A., Stancheva, N., Ivanova, V., & Stoyanov, S. (2021). Structure of an Ontology Used in a Test Generation Environment, *AIP Conference Proceedings*,Volume 2333, Issue 1, 8 March 2021, DOI: 10.1063/5.0042057, ISBN: 978-0-7354-4077-7

Stoyanova-Doycheva, A., Ivanova, V., Doychev, E., & Spassova, K. (2020). Development of an Ontology in Plant Genetic Resources, 2020 IEEE 10th International Conference on Intelligent Systems, IS 2020 - Proceedings, 2020, pp. 246–251, ISBN: 978-172815456-5, DOI: 10.1109/IS48319.2020.9199935

Stoyanov, S. (2012). *Context-Aware and Adaptable eLearning Systems*. PhD Thesis. STRL. De Montfort University. Leicester. UK, 2012.

Stoyanov, S., Popchev, I., Doychev, E., Mitev, D., Valkanov, V., Stoyanova-Doycheva, A., Valkanova, V., & Minov, I. (2010). DeLC Educational Portal. *Cybernetics and Information Technologies (CIT*). Vol.10. No 3. Bulgarian Academy of Sciences, 2010. 49-69.

Stoyanov, S. (2016) A Virtual Space Supporting eLearning. Proceedings of the Forty Fifth Spring Conference of the Union of Bulgarian Mathematicians. Pleven, 2016. 72-82.

Stoyanov, K., Rajcheva, C., Cheshmidjiev, L. (2019). Determinant of Native and Foreign Plants in Bulgaria. Stage 1, Academic Publishing House of Agrarian University – Plovdiv, 2019.

Zeileis, A., Umlauf, N., & Leisch, F. (2014). Flexible Generation of E-Learning Exams in R: Moodle Quizzes, OLAT Assessments, and Beyond. *Journal of Statistical Software*, 58(1), 1–36. https://doi.org/10.18637/jss.v058.i01

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14573

Open Educational Resources for Social Science Research Methods – A Case Study from the D-A-CH-Region

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Abstract

The D-A-CH region has traditionally been sceptic towards OER materials. Despite a very active open science community the three German speaking countries in Europe did not embrace wide reaching OER policies. This can be seen in the field of social science research materials as well. With national initiatives missing it falls to individual universities, organizations and persons to provide free online education materials. Most of those do not match the OER criteria and have limited application scenarios. If the region wants to truly embrace an open science policy, it needs to strengthen OER in the future.

Keywords: *OER; D-A-CH region; social science research methods, Austria, Germany, Switzerland.*

1. Introduction – Crisis and the rising need for OER?

In 2002, twenty years ago, *UNESCO* first drew attention to the societal importance of free educational resources (Kerres, 2019). Ten years later the ubiquitous nature of digital technologies (e.g.: smartphones, tablets, broadband internet) made it possible that online based learning and teaching platforms could establish themselves as a central pillar for education. The *Paris OER declaration* was put forward, highlighting the benefits of open education and as a mean to further the right to education for everyone (UNESCO, 2012). In this document *OER* were defined as "teaching, learning and research materials in any medium, digital or otherwise, that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions" (ibid).

The importance of OER has further increased in the decade since, especially after the Covid-19 pandemic struck. In early 2020 most of the education sector was forced to switch to online based teaching modes, often relying on digital resources. While the majority of those resources are not broadly accessible because of copy right laws, ownership of material by publishers and associated pay walls, *OER* offered a sensible alternative for adopting teaching and learning to the circumstances forced upon educators (Huang et al., 2020, p. 4). This was especially important for the research methods education in the social sciences. This discipline gained prominence as the interest in and the relevance of quantitative and qualitative research that track public opinions and attitudes, including – but not limited to – the interpretation of such data, rose (Dada et al., 2021). Thus, easily accessible high quality *OER* for this discipline became relevant for a broader public as well. However, despite their arguable importance, *OER* development was not equally embraced in the past. While in many regions national and even supranational plans were put forward to foster the development of such materials the German speaking region of Europe – also known as the *D-A-CH* region, for Germany (D), Austria (A) and Switzerland (CH) – did not develop such strategies and let individual actors and educational institutions find their own solutions.

Accordingly, we ask how numerous available *OER* material for social science research *(SSRM)* methods in the *D-A-CH* region were during the pandemic years of 2020 as well as 2021 and what can be stated about their quality?

To do so we give an (2) overview over the reasons for developing *OER* and the documented situation in the *D-A-CH* region, (3) provide insights into our research design and (4) present as well as (5) discuss the results of our case study.

2. Literature Review - Importance of OER and the situation in the D-A-CH region

The following section provides a short literature review, illustrating both the relevance of *OER* and discussing the situation in the German speaking part of the world, which has been historically known to be critical of the *OER* movement (see Hylén et al. 2021).

2.1. The importance of OER

As illustrated in the 2012 *Paris OER* declaration by *UNESCO*, the importance of *OER* lies in the fact that they help to promote formal and non-formal education at all levels, contributing to broad social inclusion (UNESCO, 2012). This can lead to a democratization of knowledge (Lane, 2008), potentially reducing the financial costs traditionally associated with education and increasing the chance for open science. The last aspect must be stressed, as the origins of modern *OER* are at the *MIT - Massachusetts Institute of Technology*. Despite being a prestigious higher education institution in the US, with high entry costs and tuition fees, it was one of the first institutions to create *massive open online courses* (*MOOC*), where all their lectures became available for anyone with internet access (Alquézar Sabadie et al., 2014, p. 3). Because of this *OER* can be seen as disruptive elements in the educational landscape, challenging not only the professional educational sector, but also traditional commercial textbook publishers. During the financial crisis of the late 2000s the advantages of *OER* could be felt around the globe, as socio-economic issues were limiting access and chances for (lifelong) education (Falconer et al. 2013, pp. 5). People who had no access to structural or formal education could bolster their knowledge on the one hand, while institutions that had only limited resources could offer their pupils and students materials to continue their education on the other (Alquézar Sabadie et al., 2014). Despite those benefits the quality of *OER* is a highly controversial topic, with authors like Knox (2013) arguing, that because of a lack of institutional or pedagogical quality insurance *OER*-users must fend for themselves when it comes to assessing quality. While it is true that criteria like academic peer review are less prevalent for *OER* assessment, defenders of *OER* argue that the collaborative character of the materials is a substitute (Alquézar Sabadie et al. 2014). Typically, *OER* quality is not judged on the merits of their learning content, but by their usability – e.g. navigation, use of keywords, requirements to use them on a topical level (e.g. previous knowledge) –, their openness and transparency regarding sharing and re-using them as well the opportunities to identify and engage with the creator to assess and improve the OER wherever possible (Elias et al., 2020).

2.2. The role of OER in the D-A-CH region

While many countries champion *OER* and are actively involved in fostering the systematic development of such resources, the German speaking region of Europe can generally be

classified as sceptic towards the concept. Ten years ago, in 2012, the *OECD* reported that only four for their survey countries had no structured *OER* activity, with two of them being Germany and Switzerland (Hylén et al., 2021, pp 8-10). And even as Austria reported some activity, this was mostly tied to an emphasis on the open access publication of research results and articles (Hoosen, 2012, p. 8). Reasons for missing activity in Germany were a series of concerns: The practicality and usefulness of *OER* were doubted, as questions regarding content quality, technical interoperability, and legal aspects – especially regarding copyright – were not solved (Hylén et al., 2021, p 8). For Switzerland it was reported that they have no countrywide *OER* programs as regulators saw it as the duty of the Cantons (Provinces) to provide a framework (ibid.). Those sentiments can still be seen today, as the *Registry of Open Access Repositories* (see: http://roar.eprints.org/) is currently not listening any open access repositories focusing on teaching and learning in Austria or Switzerland and only one for Germany, despite the interest the German federal Ministers of Education showed in the issue, as early as 2015 (Marín et al., 2020). However, government-sponsored initiatives like *Open Education Austria* (https://www.openeducation.at/), which was funded in 2020, and an *OER* section at the homepage of the *Austrian Social Science Data Archive – AUSSDA* (see: https://www.aussda.at), hint at the development of the sector in Austria and well-known platforms like the *Methodenberatung* of the University of Zurich (see: https://www.methodenberatung.uzh.ch/de.html) show fruitful regional developments in Switzerland. Next the situation of Social Science Research Methods *OER* in the *D-A-CH* region will be assessed and discussed if the assumptions of German representatives in the *OCED* 2012 survey on the state of *OER* could be rectified in the field of *SSRM*.

3. Study design

The study design is based on a structured content analysis (Mayring 2010). The corpus for the analysis are freely available online learning materials, in the German language dealing with the field of social science research methods (following either the quantitative or qualitative paradigms or mixed forms). While the definition of the *UNESCO* includes the necessity to publish under creative commons licenses, it was decided to start with a classification of *OER like materials*, as e.g., defined by Ochieng and Gyasi (2021, p. 9), that can be subsumed as freely available teaching and learning materials that can be found on the internet. This broader approach was taken as it had to be anticipated that German language *OER*– matching the *UNESCO* definition – would be too few for a structured analysis. For the whole process of the structured analysis a three-pillar approach was taken.

The first pillar consisted of *OER* offered via socials science associations in the German speaking countries coming from sociology, psychology, communication and media studies, political science and educational studies (e.g.: *DVPW, DGPuK, DGfE, ÖGS, SGS, SGKM, ÖFEB*). The second pillar for cataloging were the offerings from public universities and

universities of applied sciences in the *D-A-CH* region having chairs in empirical social research or departments focusing on such matters (e.g.: departments that included descriptions like “empirical social research”, “social science research methods”). When it comes to both the offerings from the associations as well as universities the regular web-front end as well as e-learning platforms were used for data collection. Finally, the third pillar were non-institutionalized *OER*. Cataloguing happened via *OER* hubs as well as using a free web search via google and *YouTube*. Logical operators and registered *ELSST – European Languages Social Science Thesaurus* – keywords for (research) methods, social sciences and *OER* were used as well as more specific terms for twenty common analytical procedures like e.g., grounded theory, factor analysis, regression, topical analysis. For each combination the first five pages – approximately 50 entries – of search results were considered. New combinations of the key words were used until no new useful hits emerged. For both *Google* and *YouTube* cleaned browsers, with all tracking tools disabled, were used. Later results may have been (willingly) influenced by the algorithms that started to track the search interests. This research created the corpus of *OER* for analysis. To be part of this corpus the following criteria had to be met: The materials had to be online based (1), in the German language (2) and needed to cover quantitative or qualitative research methods from the social sciences (3). Furthermore, they needed to be at least partially openly available (4) and go beyond simple reference or reading lists or syllabi (5). Following the arguments from Atenas and Havemann (2013, p. 27) course or seminar scripts and slidesets, encyclopedia or glossary entries as well as repositories that contained scientific papers or qualification work (e.g., doctoral dissertations) were excluded. This limits the scope of the study and may result in some undercoverage but made it possible to systematically collect data. Read results accordingly.

Data collection was conducted research associate Matthias Forstner (JKU) between May 19 and August 3, 2021 afterwards all the materials were analyzed regarding the topics they cover (e.g., data collection, quantitative data analysis, qualitative methodology etc.), the knowledge required to work with them, their mode (e.g., text or video), if they provide information on the license for use and furthermore what type of license and if the offer the chance for feedback, collaboration and interaction. Next to these quantitative assessments a qualitative judgement regarding the quality of the free online learning resource was formulated.

4. Results and Insights

First and foremost, it must be stated that even the world database of open access educational resources does not identify a larger number of *OER* content for *SSRM* in the *D-A-CH* region. In January 2022 only 1 *OER* activity can be found that matches the criteria in the *Registry of Open Access Repositories*. While other aggregation platforms like e.g., *Eudukatico* or the *OER-Content Buffet* offered at least some more basic content or links to such content, most of the material was either in a non-German language or not matching the established criteria

in one way or another. This limited *OER* activity is also mirrored by the activities of the subject based associations, our first pillar: not a single *OER* – or other forms of free online learning materials – could be found in their online presences, even if dedicated research methods sections existed, that were hosting workshops or conferences like e.g., the methods section of the *Austrian Sociological Association (ÖGS).* However, research showed that there was at least some relevant activity in the field, tied to our second pillar for analysis: individual universities. Eighteen platforms could be identified, twelve of them text based and six of them video based. While those are often hard to find because of the structure of university homepages, complex navigation structures and problematic URL-denominations, they can be generally seen as high-quality *OER* materials, that are often highly structured and can be easily navigated – including relevant key words. While in Germany the resources are spread out over several universities, the main contributions in Austria and Switzerland are at the most prestigious universities of the countries – the *Universities of Vienna* and *Zurich*.

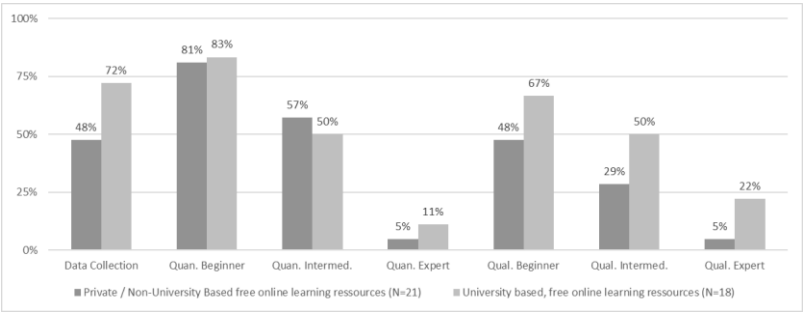

Figure 1. Distribution of topics covered by German language free online learning materials on social science research methods

When it comes to the type of content the learning materials provided by the universities cover, it can be stated that they cover a broad range of quantitative as well as qualitative methods, mostly at beginner or mid-level. Expert level quantitative methods like e.g., structural equation modelling or confirmatory factor analysis were covered by none of the text platforms. However, two expert level resources were available on the video-based platforms. Furthermore, three of the text-based platforms covered expert level information on qualitative methods like e.g., discourse analysis. Additionally, a video-based platform provided content on these topics (see figure 1 for an overview on covered topics). Only one of the platforms identified allowed for a rating of the provided materials. While none allowed for direct interaction, most provided e-mail contacts for an exchange. Regarding the openness of the university offerings, it can be stated that only five of twelve text-based platforms provided information on a creative commons license, while the rest either used closed licenses or protected their material with strict copy right. When it comes to the videos only one – the platform of the *University of Darmstadt* – provided materials that had an actual creative commons license. Most of the university-based pages provided little information on authors

or creators of the resources. Moving away from official platforms offered by universities and looking at content hosted by individuals, organizations or published on social media platforms like *YouTube*, a highly heterogenous field of resources can be found. Firstly, several commercial software providers like e.g., the startup *Datatab* (quantitative data analysis tool) and prominent text analysis software provider *MAXqda* (qualitative data analysis tool) offer free materials to support their key business. Springer-owned *Iverstiy* offers some courses for free as well. However, those initiatives are not *OER*, as they serve a commercial interest and are often copy right protected. Furthermore, offerings that are not tied to such commercial enterprises are often presented in blog-format or on sub-pages of other open science initiatives like e.g., the *Austrian Social Science Data Archive – AUSSDA* and thus hard to find and use. However, most of those initiatives have the advantage that they allow for direct communication, exchange and feedback via communication tools and identify the content creators. Coming from a content perspective they are not too different to the offerings found at university sites, mainly focusing on beginner level material (see figure 1).

5. Conclusion

Despite the increasing importance of *OER* the number of freely available learning materials in the *D-A-CH* region covering social science research methods is still small, mostly focused on beginner and intermediate skill levels and tied to either universities or corporations with a strict interest to provide materials for their (potential) costumers. This matches the results of other analysis of the region (Höhne, 2018, p. 150 and 155). While creative common licenses and potential ties to commercial actors may not be a hinderance for the quality of the content it at least limits the use of such materials and their application in educational scenarios – be the institutionalized or even driven by the personal interest in the topic (Kerres, 2019, p. 6). True *OER* are still the exception rather than the rule. Accordingly, it has to be recommended that a national or even supranational strategy should be put in place to foster *OER* development at the level of associations and universities. These strategies need to address open licenses and gives guidance on quality related concerns, making sure that times of crisis – when e.g., in our case the information on how to read and understand statistical data presented in the media would be very important – free and open learning materials of high quality are readily available.

Overall, it is an alarming result that ten years after the *Paris OER declaration* a region that is committed to open science and a key partner in establishing the *European Open Science Cloud* (Burgelman, 2021), seems to be lacking highly societally relevant open educational resources that are central for navigating the increasingly digitized and datafied society.

References

Atenas, J., & Havemann, L. (2013). *Quality assurance in the open: an evaluation of OER repositorie*s. INNOQUAL, 1(2), 22-34.

Alquézar Sabadie, J. M., Castaño Muñoz, J., Puni, Y., Redecker, C., & Vuorikari, R. (2014). OER: A European Policy Perspective. *Journal of interactive Media in Education*, 5(1)., 1-12. Retrieved Feb. 10, from: https://files.eric.ed.gov/fulltext/EJ1034709.pdf

Burgelman, J. C. (2021). Politics and Open Science: how the European open science cloud became reality (the untold story). *Data Intelligence*, *3*(1), 5-19.

Dada, S., Battles, H., Pilbeam, C., Singh, B., Solomon, T., & Gobat, N. (2021). Learning from the past and present: social science implications for COVID-19 immunity-based documentation. *Humanit Soc Sci Commun*, Vol 8, 1-9.

Elias, M., Oelen, A., Tavakoli, M., Kismihok, G., & Auer, S. (2020, September). Quality evaluation of open educational resources. In Alario-Hoyos, C., Rodríguez-Triana, M. J., Scheffel, M., Arnedillo-Sánchez, I., Dennerlein, S. M., Frey, T. F., & Weidlich, J. (eds), *European Conference on Technology Enhanced Learning* (pp. 410-415). Cham: Springer.

Falconer, I., McGill, L., Littlejohn, A., & Boursinou, E. (2013*). Overview and analysis of practices with Open Educational Resources in adult education in Europe*. Seville: European Commission

Höhne, T. (2018). Ökonomisierung der Produktion von Schulbüchern, Bildungsmedien und Vermittlungswissen. In Engartner T., Fridrich C., Graupe S., Hedtke R. & Tafner G. (eds), *Sozioökonomische Bildung und Wissenschaft* (pp. 141-162). Wiesbaden: Springer.

Hoosen, S. (2012). Survey on governments' open educational resources (OER) policies. Vancouver: Commonwealth of Learning.

Huang, R., Liu, D., Tlili, A., Knyazeva, S., Chang, T. W., Zhang, X., Burgos, D., Jemni, M., Zhang, M., Zhuang, R., & Holotescu, C. (2020). *Utilizing OER under COVID-19 Pandemic in line with UNESCO OER Recommendation*. Beijing: Smart Learning Institute of Beijing Normal University.

Hylén, J., Van Damme, D., Mulder, F., & D'Antoni, S. (2012). Open Educational Resources: Analysis of responses to the OECD country questionnaire. Paris: OECD Publishing.

Kerres, M. (2019). Offene Bildungsressourcen und Open Education: Openness als Bewegung oder als Gefüge von Initiativen. *MedienPädagogik*, 34(1), 1-18.

Lane, A. (2008). Widening participation in education through Open Educational Resources. In V T. Iiyhoshi & M. Vijay Kumar (Eds.), Opening up Education (pp. 149–164). Cambridge: The MIT Press.

Marín, V. I., Zawacki-Richter, O., & Bedenlier, S. (2020, October). Open Educational Resources in German Higher Education – An International Perspective. In *EDEN Conference Proceedings* (No. 1, pp. 85-94).

Mayring, P. (2010). *Qualitative Inhaltsanalyse. Grundlagen und* Techniken. Basel: Beltz.

Ochieng, V. O., & Gyasi, R. M. (2021). Open educational resources and social justice. E-Learning and Digital Media, 18(2), 105-124.

UNESCO (2012). Paris Declarion. Retrieved Feb. 10, from: 2012 WORLD OPEN EDUCATIONAL RESOURCES (OER) CONGRESS (unesco.org)

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14680

A case study of hybrid learning in higher education using quantitative research design

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Abstract

There is currently limited work on synchronous forms of hybrid education although it has become the norm in university education. In addition, there is a gap on empirical studies that are focusing on quantitative measures (such as student performance data) in this particular setting. To compensate for this gap in the literature, the paper presents a case study of hybrid teaching in the context of higher education that revolves around a quasi-experimental design with student performance data. The results were analysed quantitatively and they indicate that there was no significant statistical difference between the two groups in their performance in the final exams (with a large size effect). That finding is somewhat surprising since there is research indicating that the learning experience and performance of the students that attend a hybrid learning course remotely are not equally good as in the case of the students that participate in-class/on-site.

Keywords: *Hybrid learning; university teaching; online learning; higher education.*

1. Introduction

Hybrid teaching and learning is the main learning mode in higher education nowadays (Mavroudi & Gynnild, 2021), yet more research focusing especially on synchronous forms of it is still needed (Raes et al., 2020). In the context of this case study, hybrid learning is defined as synchronous blended learning "in which both on- site and remote students can simultaneously attend learning activities" (Raes er al., 2020, p. 1). Most of the existing literature in synchronous forms of hybrid teaching and learning in higher education is exploratory and qualitative in nature focusing on parameters such as students' learning experiences and perceptions of the learning environment, whereas empirical studies that fall within the quantitative research paradigm taking into account data associated to the students' outcomes have only begun to emerge (Raes et al., 2020). Yet, research in some cases has shown that there is an achievement gap between students taking courses exclusively offered online versus those enrolled in face-to-face classes in higher education (Lightner & Lightner-Laws, 2016). The Covid19 pandemic intensified the adoption of hybrid forms of education since higher education institutions all over the world had to abruptly shift to online learning. A question that is posed by Matta and Palvia (2021) and many others is: which pedagogical innovations should we keep when the situation returns back to normal? One answer is that we could consider these ones for which there is evidence that they can effectively support student learning outcomes.

Taking into account the lack of empirical evidence on synchronous hybrid university learning and the question posed by Matta and Pavlia (2021), this case study collected and analysed student performance data from students that participated in the same course via different learning modes. The difference refers to following a significant part of the same course via different modes of participation: online versus face-to-face. Except for this difference, the remaining parts of the course were the same for both student groups.

The remainder of the paper is structured as follows: the Background section provides a view on relevant recent literature, while the Context section is providing a description of a) the teaching context and b) the course design. The following section revolves around the analysis of the collected student data and the results. Finally, the last section interprets the results, concludes on implications, presents limitations and suggests future research.

2. Background

The authors of this paper scanned the relevant research literature searching for similar research works like the one described herein following this method: for papers before year 2020, they used as point of reference the systematic review of Raes et al. (2020), whilst for papers with publication year 2020 or later they searched using appropriate keywords and the google scholar engine. Regarding the former mode, three papers were elicited from the

systematic review of Raes et.al (2020) with selection criterion that they present and discuss some form of empirical research on synrchonous hybrid university education. From these three studies only one was focusing on student performance, the study of Lightner and Lightner- Laws (2016). This paper is an empirical study comparing course delivery modes: (online, remote and traditional) and investigates its impact on students grades. More specifically, it revolves around a blended course model for statistics and quantitative methods that allowed students to choose between three different course delivery modes: online, remote (via interactive television), and traditional course delivery. The study collected students grades along the three delivery modes and analysed them quantitively. It concluded that there was no signitificant difference on student academic achievement for the students that used this particular blended course model. They did noticed though in their preliminary analysis (i.e. before introducing this particular model) that there was a performance gap in the students achievement between the traditional face-to-face course delivery and the online coure delivery in their university.

The manual search of revevant and recent literature (2020 or later) revealed a few relevant articles which are briefly described in the remainder of this section. The purpose of the study of Kustiawan et al. (2021) was to determine the effect of hybrid education to the training on pedagogic competence of kindergarden educators. The authors used an experimental research method on the pedagogical competence variable based on the learning method factor (i.e. hybrid format and conventional format). The analysis of their results indicate that there are significant differences in the development of pedagogical competences of the two groups of educators in favour of the group that was trained using the hybrid format. In another study, Denton (2020) compared learning outcomes between two groups of students: those following a hybrid blended model and those following a traditional classroom model for the same course (a musculoskeletal spine assessment course) in a doctor of physical therapy program. The study examined differences in student safisfaction, student academic achievement, and competency skills. The results indicate no significant difference between the two modes with respect to student satisfaction as well as academic achievement. However, findings suggest a significant difference between the two groups with respect to competency skills in favour of the student group that followed the hybrid learning program. Finally, the study of Rhoads (2020) included a purposive sample of students following several undergraduate courses offered in the traditional and non-traditional programs of a private college in California over the course of five academic semesters. Statistical findings on student performance/learning ganins did not reveal a significant difference between course delivery modalities focusing on the final grade average.

3. Context

3.1. Teaching context

The case stude involves a course in a renewable energy program for bachelor students offered by the Norwegian University of Science and Technology to students affiliated to different campuses: the main campus located in the city of Trondheim and peripheral campuses located in two different cities in Norway (namely, Ålesund and Gjøvik). The course revolves around a methodology to evaluate the environmental impacts of products and processes, with emphasis on energy systems. The first part of the course consists of the theoretical foundation of modelling and methods for evaluating the environmental impacts. The second part is focused on the use of a dedicated software for the impact assessment of specific case studies. The course is following the project-based learning paradigm, that is, the students are working in groups with a project that revolves around the use of the dedicated software. The tutor of the course is physically located in one of the peripheral campuses (in Gjøvik). The course is mandatory for the students based in the Gjøvik campus, while it is elective for the other two campuses (Ålesund, Trondheim). The student population registered in spring 2021 was derived from two campuses (Gjøvik, Trondheim).

The first two weeks of the course took place fully online for all students due to covid-19 restrictions. After teaching online for a period of two weeks, the covid-19 restrictions were lifted only in Gjøvik, so that the students could participate by being physically present in-class, whilst students in Trondheim continued to participate online. That is, the course followed a hybrid learning approach with both groups of students participating. For the students participating online (i.e. the students that were registered with the Trondheim campus) the lesson was streamed in real-time using a dedicated commercial platform provided by the university to the faculty members. These students could have the opportunity to ask questions orally by using their microphones or in a written format by using the chat of the webconference tool. This learning situation lasted from week 3 to week 8. From week 9 up until near the end of the semester the students were working in groups with their projects, and they received guidance and support from the tutor on an as-needed basis via online group meetings. Each group consisted of students that were registered in the same campus (i.e. either Trondheim campus or Gjøvik campus). Near the end of the semester, all participant students took the same final exam. The final exam was a summative assessment designed to assess to what extent the students have achieved the course outcomes. The assessment schema was following a grading scale from A to F, where grades were assigned using percentage points suggested by the university for all course following a 6-level grading scale (A: 89–100 points, B: 77–88 points, C: 65–76 points, D: 53–64 points, E: 41–52 points, F: 0–40 points).

3.2. Course design

The learning design of the course can be described using a Teaching-Research (T-R) nexus framework (Healey, 2005). The framework maps different activities along two dimensions: the content of learning (what students learn) and the process of learning (how students are involved in learning). The content of learning can either be focused on research results or research processes and skills, and students can either be involved as participants or as an audience. Based on these two dimensions, four distinct approaches establishing the T-R nexus (figure 1) can be discerned: research-led, where students learn about current research; research-tutored, where students are engaged in research discussions; research-based, where students undertake research and inquiry; and research-oriented, where students learn about research methods and techniques.

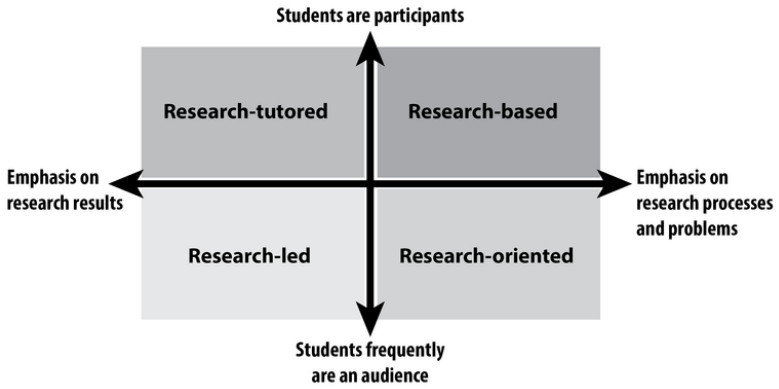

Figure 1. The 'Healy Matrix' showing the Teaching -Research nexus (adapted from Healy, 2005).

According to the Healy's T-R nexus framework, the course herein can be described as research-tutored, where students are engaged in research groups working with a dedicated software using a project-based learning approach. The fact that the course activities were mapped to this framework in this particular way had implications on its learning design, including the sequence of its main learning activities. For instance, the tutor was offering possibilities to the students to learn about the use of the dedicated software at the beginning of the course and not after the theory. Pedagogically speaking, the rationale is that the students would benefit from being involved in the research activity at the very early stage of the learning process. Student support on how to develop the project and guidance from the lectures was highly demanded in the first phase of the course to start the main student project.

4. Student data analysis and results

Regarding some basic student demographics, the majority of the students was bachelor students in their second year of study. They had almost the same age (around 22 years old).

Regarding the distribution of the students sample in terms of gender, it was similar in both groups, that is equivalent to a ratio of 4 males to 3 females. The sample size was comprised of 27 students in Gjøvik and 7 students in Trondheim.

Figures 2a and 2b depict the distribution of the final grades for the course where the students could attend in presence (in Gjøvik) and where the students were attending online (those that were registered in Trondheim), respectively. An independent-samples t-test was conducted to compare the student performance between the two student groups (where the highest score of "A" was mapped to "6", score "B" to "5", …, score "F" to 1). The results (t(32) =0,41, p =0.680) indicated that there was no significant difference in the student performance scores for students participating online (M=5.11, SD=0.641) and students participating on-site in Gjøvik campus (M=5.00, SD=0.577). These results suggest that student performance in the course was not affected by the mode of participation (online or on-site). To calculate the effect size of this result, the Hedge's G coefficient was calculated. This particular coefficient was selected due to the fact that the two groups have almost similar standard deviations and different sizes, which are rather small. The Hegde's G coefficient had a value of 0,804 (>0,8) indicating a large effect size. In effect, this value means that the samples sizes were adequate (Sullivan & Feinn, 2012), even though they were rather small.

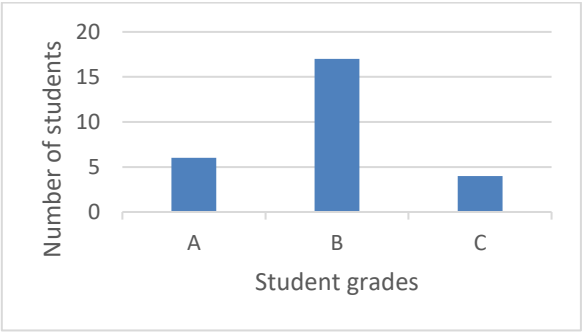

Fig. 2a. Distribution of student grades from Gjøvik campus (14%A; 71%B; 14% A)

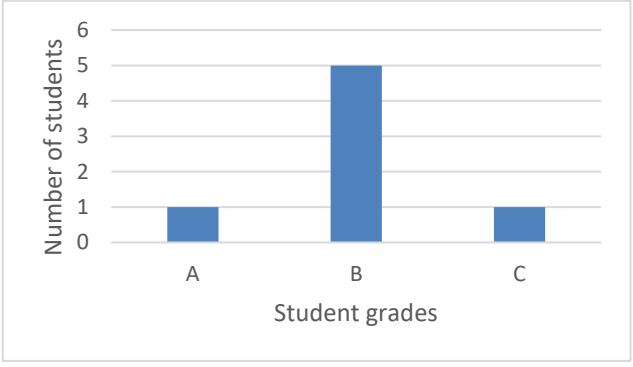

Fig. 2b. Distribution of student grades from Trondheim campus (26% A; 59% B; 15% C)

5. Conclusion and discussion

A recent review on hybrid teaching and learning revealed that only a limited number of studies have involved empirical research to assess differences in outcomes between students who attend online versus in-person courses. There is currently limited work that 1) provides insights on synchronous forms of hybrid education and 2) employs empirical research using a quasi-experimental design focusing on student performance data. Furthermore, there is a fundamental question posed by several researchers recenty asking what kind of pedagogical innovations related to online learning is worth considering in the context of higher education after the end of the pandemic.To compensate for this gap in the literature and to contribute to the debate around the aforementioned question, the paper presents a case study of hybrid teaching and learning in the context of higher education. Current research is rather inconclusive on whether the distance education aspect in the hybrid learning settings might by associated with lower student academic achievement and outcomes. In this case study, student performance data were collected and statistically analysed.

The findings of the statistical analysis herein indicate that the students' performance was not affected by the distance, since there was no significant difference between the two groups (with a large size effect of more than 0.80). One possible interpretation is that it might be due to the nature on this course (based on the use of the dedicated software) and also due to the constant involvement of the lecturer in providing support and guidance to the different student groups. Taking into account these findings, we conclude that hybrid synchronous learning might be one of the approaches that the community could consider after the end of the pandemic.

This study adds on to the literature on hybrid synchronous university learning, but not without limitations. Limitations of this study pertain to the fact that the size of the groups is relatively small, but the large size effect value indicates that it is appropriate. Furthermore, the quasi-experimental research design employed herein cannot determine causes (i.e., why did both student groups performed equally well in the final exams) as other variables, both known and unknown, could still affect the outcome. There are several external threats in this research and interviewing the students could eliminate their negative effects. Thus, more research is needed to establish a cause-and-effect relationship. Future research could focus on a mixed method approach that involves combined results of quantitative analysis of performance grades and qualitative analysis of students' interviews. In general, it has emered from reviewing the literature that there is a lack in studies taking into account in a mixed method research approach student performance data focusing on a comparison regarding learning gains in the different modes along the spectrum of blended learning.

References

Denton, D. J. (2020). Examination of student learning outcomes during a musculoskeletal spine assessment course: hybrid blended model versus traditional classroom delivery in a doctor of physical therapy program (Doctoral dissertation, Marshall University).

Healey, M. (2005). Linking research and teaching to benefit student learning. *Journal of Geography in Higher Education*, 29(2), 183-201.

Kustiawan, U., Yafie, E., Samawi, A., Iriyanto, T., & Robbaniyah, I. (2021, September). The Effect of Hybrid Learning-Based Training on Pedagogic Competence through TPACK as a Moderation Variable. In *2021 7th International Conference on Education and Technology (ICET)* (pp. 52-59). IEEE.

Lightner, C. A., & Lightner-Laws, C. A. (2016). A blended model: Simultaneously teaching a quantitative course traditionally, online, and remotely. *Interactive Learning Environments*, 24(1), 224-238.

Matta, V., & Palvia, S. (2021). Instructional Modes for the New Normal: In-Class, Synchronous or Asynchronous?. In *Proceedings of the EDSIG Conference* ISSN (Vol. 2473, p. 4901).

Mavroudi, A., & Gynnild, V. (2021, November). A review of cross-campus teaching projects In Proceedings of ICERI2021 Conference (Vol. 8, p. 9th).

Raes, A., Detienne, L., Windey, I., & Depaepe, F. (2020). A systematic literature review on synchronous hybrid learning: Gaps identified. *Learning Environments Research*, 23(3), 269-290.

Rhoads, D. D. (2020). Traditional, Online or Both? A Comparative Study of University Student Learning and Satisfaction Between Traditional and Hyflex Delivery Modalities (Doctoral dissertation, Concordia University Irvine).

Sullivan, G. M., & Feinn, R. (2012). Using effect size—or why the P value is not enough. *Journal of graduate medical education*, 4(3), 279-282.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14406

Employers' perception of the role of higher education in Portugal: The varying solutions for skill problems

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Abstract

Higher education is under great pressure to provide skills that smooth graduates' transition into the labour market, prepare them for the world of work and, ultimately, contribute to their employability. This supply-side perspective does not, per se, reflect employers' view of the mission of higher education. Our research provides empirical evidence on how employers in Portugal perceive the role of higher education. It relies on data gathered in 2020 through an original online survey applied to N = 162 employers in Portugal. A k-means clustering distinguishes three groups of employers: those that acknowledge the autonomy of higher education; those who prefer to train their workforce; and those that blame higher education for their skill problems. The latter employers report skill shortages and propose different answers to mitigate them. Ultimately, the findings indicate that there is no one-size-fits-all solution for skill problems; firms have agency in finding appropriate solutions.

Keywords: *Employers' perception; Role of higher education; Skill shortage; Make-or-buy; Portugal.*

1. Introduction

Higher education (HE) institutions are often critiqued as being ivory towers where teaching and research are isolated from the needs of firms and community. These institutions have been experiencing multifaceted changes worldwide in recent decades, notably due to the demand for constantly changing high-quality services and to become socially and economically relevant, and thus engaged with society. It is labelled the third mission, which attempts to respond to critics regarding the isolation of HE (Etzkowitz et al. 2000).

Employers frequently complain about graduates' skills, and the education system is often thought to be to blame (Cappelli 2015; Suleman and Laranjeiro 2018; Suleman, Videira and Araújo 2021). These issues are captured through the concept of employability which focuses on the relationship between HE and the workplace (Römgens, Scoupe & Beausaert 2020). This implies a match between the skills acquired at university and those required in the workplace. HE is therefore under great pressure to provide skills that smooth graduates' transition to the labour market, prepare them for the world of work and, ultimately, contribute to their employability. But what do employers expect from the HE institutions? To the best of our knowledge, the literature has not provided a clear answer to this question. Our study attempts to provide insights into this question by providing some empirical evidence on how employers in Portugal perceive the role of HE. The data were gathered in 2020 through an original online survey and the sample comprises N = 162 employers.

It is well-known that various national and supranational initiatives have sought to boost employability. The Dearing report in the UK (Bennett 1997) and the Bologna Process in Europe illustrate shifts towards a new HE mission as well as the introduction of the tools required to implement it. It is clear that an essential part of the employability agenda involves the employers and HE institutions working together in several key areas. Available research highlights a range of skill problems identified by employers, namely skill gaps that affect the individual's performance within the firm; and skill shortages, which lead to hard-to-fill vacancies; and under or oversupply, i.e., skill mismatch (Cappelli 2015; Suleman, Videira & Araújo 2021). It seems that employers blame HE institutions for their skill problems and expect them to produce graduates with the skills they require. Nevertheless, this is not the attitude of all employers when recruiting recent graduates. Whereas some are unwilling to accept responsibility for training them, others acknowledge workplace training as a crucial step to prepare graduates for work and believe it should be part of company policy (Suleman and Laranjeiro 2018). Consequently, employability is regarded either as synonymous with work readiness or as having the ability to learn. This general observation raises the following two research questions: How do employers classify the collaboration between business and HE? Do all employers blame HE for their skill problems? This research attempts to respond to these questions using an empirical approach based on a k-means clustering of survey data from 162 firms in Portugal.

2. Data and methodology

Our study draws on original data collect through an online survey applied to employers in Portugal. The information on employers was provided by the careers office of a public university in Portugal and was collected during a job fair at that university. A link for the questionnaire was sent to the 2997 firms that were in the careers office database, as well as to 62 firms which participated in the job fair but were not included in the database. The questionnaire was applied since mid of February 2020 but was suspended in mid of March 2020 due to the pandemic and subsequent lockdown. Furthermore, the unexpected context might affect the answers of employers and create a bias that can lead to imprecise results and mistaken analyses.

The dataset comprises information on 162 firms and it is used to explore employers' perceptions on the roles of HE in training and skills. Despite the small response rate, our sample includes firms of all sizes. The dataset is made up of five items regarding employers' perception about the mission of higher education (short name in parenthesis); employers were asked to state their agreement/disagreement with each of the following statements, using a 7-point Likert scale:

- Higher education should be concerned with general training and firms with on-the-job training (general vs specific).
- Firms should not interfere in the choices of higher education institutions (autonomy).
- Companies have a training policy that enables them to meet their training and skills needs (training policy).
- Higher education institutions are not able to respond to the firms' skill needs (blame).
- Higher education institutions are not open to collaborating or to provide training to meet specific company needs (isolation).

The agreement with the three first sentences suggest employers acknowledge HE's autonomy and use their own resources to meet skill needs; on the other hand, full agreement with the last two statements mean that employers expect HE to provide appropriate responses to their skill needs and are therefore critical of HE's ability to supply suitable skills. The data on the level of agreement is used to group employers by their perceptions. Additionally, the dataset includes information of firms' characteristics, notably the size, source of capital (national or multinational), industrial affiliation, tenure, geographical location, skill shortages, quality of workforce, hiring criteria, and proxies of training policy (training plan, own training centre); these variables are expected to help differentiate groups of employers by the underlying characteristics of firms.

We carried out a k-means clustering (Jain 2010) to examine how employers perceive the role of HE. We replaced the missing data with series means and used a cosine distance, which entails each observation having unit Euclidean norm; this distance measure yielded benefits in terms of interpretability. We run the algorithm for k = 2 to k = $\sqrt{N}$, where N = 162 is the sample size, and realised that the solution k = 3 best fits the data, according to the Davies and Bouldin (1979) (D-B) index. Figure 1 displays the behaviour of D-B index for different values of k, and it attains the minimum value, i.e. best fit, for k = 3. We also note that $\sqrt{N}$ is a consensual upper bound for the number of clusters in data.

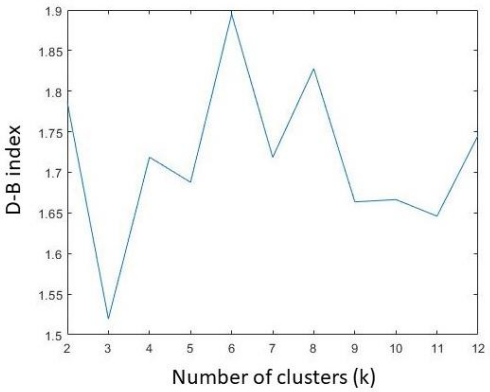

Figure 1. D-B index value for different number of clusters; k=3 is the optimal solution.

In order to characterise the typology associated with each cluster that emerged, we used the sample mean of each variable as the baseline and measured the prevalence of any variable in a particular cluster if its mean in that cluster is much higher than in the sample (see, e.g., Berkman et al. 1989). Herein, we subjectively adopted a 15% criterion, i.e., 1.15 times the sample mean.

3. Empirical analysis

Our empirical analysis comprises two steps. First, we examine the clusters of employers regarding their perception of the role of HE. The second step consists of associating each cluster with the firms' characteristics. The referred measure of 1.15 allows us to easily label the employers' perception of the role of HE as follows: Autonomy of HE (Cluster 1), Self-sufficiency of firm (Cluster 2) and Isolation (Cluster 3). Table 1 displays the variables that prevail in each cluster in bold (note: we tagged Autonomy in Cluster 1, which is slightly less than 1.15 times the sample mean, 0.38 vis-à-vis 0.39).

We found that 64.8% of sampled employers refuse the principle of proximity and pressure HE to respond to business needs. These employers recognise HE as the supplier of general skills and assume the responsibility of training specific skills. In this context, employers should avoid making demands of HE. However, almost a quarter of employers (24.1%) are critical about HE and blame it for not responding to their specific skill needs. Firms using their own resources for a timely solution to their skill problems predominate in Cluster 2. However, it is the smallest cluster of the sample (11.1%).

Table 1. The perception of employers of the role of higher education*

Role of HE	Sample mean	**Cluster 1** Autonomy of HE	**Cluster 2** Self-sufficiency of firm	**Cluster 3** Isolation
General vs Specific	0.42	**0.49**	0.24	0.30
Autonomy	0.34	**0.38**	0.20	0.27
Training policy	0.44	0.45	**0.67**	0.29
Blame	0.49	0.44	0.50	**0.60**
Isolation	0.43	0.39	0.35	**0.58**
% of firms	100.0	64.8	11.1	24.1

* The variables prevailing in clusters are represented in bold.

The next step of our data analysis was to ascertain how specific firms' characteristics influence the way employers see HE. We used the same 15% criterion to highlight the influence of the associated variables and show in Table 2, columns four to six, how they are distributed across different clusters. Explicitly, we calculated the mean value of every variable in each cluster and considered it as a discriminant condition for the cluster if its value is 1.15 higher than the corresponding sample mean. This helps understand how firms' characteristics condition employers perspective on HE.

The very large firms prevail in Cluster 1, and the figures indicate that employers interact with vocational HE institutions. This collaboration might help them meet their skill needs and probably explains the missing information in all other variables.

The major differences are found between Clusters 2 and 3 and suggest a divide between make, i.e. train the workforce, (Cluster 2) and buy, i.e. hire ready-to-work graduates from the labour market (Cluster 3). The medium-sized firms (50-249 workers) and non-graduates are predominant in Cluster 2. More importantly, these firms define the non-graduate level as the major hiring criterion but report skill shortages. It seems that self-sufficiency firms hire fewer educated workers and implement a training policy that helps them to adjust the workforce to specific needs. As can be seen from figures in Table 2, firms in this cluster have their own

training centre but they are unlikely to have a training plan. In addition to training, they interact with both types of HE institutions (universities and vocational HE) to tackle their skill shortages.

Table 2. Descriptive statistics of firms' characteristics*

Firm Characteristic	Category	Relative Frequency (x 100%) Sample	Cluster 1	Cluster 2	Cluster 3
Size	1 to 9	22.8	24.8	11.1	23.1
	10 to 49	18.5	18.1	5.6	**25.6**
	50 to 249	27.8	24.8	**50.0**	25.6
	250 to 499	10.5	9.5	11.1	**12.8**
	500 to 999	5.6	4.8	**11.1**	5.1
	1000 or more	14.8	**18.1**	11.1	7.7
Capital	Multinational	37.0	38.1	38.9	33.3
	National	63.0	61.9	61.1	66.7
Hiring (last 3 years)	Missing	1.2	**1.9**	0.0	0.0
	Yes	94.4	95.2	94.4	92.3
	No	4.3	2.9	**5.6**	**7.7**
Hiring Criteria	Missing	7.4	7.6	5.6	7.7
	Non-graduates	19.8	18.1	**38.9**	15.4
	Bachelors	51.2	51.4	50.0	51.3
	Post-graduates	21.6	22.9	5.6	**25.6**
Labour force quality	Missing	3.1	**4.8**	0.0	0.0
	Non-graduates	22.8	21.0	**50.0**	15.4
	Bachelors	55.6	56.2	44.4	59.0
	Post-graduates	18.5	18.1	5.6	**25.6**
HEI	Missing	29.6	33.3	22.2	23.1
	Mostly universities	45.7	41.9	33.3	**61.5**
	Mostly vocational HE	3.1	**3.8**	**5.6**	0.0
	Universities/Vocational HE	21.6	21.0	**38.9**	15.4
Shortage	Missing	27.2	**35.2**	11.1	12.8
	Yes	42.6	32.4	**66.7**	**59.0**
	No	30.2	32.4	22.2	28.2
Training Plan	Missing	26.5	**34.3**	11.1	12.8
	Yes	56.2	48.6	55.6	**76.9**
	No	17.3	17.1	**33.3**	**28.2**
Own training centre	Missing	27.2	**35.2**	11.1	12.8
	Yes	26.5	24.8	**38.9**	25.6
	No	46.3	40.0	50.0	**61.5**

* The boldface figures indicate prevailing conditions in emerged clusters based on 1.15 criterion.

The firms in Cluster 3 blame HE for skill shoratges but have highly skilled workforce and have defined post-graduation as hiring criterion. It is about small businesses, which prefer to collaborate with universities to mitigate skill problems. However, they have designed a training plan but, probably, lack resources to own training centre to implement such plan.

4. Conclusion

Our research explored an original dataset to provide evidence on how employers perceive the role of HE in Portugal. Not only did the cluster analysis show different perceptions, but also that most of the sampled employers acknowledge the autonomy of HE. Some blame HE for their skill shortage, probably because they do not have their own resources to train their workforce. Finally, a small number of firms state their preference to train the skills and deal with the skills shortage in own training centre. While our findings corroborate previous analyses of the trade-off between make-or-buy and blaming, it adds that a non-negligible proportion of employers perceive HE to be autonomous (Suleman and Laranjeiro 2018). The firms in Cluster 2 explicitly assume that the skills matched to jobs should be provided through workplace training; and the Cluster 1 comprises firms that seems to undertake the same argument. The employers that blame HE expect ready-to-work graduates and argue in support of a strong relationship between HE and the workplace (Römgens, Scoupe & Beausaert 2020).

In sum, there are significant differences between the clusters of firms. These differences arise from the size but also involve a trade-off between make-or-buy to access suitable skills. It is important to note that firms target different skill levels and design skill acquisition policies accordingly. Ultimately, the findings indicate that there is no one-size-fits-all solution for skill problems; firms have agency in finding appropriate solutions. HE policy makers should be aware that HE reform may have been based on an incomplete view of employers; it is being, in an unsustainable way, admitted that the market wants only ready-to-work graduates. Most of employers acknolwdege and appreciate HE autonomy, and consequently implement training policies to obtain the required skills timely.

Although this research has provided original findings, the interpretation of results achieved deserves caution. Unfortunately, the pandemic restricted our access to employers and limited the sample size. We hope to return to this survey shortly to collect more data. Hence, there is room for further research that will allow us to compare the perceptions over time.

References

Bennett, P. (1997). The Dearing Report: paving the way for a learning society. *Australian Universities Review*, 40(2), 27-30. https://files.eric.ed.gov/fulltext/EJ558362.pdf

Berkman, L., Singer, B., & Manton, K.G. (1989). Black/White differences in health status and mortality among the elderly. *Demography*, 26(4), 661-678. doi: 10.2307/2061264

Cappelli, P.H. (2015). Skill gaps, skill shortages, and skill mismatches: Evidence and arguments for the United States. *Industrial and Labor Relations Review*, 68(2), 251–290. doi: 10.1177/0019793914564961

Davies, D. L., & Bouldin, D. W. (1979). A cluster separation measure. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 1(2), 224-227, doi: 10.1109/TPAMI.1979.4766909.

Etzkowitz, H., Webster, A., Gebhardt, C., & Terra, B. R. C. (2000). The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm. *Research Policy*, 29(2), 313-330, doi: 10.1016/S0048-7333(99)00069-4.

Jain, A. K. (2010). Data clustering: 50 years beyond K-means. *Pattern Recognition Letters*, 31(8), 651-666, doi: 10.1016/j.patrec.2009.09.011

Römgens, I., Scoupe, R., & Beausaert, S. (2020). Unraveling the concept of employability, bringing together research on employability in higher education and the workplace. *Studies in Higher Education*, 45(12), 2588-2603, doi: 10.1080/03075079.2019.1623770.

Suleman, F. & Laranjeiro, A.C. (2018). The employability skills of graduates and employers' options in Portugal: An explorative study of anticipative and remedial strategies. *Education + Training*, 60(9), 1097-1111, doi: 10.1108/ET-10-2017-0158.

Suleman, F., Videira, P., & Rodrigues Araújo, E. (2021). Tackling regional skill shortages: from single employer strategies to local partnerships. *Journal of Vocational Education & Training*, 1-20. doi: 10.1080/13636820.2021.1931945.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14319

The Science of Complex Systems for Preparing the New Generation to Tackle Global Challenges

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Abstract

The contemporary Information and Communication Technologies and always faster means of transport facilitate the interconnection among the humans on Earth as never before. There is the awareness that every human is a node of a giant network, which is the humanity on Earth. A problem in a community might easily become a global issue and involve everyone living on the planet Earth. A challenge in a specific sector can have repercussions in other areas. If humanity wants to face global challenges more easily, it is necessary that higher education prepares not only specialists, but also generalists. This work proposes a strategy to form a new generation of generalists. Our strategy is based on teaching the science of Complex Systems. Complexity Science prepares a class of generalists who have the necessary knowledge and thinking skills to face any global challenge of this century.

Keywords: *Complexity Science; Generalists; Interdisciplinarity; Systems Thinking; Sustainability; Natural Computing.*

1. Introduction

A major goal of Higher Education is to prepare the new generations to tackle the global challenges of this new century. These challenges are global because they involve everyone on Earth from both the health and economic and social and ethical points of view (UN General Assembly, 2015) (Harari, 2018) (Martin, 2007). Examples are (1) the COVID-19 pandemic that affects not only physical health but also mental health, social lives, and economic activities; (2) the poverty in the world, which favors social unrest, uncontrolled migration, and wars; (3) the productive activities must transform from linear to circular, turning goods at the end of their service life into resources for others, minimizing waste (Stahel, 2016); (4) manufacturing processes and all other human activities should not perturb the fragile stability of natural ecosystems (Williams at al., 2017); (5) the warming of our planet should be curbed.

All these global challenges regard Complex Systems that are human beings, their societies, the world economy, the natural and urban ecosystems, and the climate of the Earth. Seemingly, such Complex Systems are diverse. Well-distinct disciplines traditionally investigate them: Medicine, Biology, Psychology, Social Sciences, Economy, Ecology, Engineering, Physics, Chemistry, et cetera. Such disciplinary fields are usually taught separately in higher education. The consequence of monodisciplinary teaching is that we prepare specialists who are not endowed with the required knowledge and skills to face the global challenges of this century.

It is urgent to form professional figures who know the concepts and methodologies valuable to face global challenges. Such new figures are called either polymath (Ahmed, 2019) or generalist (Epstein, 2019) or hybrid (Dominici, 2020). In our view, the minds of the young polymaths should be formed by teaching them Complexity Science (Mitchell, 2009) (Homer-Dixon, 2011) (Gentili, 2018a). Complexity Science is an interdisciplinary domain of research outlining the phenomenology and laws of Complex Systems and giving the thinking skills to tackle global challenges. In section 2 of this paper, we highlight the features of those Complex Systems that have been aforementioned and are the targets of the 2030 Agenda (UN General Assembly, 2015). We propose the fundamental theories to understanding Natural Complexity from an ontological perspective. In section 3, we point out the difficulties we encounter in describing and predicting the behaviour of Complex Systems. In other words, we present Natural Complexity from an epistemological point of view. The limitations we experience in predicting Complex Systems make the technologies that modify them highly disputable. Cumbersome ethical issues arise, as explained in section 4. Therefore, the new generations should be formed not only technically but also ethically. Finally, in section 5, we propose what we consider to be fundamental thinking skills to deal with Complex Systems. This work suggests a Higher Education path for preparing the new generations to generalists.

2. The theories for describing Complex Systems

Complex Systems as diverse as living beings, ecosystems, human societies, world economy, and climate share some features (Gentili, 2018a).

First of all, all Complex Systems can be described as networks (Mitchell, 2009), whose constitutive elements are nodes and links. The nodes are the essential elements of the network, whereas the links represent the relationships among the nodes (Newman, 2010). Nodes and links are often diverse and even variable in their behavior. The relationships are usually mutual. Furthermore, the states of the nodes affect the links and vice versa. Networks are characterized by a high degree of non-linearity. Human social networks are the most complex. Their complexity has soared. The most recent innovations in Information and Communication Technologies (ICT) remarkably affect the number, types, diversity, and variability of the relationships. Such relentless ICT innovations have promoted a transition of human societies from Complexity to Hyper-Complexity (Dominici, 2019). Clearly, Network Science is one of the fundamental theories to be taught to describe Complex Systems.

Secondly, Complex Systems are always "Out-of-equilibrium" in the thermodynamic sense (Gentili, 2018a). They are dissipative structures because they constantly squander matter and energy, producing entropy discharged mainly in the surrounding environment. Out-of-equilibrium Thermodynamics is another fundamental theory to be taught.

Thirdly, Complex Systems exhibit emergent properties (Gentili, 2021). A property is emergent when it belongs to the network as a whole. It cannot be attributed to a few nodes and links but to the entire collection of nodes and relationships. Examples are the phenomena of temporal and spatial self-organization and deterministic chaos. Some of the emergent properties can be interpreted by referring to Nonlinear Dynamics (Strogatz, 1994), the third fundamental theory to be taught to prepare the new generations of polymaths.

3. The Epistemology of Complex Systems

There are emergent properties that are not fully understood and cannot be predicted. The phenomenon of life is an example. Life has many peculiar attributes. However, we do not know its origin, we are not able to obtain it from scratch (i.e., from its molecular constituents), and we cannot predict the evolution of its forms.

Why are there emergent properties that are not understood and cannot be predicted yet? There are, at least, three primary reasons (Gentili, 2018a), which outline an "Epistemological Complexity."

The first reason is related to the difficulties we encounter in describing any Complex System by using a reductionist approach. Since any Complex System is representable as a network, its description is challenging due to:

1. The number of nodes, their diversity, and behavioral variability.
2. The number of links, their diversity, and variability.
3. The sensitivity of all these features towards the context.

In social science, not all the links are measurable in quantitative terms. Moreover, their analyses might perturb them (Dominici, 2018). The emergent properties that are not understood yet have the features of the variable patterns. Variable patterns are entities or events whose recognition is made difficult by their multiple features, variability, and extreme sensitivity to the context. Examples of variable patterns are the biological species, symptoms and patterns in medical diagnosis, and social, political, and economic events. There are no universally valid and effective algorithms for recognizing variable patterns.

The second reason we find difficulties in rationalizing certain emergent properties is bound to Computational Complexity. Many of the computational problems regarding Complex Systems are solvable but intractable. Examples are scheduling, the Traveling Salesman Problem, the Schrödinger equation, machine learning, financial forecasting. According to Computational Complexity theory, all the solvable problems can be either polynomial (P) or exponential. All the polynomial problems are tractable because it is possible to determine the exact solution in a reasonable time lapse, whatever the problem's dimension is. On the other hand, the exponential problems having large dimensions are intractable because it is impossible to determine the exact solution in a reasonable time lapse, even if the fastest supercomputer in the world is employed. Such exponential problems are transformed into non-deterministic polynomial (NP) problems. After fixing an arbitrary criterion of acceptability for a solution, specific heuristic algorithms generate acceptable solutions that can be achieved in reasonable lapses of time. Meanwhile, many scientists, also drawn by one million dollars offered by the Clay Mathematics Institute in Cambridge, are trying to verify if algorithms can transform NP-problems into P-problems or if such transformation is impossible. If anyone rigorously demonstrated that the NP-problems are reducible to P-problems, Computational Complexity would melt like snow under the sun. This improbable event would not render any emergent property of Complex Systems predictable.

The predictive power of science has intrinsic limitations. A limitation concerns the microscopic world, and the Heisenberg Uncertainty principle expresses it. According to this principle, it is impossible to accurately and simultaneously determine two relevant features as position and momentum of any particle. Therefore, it is impossible to make trustable predictions of the microscopic particles' dynamics. Aware of this limitation, we might think

of limiting our description of Complex Systems to the macroscopic scale. However, Complex Systems might exhibit chaotic dynamics. Any deterministic chaotic dynamic is aperiodic and extremely sensitive to the initial conditions. Since unavoidable uncertainties always taint any determination of the initial conditions, it derives that any chaotic dynamic is unpredictable in the long term by definition. The three fundamental reasons why specific emergent properties of Complex Systems are not understood and predictable, i.e., (1) Descriptive Complexity, (2) Computational Complexity, and (3) the intrinsic limitations of the predictive power of science, should be evident in the minds of all the future polymath figures.

4. Bio-ethical Complexity

The awareness of the limitations humanity encounters in describing and predicting the behavior of Complex Systems makes all those technologies that perturb and modify the spontaneous evolution of Complex Systems highly disputable. A fundamental question arises: "Is it always fair to do what technologies make doable?". Some technologies manipulate and re-engineer living species. Questions, such as "Is it fair to manipulate embryonic stem cells?", “Is it safe to promote the diffusion of Genetically Modified Organisms?” emerge. These and many other analogous questions are raised continuously, and when societies look for possible answers, they are usually polarized into “pro” vs. “contra” factions. Other bio-ethical issues generate societal polarization. For instance, some technologies can enhance human intellect and modify human physiology: “Should such techniques be allowed although they change the material essence of what any human being has been so far?”. Other subjects, generating harsh debate, concern about suffering and the end of life: “Is euthanasia fair?”, “Is it fair to pursue therapeutic obstinacy?”, “Is it fair to perform experiments with animals?”. Finally, human activities of production and consumption affect ecosystems and even climate. “How is it possible to feed the growing world population without polluting natural ecosystems?". "Is it possible to preserve natural biodiversity?". All these questions and other similar ones give rise to what can be named as “Bio-Ethical Complexity” (Gentili, 2021). Polymaths must be formed not only technically but also ethically to assure an equitable future.

5. Thinking Skills of Polymaths

Polymaths should have some thinking skills that are fundamental to facing global challenges.

The first skill is “Interdisciplinary Thinking” which is forged only through interdisciplinary education (Gentili, 2019). Unfortunately, the academic disciplines, as established in Western countries during the late 18th and 19th centuries and now settled in higher education and university structures, hamper inter-disciplinarity (Gombrich, 2018). Interdisciplinary degrees should be spread around the world.

The second skill is "Systems Thinking" that should be taught along with "Reductionist Thinking" (Capra, 1985). Reductionism focuses on details at smaller and smaller scales. At the same time, the systemic approach helps students zoom out from detailed and fragmented disciplinary contents and obtain a more holistic view of Complex Systems (Morin, 1992). Systems Thinking can be trained in different ways (Grohs, Kirk, Soledad, and Knight, 2018). Cognitive Maps, Systems Thinking Concept Map Extension (SOCME), and Geographical Information System (GIS) aid in exploring, understanding, and depicting both within-systems and cross-system interactions and in managing complex scenarios (Stella et al., 2019) (Wang et al., 2021). Alternatively, there is Service-learning. Service-learning is a teaching strategy that intentionally engages students with the complexity of communities through service activities (Menconi et al., 2020).

The third skill is "Computational Thinking" rooted in the research line of Natural Computing (Gentili, 2018a) (Gentili, 2018b). The rationale of Natural Computing is that any distinguishable state of either matter or energy can be used to encode information, and any of its transformations can be conceived as computations. Within Natural Computing, there exist two programs. In the first program, scholars exploit the physicochemical laws to make computations. Any physicochemical law describes a causal event. Any causal event can be assumed to be a computation since the causes are the inputs, the effects are the outputs, and the law governing the transformation is the algorithm of the computation. In the second program, scholars mimic the natural information systems, i.e., the cells, nervous systems, immune systems, and the societies of living beings. Scholars working in the field of Natural Computing propose (1) new algorithms and (2) new materials and architectures to compute in alternative to those employed in current electronic computers for facing Complexity from an epistemological point of view. Furthermore, they formulate new methodologies and models to understand Complex Systems from an ontological point of view.

6. Conclusions

It is urgent to form polymaths who can face global challenges. This work outlines a path for their formation. It regards three dimensions of a polymath: (1) the cognitive dimension, (2) the ethical dimension, and (3) the skills' dimension. The cognitive dimension is shaped by learning the ontology and epistemology of Complex Systems. Teaching the features shared by all those Complex Systems that are at the core of the 2030 Agenda allows understanding Natural Complexity from an ontological point of view. The concrete awareness of the limits humanity encounters in describing and predicting the behavior of Complex Systems allows knowing Natural Complexity from an epistemological point of view. The ethical dimension of a polymath is rooted in this awareness. Finally, the skills' dimension is rooted in an interdisciplinary mindset, systems thinking, and Natural Computing. Such skills are valuable to deal with the ontology and the epistemology of Natural Complexity.

References

Ahmed, W. (2019). *The Polymath: Unlocking the Power of Human Versatility.* John Wiley & Sons Ltd, The Atrium, Southern gate, Chichester, West Sussex (UK).

Capra, F. (1985). "Criteria of systems thinking", *Futures*, 17(5), 475-478. https://doi.org/10.1016/0016-3287(85)90059-X

Dominici, P. (2018). For An Inclusive Innovation. Healing The Fracture Between the Human and the Technological in The Hypercomplex Society. *Eur. J. Futures Res.,* 6, 3. https://doi.org/10.1007/S40309-017-0126-4

Dominici, P. (2019). Controversies On Hypercomplexity And On Education In The Hypertechnological Era, In, A. Fabris & G. Scarafile, Eds, *Controversies In The Contemporary World*, Amsterdam-Philadelphia: John Benjamins Publishing Company.

Dominici, P. (2020). Educating for the Future in the Age of Obsolescence. *CADMUS,* 4(3), 93-109.

Epstein, D. (2019). *Range. How Generalists Triumph in a Specialized World*. MacMillan, London (UK).

Gentili, P. L. (2018a). *Untangling Complex Systems: A Grand Challenge for Science*. CRC Press, Taylor & Francis Group, Boca Raton (FL, USA).

Gentili, P. L. (2018b). The fuzziness of the molecular world and its perspectives. *Molecules,* 23(8), 2074. https://doi.org/10.3390/molecules23082074

Gentili P. L. (2019). Designing and Teaching a Novel Interdisciplinary Course on Complex Systems to Prepare New Generations To Address 21st-Century Challenges. *J. Chem. Edu.,* 96, 2704-2709. https://doi.org/10.1021/acs.jchemed.9b00027

Gentili, P.L. (2021). Why is Complexity Science valuable for reaching the goals of the UN 2030 Agenda?. *Rend. Fis. Acc. Lincei,* 32, 117–134. https://doi.org/10.1007/s12210-020-00972-0

Gombrich, C. (2018). Implementing Interdisciplinary Curricula: Some Philosophical and Practical Remarks. *European Review*, 26(S2), S41-S54. doi:10.1017/S1062798718000315

Grohs, J. R., Kirk, G. R., Soledad, M. M., Knight, D. B. (2018). Assessing systems thinking: A tool to measure complex reasoning through ill-structured problems. *Thinking Skills and Creativity*, 28, 110-130, https://doi.org/10.1016/j.tsc.2018.03.003

Harari, Y. N. (2018). *21 Lessons for the 21st century*. Penguin Random House, London.

Homer-Dixon, T. (2011). Complexity science. Oxford Leadership Journal, 2(1).

Martin, J. (2007). *The meaning of the 21st century: a vital blueprint for ensuring our future*. Riverhead Books, New York.

Menconi, M.E., Tasso, S., Santinelli, M., Grohmann, D. (2020). A Card Game to Renew Urban Parks: Face-To-Face and Online Approach for The Inclusive Involvement of Local Community. *Evaluation And Program Planning*, 79, 101741. https://doi.org/10.1016/j.evalprogplan.2019.101741

Mitchell, M. (2009). *Complexity. A guided tour*. Oxford and New York: Oxford University Press.

Morin, E. (1992). From the concept of system to the paradigm of complexity. *Journal of Social and Evolutionary Systems*, 15 (4): 371–385. https://doi.org/10.1016/1061-7361(92)90024-8

Newman, M. E. J. (2010). *Networks: An Introduction*. Oxford University Press, New York, USA.

Stahel, W. R. (2016). Circular economy. *Nature*, 531:435–438. https://doi.org/10.1038/531435a

Stella, G., Coli, R., Maurizi, A., Famiani, F., Castellini, C., Pauselli, M., Tosti, G., Menconi, M.E. (2019). Towards a National Food Sovereignty Plan: Application of a new Decision Support System for food planning and governance. *Land Use Policy*, 89, 104216. https://doi.org/10.1016/j.landusepol.2019.104216

Strogatz, S. H. (1994). *Nonlinear Dynamics and Chaos*. 1st ed. Westview Press, Perseus Books Publishing, Boulder, CO.

UN General Assembly (2015) Transforming our world: the 2030 agenda for sustainable development. A/RES/70/1. https://www.refworld.org/docid/57b6e3e44.html. Accessed May 27, 2021.

Wang, R., Murayama, Y., Morimoto, T. (2021). Scenario simulation studies of urban development using remote sensing and GIS: review. *Remote Sensing Applications: Society and Environment,* 22, 100474. https://doi.org/10.1016/j.rsase.2021.100474

Williams, A., Kennedy, S., Philipp, F., Whiteman, G. (2017). Systems thinking: A review of sustainability management research. *Journal of Cleaner Production,* 148:866-881. https://doi.org/10.1016/j.jclepro.2017.02.002

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14539

Student approaches to learning and entrepreneurial intentions

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Abstract

An increasing number of universities are incorporating compulsory entrepreneurship subjects into their degrees in an attempt to develop the entrepreneurial mindset of students. Previous studies have found that the main reasons for the entrepreneurial intention of students after having received training in entrepreneurship, are fear of failure, perceived self-efficacy, family entrepreneurial background and gender. This study examines the role of the student approach to learning (SAL) on their entrepreneurial intention. Based on the SAL theory, the study shows that a deep learning approach explains students' entrepreneurial intentions after having taken the course, and that fear of failure, perceived self-efficacy, family entrepreneurial background lack explanatory value. In light of the SAL theory, the results of the study point to the important role of teachers in designing methodologies that ensure that assessment and other contextual elements of the teaching and learning system are constructively aligned to promote a deep learning approach, and thus an entrepreneurial mindset.

Keywords: *Learning approaches; entrepreneurial intentions; entrepreneurial learning; entrepreneurship education; deep learning.*

1. Introduction

There is a broad consensus that it is important to promote entrepreneurship to stimulate innovation, job creation and, ultimately, the progress of society. Accordingly, entrepreneurial activity has become a priority on the agendas of many governments, and a recurring question is, *how can people be encouraged to become entrepreneurs?* The answer to this question requires an understanding of the factors associated with the intention to start a business.

Several perspectives have been used to explain the factors associated with the intention to start a business. One of these lines of research on entrepreneurial intention has focused on analysing the role of entrepreneurship education in business creation.

Nabi et al. (2017) found a positive relationship between entrepreneurial education and entrepreneurial intention. However, many studies have also provided mixed, ambiguous, negative or non-significant results (Bae et al., 2014).

Liñán and Fayolle (2015) affirm that knowledge of the possible causal link between some educational variables (such as pedagogical methods) and the impact of entrepreneurship education on entrepreneurial intention is still scarce. The aim of the present study is to contribute to reducing this knowledge gap through the study of the relationship between entrepreneurial intention and entrepreneurship education by considering students' approaches to learning.

Accordingly, this study uses a new perspective – that of the student approach to learning (SAL) model – to analyse the factors that affect the formation of entrepreneurial intentions amongst university students who, in the last year of their degree, have taken a compulsory course in business creation. As far as we know, this perspective has not been used to study the relationship between entrepreneurial intention and entrepreneurship education, yet it has been widely used in other education-related areas (see e.g. Zhao et al., 2018).

Understanding how students learn is important to develop an effective learning system. This understanding can help educators adopt teaching strategies that encourage students'deep learning. In the case of the present study, these strategies can help foster entrepreneurial intentions and, ultimately, help students view business creation as a viable route of professional development. The results reveal that entrepreneurial intention after taking a compulsory entrepreneurship course depends on the student's learning approach. This finding helps to explain the differences in the results regarding the relationship between entrepreneurship education and entrepreneurial intention.

2. Theoretical framework

2.1. Entrepreneurial intentions, self-efficacy and fear of failure

Self-efficacy highlights the importance of entrepreneurs' beliefs about their abilities as a predictor of success in business creation. Individuals will be more inclined to start a business if they believe they have the skills needed to successfully run their own business. The empirical evidence corroborates this relationship (see e.g. Esfandiar et al., 2019). Therefore, we propose the following hypothesis:

H1: *The perceived self-efficacy of entrepreneurship students is positively related to their entrepreneurial intentions.*

The dominant approach to research on fear of failure is to consider it a personality trait that acts as a powerful inhibitor of entrepreneurial activity (see e.g. Langowitz and Minniti, 2007). Fear of failure is a feeling about the outcome of creating a new business. This feeling affects judgements about the likelihood of success. Consequently, it creates a barrier to entrepreneurship that inhibits entrepreneurial behaviour. Therefore, we propose the following hypothesis:

H2: *The fear of failure of entrepreneurship students is negatively related to their entrepreneurial intentions.*

2.2. Entrepreneurial education, learning approaches and entrepreneurial intentions

The theory of Student Approaches to Learning (SAL) describes how students learn. According to Biggs (1987), when students find themselves in a learning situation, they ask themselves two important questions. The first relates to the motives and goals that they hope to achieve: *what do I intend to achieve with this?* The second relates to the strategies and cognitive resources that they must deploy to satisfy these intentions: *what must I do to achieve this?* Thus, an approach to learning is based on a motive and a strategy.

There is an extensive literature on how students learn. From this literature, Biggs (1987) identifies two approaches to learning: deep and surface. Students who adopt a deep approach to learning are intrinsically motivated and seek to maximise the meaning of what they learn by linking new knowledge to prior knowledge. Students with a surface approach are motivated by the fear of failure and focus on reproduction and memorisation as a learning strategy.

In relation to entrepreneurship education, Carland and Carland (2010) point out teaching techniques should promote interactive pedagogy that increases students' ability to identify opportunities, find diverse solutions to specific problems and develop a practice-oriented mentality. In other words, teaching methodologies that require deep approaches to learning should be used. The above arguments lead to the following two hypotheses:

H3: *A deep approach to learning is positively related to students' entrepreneurial intentions.*

H4: *A surface approach to learning is negatively related to students' entrepreneurial intentions.*

2.3. The explanatory power of students' entrepreneurial intentions before an entrepreneurship course in explaining post-course entrepreneurial intentions

To understand the relationship between entrepreneurship education and entrepreneurial intentions, scholars have highlighted the need to consider students' entrepreneurial intentions before taking a course on entrepreneurship. Bae et al. (2014) empirically observed that when entrepreneurial intentions before students take a course are considered, their entrepreneurial intentions after the course are unchanged. However, if students must take a compulsory course on entrepreneurship, the relationship should change when teaching and learning methods associated with entrepreneurship education have been developed. That is, the relationship should change when the methodology is able 'to unleash the entrepreneurial spirit of our students, cultivate a mindset of practice, and build environments in which practice can occur' (Neck, Greene, and Brush 2014, 1). Therefore, we propose the following hypothesis:

H5: *When entrepreneurial intentions before taking a course are considered, there is a positive relationship between students' entrepreneurial intentions after taking an entrepreneurship course and a deep learning approach.*

3. Method

To test our hypotheses, we gathered data on a sample of 90 students from a public university in the Community of Madrid (Spain). The students were enrolled in a compulsory course of Labour Relations and Human Resources bachelor's degree programme and took an 'Entrepreneurial Initiative' course in the 2018 to 2019 academic year.

3.1. Variables

Entrepreneurial intention at time T1 was the dependent variable. Entrepreneurial intention was measured as the degree to which students seriously considered becoming entrepreneurs. It was measured with a single item, similar to the approach used by Arafat and Saleem (2017) and Barba-Sánchez and Atienza-Sahuquillo (2018). The item asking whether 'respondents expect to start a new business in the future' was measured on a 7-point scale ranging from 0 (*never*) to 6 (*already an entrepreneur*). *Entrepreneurial intention at time T0* was an independent variable. It measured students' initial entrepreneurial intentions (T0).

Perceived self-efficacy was an independent variable. It was measured using the same approach as Arafat and Saleem (2017) by asking respondents whether they thought they had

the knowledge, skills and experience required to start a new business. *Self-efficacy* was a dichotomous variable that took the value 0 when students considered that they did not have the necessary knowledge to start a business and 1 when they considered that they did have the necessary knowledge to start a business.

Fear of failure was another of the independent variables. It was recorded using the same method as Arafat and Saleem (2017) by asking respondents whether the fear of failure prevented them from starting a business. This was a dichotomous variable that took the value 0 when students considered that fear of failure would not prevent them from creating their own business and 1 when they considered that fear of failure would prevent them from creating their own business.

Approaches to learning. Students completed the Spanish version (Gargallo López et al. 2006) of the revised two-factor version of the Study Process Questionnaire (R-SPQ-2F; Biggs et al. 2001).

We included two commonly used control variables: gender and entrepreneurial family background. *Gender* was a dichotomous variable that took the value 1 for men and 0 for women. *Entrepreneurial family* was a dichotomous variable that took the value 1 when there was a family history of entrepreneurship and 0 when there was not.

4. Results

Table 1 presents the results of the linear regressions performed to test our hypotheses. Model 1 explains the entrepreneurial intentions of students after taking the course. The results for Model 1 show that the entrepreneurial intentions of students after taking the course (T1) are significantly and negatively related to fear of failure (fear of failure T1 = -0.525, $p < 0.05$), significantly and positively related to a deep approach to learning (deep approach T1 = 0.372, $p < 0.05$), and significantly related to gender (gender = 0.271, $p < 0.1$). However, the results for Model 1 show that despite observing the expected signs for the coefficients associating entrepreneurial intentions after the course with self-efficacy, a surface approach to learning and an entrepreneurial family, we did not detect statistically significant relationships. The non-significant relationship between self-efficacy and entrepreneurial intention has also been reported in other studies (Shinnar et al. 2018). The results for entrepreneurial family background coincide with those reported by Dohse and Walter (2012) in their analysis of entrepreneurial intentions amongst students. They did not find a statistically significant relationship between having an entrepreneurial family background and entrepreneurial intentions.

Model 2 explains students' post-course entrepreneurial intentions (T1) whilst controlling for students' initial entrepreneurial intentions (T0). The results for Model 2 show that a deep approach to learning (deep approach T1 = 0.27, $p < 0.05$) explains students' post-course

entrepreneurial intentions whilst controlling for students' entrepreneurial intentions before the course (T0). This result supports H5. Fear of failure and perceived self-efficacy have no explanatory power in Model 2.

Table 1. Results of the estimation of the regression models.

Dependent variable	**Intention T1**	**Intention T1**
	Model 1 *Standardized coefficients*	Model 2 *Standardized coefficients*
Self-efficacy T1	0.17	0.041
Fear of failure T1	-0.525**	-0.287
Deep approach T1	0.372**	0.27**
Surface approach T1	-0.046	-0.012
Gender	0.271*	0.332**
Entrepreneurial family	0.241	-0.056
Intention T0		0.532***
R	0.723	0.827
R^2	0.522	0.684
R^2 *adjusted*	0.412**	0.597***
F	4.734**	7.719***

Notes: *** $p < 0.001$; ** $p < 0.05$; * $p < 0.10$.

In summary, following the recommendations of Bae et al. (2014) to carefully control for the effect of any variable that may influence the effectiveness of entrepreneurship education before testing its effect, we considered the possibility that a student's entrepreneurial intention might not be determined by the student's learning approach but rather by the student's intention prior to taking the course. Our results show that a deep approach to learning is significantly associated with entrepreneurial intentions after taking an entrepreneurship course, even after controlling for entrepreneurial intentions prior to the course.

5. Conclusions and limitations

This study takes a further step towards understanding how the students approaches to learning affects entrepreneurial intentions and, consequently, entrepreneurial spirit. As far as we know, no previous study has examined the relationship between approaches to learning and entrepreneurial intentions. However, the role and importance of entrepreneurial education and students approaches to learning regarding entrepreneurial intentions have been acknowledge but not investigated.

Biggs (1987, 11) reports that the 'most effective way of ensuring high quality teaching and learning is for teachers to take responsibility for ensuring that assessment and other contextual elements in the teaching and learning system are constructively aligned to promote deep approaches to learning.'

On the other hand, and without forgetting the relevance that the teaching-learning methodology has on entrepreneurial intention, the findings of this work also contribute to answer the call for research by Nabi et al. (2017) by explaining why students with different value priorities may interpret entrepreneurship education differently. Students with a superficial learning focus, motivated by security, conformity will be afraid of the uncertainty inherent in entrepreneurship and therefore reluctant to entrepreneurship. Whereas students with a deep learning approach, motivated by self-direction, will be more encouraged to entrepreneurship. In this regard, perhaps one of the most remarkable aspects of student approaches to learning (SAL) theory is that through a suitable teaching and learning methodology and a consistent evaluation system, teachers can foster the development of deep approaches to learning.

Additionally, the results of this study suggest that the entrepreneurship education offered by universities could work as a motivator to channel students' aspirations and attitudes towards a professional career as an entrepreneur. In this regard, in line with the work by Esfandiar et al. (2019), research on entrepreneurial intentions provides policymakers with valuable knowledge of how to foster students' entrepreneurial capacity. Accordingly, a large body of literature is dedicated to the study of entrepreneurial intentions. Although students' approaches to learning have not yet been studied in the area of entrepreneurship education courses, they have been studied in regard to other types of education, fundamentally in relation to students' academic performance, so this paper is filling this gap.

Finally, we must consider some of the limitations of our study. First, as regards the method (i.e. linear regression), although longitudinal data were used, the causality of the relationships has not been demonstrated. However, the explanatory or predictive nature of the model was tested. It should also be noted that entrepreneurial intention models have been replicated in different regions and countries, with differences in behaviour reported between regions and countries. In other words, the relationship between entrepreneurship education and entrepreneurial intentions is influenced by culture. The empirical evidence reveals that culture has a significant influence on students' approaches to learning (Bowden et al., 2015). Therefore, analysing the possible moderating role of culture in the relationship between entrepreneurial intentions and approaches to learning would help us develop a better understanding of this relationship. It would also allow us to conclude whether an entrepreneurship pedagogy actually exists.

References

Arafat, M. Y., & Saleem, I. (2017). Examining start-up Intention of Indians through cognitive approach: a study using GEM data. *Journal of Global Entrepreneurship Research*, *7*(1), 13. https://doi.org/10.1186/s40497-017-0073-3

Bae, T. J., Qian, S., Miao, C., & Fiet, J. O. (2014). The Relationship Between Entrepreneurship Education and Entrepreneurial Intentions: A Meta-Analytic Review. *Entrepreneurship: Theory and Practice*, *38*(2), 217–254. https://doi.org/10.1111/etap.12095

Barba-Sánchez, V., & Atienza-Sahuquillo, C. (2018). Entrepreneurial intention among engineering students: The role of entrepreneurship education. *European Research on Management and Business Economics*, *24*(1), 53–61.

Biggs, J. (1987). *Study Process Questionnaire Manual. Student Approaches to Learning and Studying. Australian Education Research and Development*. Melbourne. Retrieved from http://files.eric.ed.gov/fulltext/ED308200.pdf

Biggs, J., Kember, D., & Leung, D. Y. P. (2001). The revised two-factor Study Process Questionnaire: R-SPQ-2F. *The British Journal of Educational Psychology*, *71*, 133–149. https://doi.org/10.1348/000709901158433

Bowden, M. P., Abhayawansa, S., & Manzin, G. (2015). A multiple cross-cultural comparison of approaches to learning. *Compare*, *45*(2), 272–294. https://doi.org/10.1080/03057925.2013.841465

Carland, J. C., & Carland, J. W. (2010). Entrepreneurship education: Building for the future. *Journal of Business and Entrepreneurship*, *22*(2), 40–59.

Dohse, D., & Walter, S. G. (2012). Knowledge context and entrepreneurial intentions among students. *Small Business Economics*, *39*(4), 877–895. https://doi.org/10.1007/s11187-011-9324-9

Esfandiar, K., Sharifi-Tehrani, M., Pratt, S., & Altinay, L. (2019). Understanding entrepreneurial intentions: A developed integrated structural model approach. *Journal of Business Research*, *94*(August 2016), 172–182. https://doi.org/10.1016/j.jbusres.2017.10.045

Gargallo López, B., Garfella Esteban, P., & Pérez Pérez, C. (2006). Enfoques de aprendizaje y rendimiento académico en estudiantes universitarios. *Bordón*, *58*(3), 45–61.

Langowitz, N., & Minniti, M. (2007). The Entrepreneurial Propensity of Women. *Entrepreneurship: Theory and Practice*, *31*(3), 341–364.

Liñán, F., & Fayolle, A. (2015). A systematic literature review on entrepreneurial intentions: citation, thematic analyses, and research agenda. *International Entrepreneurship and Management Journal*, *11*(4), 907–933. https://doi.org/10.1007/s11365-015-0356-5

Nabi, G., Liñán, F., Fayolle, A., Krueger, N., & Walmsley, A. (2017). The impact of entrepreneurship education in higher education: A systematic review and research agenda. *Academy of Management Learning & Education*, *16*(2), 277–299. https://doi.org/10.5465/amle.2015.0026

Neck, H. M., Greene, P. G., & Brush, C. (2014). *Teaching Entrepreneurship. A practice-based approch*. Northampton, Massachusetts, USA: Edward Elgar Publishing, Inc.

Zhao, Y., Kuan, H. K., Chung, J. O. K., Chan, C. K. Y., & Li, W. H. C. (2018). Students'

approaches to learning in a clinical practicum: A psychometric evaluation based on item response theory. *Nurse Education Today*, *66*(March), 179–186. https://doi.org/10.1016/j.nedt.2018.04.015.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14245

Comparing Online and Physical Social Entrepreneurship Training: Lessons Learned moving Online

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Abstract

With soft skills such as networking, groupwork and team building being key aspects of entrepreneurship education, the Covid-19 pandemic arguably has had a larger impact than on many other subject areas by the need to switch online. Having run a four day, fully immersive Enterprise School for social enterprise off campus for many years, the Covid-19 pandemic saw a need to move online with a danger of these key aspects being lost. By using the more familiar local area, spreading out the time between sessions and increasing the interactions with guest mentors we were able to mitigate for some of these issues. This paper discusses the advantages and disadvantages of moving online with qualitative feedback from students and staff including some unexpected benefits such as improved accessibility for some students.

Keywords: *Enterprise, entrepreneurship, extracurricular education, online learning.*

1. Introduction

Entrepreneurship is acknowledged as a key component of a university education backed by employers, governments and students themselves (QAA, 2018). Whilst some students will indeed start a business on graduation, many others will use their skills within an existing organisation as intrapreneurship or start a business later in life, which makes measuring the true value of interventions difficult. There have been some longitudinal studies (Matley and Carey, 2007) and also retrospectively asking alumni entrepreneurs what was successful (Phillips, 2018), but measuring outcomes is notoriously difficult (Henry et al., 2017; Duval-Couetil, 2013). It is suggested that those that are put off entrepreneurship by understanding how difficult it could be is a useful outcome to prevent unsuitable entrepreneurs wasting money and failing when they could find a better match being entrepreneurial within an existing organisation (von Graeventiz et al., 2010). There are a range of activities both on and off curricular for those with an interest in entrepreneurship (Nabi et al., 2017, Phillips, 2010). Many studies suggest extracurricular activities are best for those interested whilst at university (Papadopoulou and Phillips, 2019). This especially applies to social enterprise where students have suggested it is better taught in a multidisciplinary environment separated from "general" entrepreneurship (Jones and Phillips, 2021). Entrepreneurship education generally works best as learning by doing, as an active experience. It was found previously that an immersive experience away from the University using a four day residential enterprise school for social enterprise has worked well in encouraging knowledge and skill building (Phillips, 2017), and that students have taken that back to their home environment, with the ability to reflect on what they have done in order to improve, such as in the Kolb learning Cycle (Kolb, 2014). The Rugby Team Framework (Rugby Team, 2008) was previously used to assess the benefits from an increase in self efficacy and an increased entrepreneurial skills set to actually creating a venture (Phillips, 2017). As with other subjects, entrepreneurship education has been affected by the urgency to switch to online, with not only the elimination of face to face teaching but also less ability to plan in advance for upcoming courses due to changing regulations. Online learning was previously a small part of university teaching prior to Covid with approximately 5% of degrees completed online in the US, and the hurried migration online in 2020 has been problematic for many academics and students, with students often perceiving it as lower value (Watermeyer et al., 2021). Since entrepreneurship education has been reinforced in the literature as a subject that needs face to face immersion, Liguori and Winkler (2020) suggest that it is even further behind other subjects in terms of understanding how successful pedagogic models can be adopted online. Online learning has many positives, for example it is cost effective, flexible and can facilitate elements of both synchronous and asynchronous activity and allow intereaction with others in many different locations. Liguori and Winkler (2020) suggest that whilst the basics of business and entrepreneurship can be taught in a straightforward manner by online teaching, aspects of the

entrepreneurial mindset and entrepreneurial competencies which are more applied in nature are more difficult and require more thought and planning. A range of options have been suggested for making the most of EdTech and Dhawan (2020) has summarized the Strengths, Weaknesses, Opportunities and Challenges of online teaching, and that accessibility, flexibility and lower costs are important positives.

The enterprise school activity tries to fulfill the elements of the EntreComp Framework (Bacigalupo et al., 2016) which lncludes the broad areas of *Into Action* (e.g. learning through experience), *Ideas and Opportunities* (e.g. Spotting opportunities, creativity) and *Resources* (e.g. Mobilising resources, financial literacy and self efficacy). Students are placed in groups from different subject areas to firstly identify a social problem in the local area they agree on to tackle and to then to make a case for a social enterprise to address it. Sessions involved an introduction to an enterprising topic, with pointers to key resources and an emphasis on the students obtaining primary and secondary data to test their assumptions. They were encouraged to speak to potential customers/end users to explore the problem in more detail and to gain feedback on potential solutions. In previous years, the physical enterprise school involved spending 4 days staying in the Lake District area of the UK, which has social issues such as an elderly population, brain drain of young people to cities, seasonal businesses reliant on tourism, transport issues and environment/ecology issues. They were able to physically speak to potential customers, business owners and guest entrepreneurs for feedback and iteratively improve their idea. Groups pitched their social enterprise idea on the last day. The Enterprise School moved online for 2021 and took place via Zoom over 4 weeks with sessions spaced out with similar material provided by lecturers and guest speakers as the previous physical version. A more familiar environment was used as the target - Manchester where the students lived, which allowed some familiarity without the need to physically explore a new area. Issues identified in Manchester included canal waste, high fat diets of South Asian women and employment skills for young people in deprived areas. Groups presented their social enterprise idea on the last day via Zoom. To emphasise more the practical side, more external speakers were used as the reduction of costs allowed this, so each group had access to a social enterprise mentor from the local area. Daily feedback was used to identify any serious issues and to allow staff to recify issues if possible, with a WhatsApp group for urgent technical issues.

Having attempted to provide a high quality online alternative in 2021, the aim of this paper was to identify what worked well and what worked less well using qualitative data from both students and staff in order to inform future activities of this nature.

2. Methodology

Primary data was collected from questionnaires prior to the commencement of the course and also on completion with opportunities for students to provide detailed feedback. There were 20 respondents and data was analysed in a qualitative manner. The pre-event questionnaire focused on reasons for attending and whether they felt online would be suitable for them, to identify any specific issues before the course started to allow time to adapt to any unexpected issues and give the best chance of high satisfaction. The post-event questionnaire focused in depth on how satisfied the students were with the activities, what they felt worked well and less well. It also asked students for an overall satisfaction rating based on a Lickert Scale.

3. Results

Pre-event students were asked their motivations for taking part, the reasons why people wanted to take part were similar and moving online not seen as a problem, if fact one participant cited it as a benefit;

"*I'd like to get the necessary skills to start a business and hear more real life business start-up obstacles and how to overcome these. I admire entrepreneurs and I'd like to start a business but I have a fear of starting / uncertain where to start*."

"I have dreamt of entering the world of Social Enterprise Entrepreneurship to try being part of the change….I wouldn't have been able to do this programme this year had it not been virtual due to my exacerbated disabilities. I hope to: feel less intimidated haling from a non-businsss background, feel confident in my understanding of the introductory skills, learn how to quickly work with a new team entirely virtually, have the opportunity to learn from the industry-experienced and a better understanding of the magnitude of problems out there".

Post-event feedback of student satisfaction was positive and is shown in table 1.

Table 1. Overall Satisfaction with the Online Enterprise School

Answer	% Response
A Great Deal	60.00
A Lot	30.00
A Moderate Amount	10.00
A Little	0.00
None at all	0.00

Qualitative comments were also collected to gain a deeper understanding of what exactly had gone well or less well during the activity. Despite the fact more time was allowed between activities to allow learning to be absorbed and for discussion between students, many felt that even more time could have helped;

"….more time between certain aspects such as pitching-masterclass, pitching surgery and pitch-delivery would have been incredibly useful. It would give us more time to implement and practice the golden nuggets of advice"

"*Maybe for online format, a couple of days (instead of one) between Day 1 and Day 2 would give a bit more time for problem research, formulation and statement*."

"*It would have also helped with the time difference barriers of our geographic locations, where we lose out on how much time we can work online together across the globe as a unit, which is particularly critical for pitches*"

The extra support that was put in place, with Whatsapp group (in case of technical problems) and the direct chat function on Zoom were deemed especially useful. Several students commented that they could ask questions directly via the chat function on Zoom privately rather than in front of everyone – this was useful for some students who may be lacking confidence, with several students saying pre-course that they didn't feel confident in the "business" area, and this was a function that was highly used;

"*The additional WhatsApp support was something no other has teacher has offered before and was very useful, and much more effective than using the typical Blackboard Discussion forum. Never come across any programme conducted virtually or otherwise with relentless support and encouragement which also flowed in parallel in the Zoom chatboxes with tonnes of useful links and resources. Every single question was followed through, and we didn't feel like there was a question too big or too small that wouldn't be received well*."

Whilst all students enjoyed the experiential learning aspects, one student wanted to take things further by taking their social business idea forward;

"…the practices learned should be put in execution phase with more rigorous targets each week. The structure, framework and mentorship in place is excellent to bring about a real product in the market rather than just executing this as a learning experience."

There were mixed views on the ability to network, whilst one was positive, another participant highlighted the difficulty in networking outside their immediate group;

"*I enjoyed that we were put into teams with different people, and got the chance to work/network with different people other than our usual team members*."

"*I think would be good to spend more time working with others outside our group of 4 on the first day- I feel I only know my group and my mentor, I don't know anybody else.*"

Table 2. The advantages and disadvantages of the physical enterprise school compared to the online version

Aspect of the Enterprise School	**Advantages/Disadvantges of Physical**	**Advantages/Disadvantages of Online**
Networking	Ease of physically networking with both own group, but also with others and informally with guest entrepreneurs and lecturers easier to approach others face to face in an ad-hoc manner.	Meetings within groups straightforward, but sessions with guest entrepreneurs and lecturers more formal with timetabled sessions and pre arranged meetings.
Cost	High cost but more immersive experience and travel element attractive to students. High cost an incentive to fill the programme with many activities.	Lower costs, but less attractive to some students to do another online course. Money saved can be used to bring in more external speakers.
Reflection	Less time to reflect with all activities fitted into four days, not much time to incorporate it into the activities.	More time to reflect, and to react to feedback and initiate change.
Level of induction needed	Spend time learning about a new area, which although time consuming can also help team bonding.	Already familiar with the area so less investigation required.
Ability to ask questions	Generally done in front of whole class, so less confident students may not ask questions.	Option to message privately, so less confident students felt more able to ask questions.
Disability Issues	The need to physically explore the area and move around the venue a potential issue.	Mostly at the PC so physical issues much less a problem, however more allowances needed for Dyslexic students.
Engagement	Away from home so student have less opportunity to disengage.	Working remotely so easier to disengage from the activities.
Staffing	Need staff to travel even if for a short presentation. Logistical issues in bringing all materials required to the venue.	Much more flexible and can do multiple shorter sessions with staff only needed for a short time for each.
Infrastructure	Extensvie infrastructure such as hotel, materials and transport needed.	Technological Infrastructure critical to success, good network connection critical to student engagement.

One participant highlighted the problems of a team member disengaging;

"…..one member of our team did not show to the 2 peer mentor sessions we had, and meetings outside of the session it really made the final pitch stressful as I did not feel prepared because we had been practising as a 2 or 3 at times."

And online perhaps more allowances could have been made for Dyslexia;

"We didn't appreciate the extent of typing or scribing that would be needed real-time. Dyslexia aside, other difficulties such as needing adaptations(software and hardware) such as voice recognition to function for the 'live' exercises did not work well, even though I've thoroughly enjoyed it!"

Table 2 brings together feedback from the qualitative comments from students and also feedback from staff to give a fuller assessment of what works well and less well.

4. Discussion and Conclusions

Since entrepreneurship education at its best is generally more interactive and practical than many other subjects, it was feared that a switch to online for the annual enterprise school might lose many of the benefits of the physical version. However, this was not necessarily the case and there were several both expected and unexpected benefits to the switch online. Even so students still wanted longer to absorb material and make connections and a small number of students were not proactive in interacting. Online works well for people with physical disabilities and the ability to message in Zoom can allow students to ask what they consider a "stupid" question, however, more should be done to compensate for Dyslexic students.

References

Bacigalupo, M., Kampylis, P., Punie, Y. & Van den Brande, G. (2016). EntreComp: The Entrepreneurship Competence Framework. Luxembourg: Publication Office of the European Union; EUR 27939 EN; doi:10.2791/593884

Dhawan, S. (2020). Online learning: A panacea in the time of COVID-19 crisis. *Journal of Educational Technology Systems*, *49*(1), 5-22.

Duval-Couetil, N. (2013). Assessing the impact of entrepreneurship education programs: Challenges and approaches. *Journal of small business management*, *51*(3), 394-409.

Von Graevenitz, G., Harhoff, D. & Weber, R. (2010). The effects of entrepreneurship education. *Journal of Economic behavior & organization*, *76*(1), 90-112.

Henry, C., Hill, F. & Leitch, C. (2017). *Entrepreneurship education and training: the issue of effectiveness*. Routledge.

Jones, M.S. & Phillips, R. A. (2021) A Qualitative Study of the Inclusion of Social Enterprise in the Entrepreneurial Education Curriculum. *7th International Conference on Higher Education Advances (HEAd '21)*, 1097-1104.

Kolb, D. A. (2014). *Experiential learning: Experience as the source of learning and development*. FT press.

Liguori, E. & Winkler, C. (2020). From offline to online: Challenges and opportunities for entrepreneurship education following the COVID-19 pandemic. *Entrepreneurship Education and Pedagogy*, *3*(4), 346-351.

Matlay, H. & Carey, C. (2007), "Entrepreneurship education in the UK: a longitudinal perspective", *Journal of Small Business and Enterprise Development*, 14(2), 252-263.

Nabi, G., Liñán, F., Fayolle, A., Krueger, N., & Walmsley, A. (2017). The impact of entrepreneurship education in higher education: A systematic review and research agenda. *Academy of Management Learning & Education*, 16(2), 277-299.

Papadopoulou, K.A. & Phillips, R.A. (2019) A comparison of on-curricular and off-curricular activities in enterprise education for postgraduate students. *5th International Conference on Higher Education Advances (HEAd'19),* 55-64.

Phillips, R.A. (2017) Measuring Entrepreneurial outcomes from a residential enterprise school for postgraduate researchers. *Journal of Asia Entrepreneurship and Sustainability* 13(2**),** 62-89.

Phillips, R.A. (2010) Encouraging a more enterprising researcher – the implementation of an integrated training program of enterprise for Ph.D. and postdoctoral researchers. *Research in Post Compulsory Education* 15(3), 289-299.

Phillips, R.A. (2018) A Retrospective Study on the Views of Alumni Entrepreneurs Towards University Enterprise Eduaction and Training. *IUP Journal of Knowledge Management*, 16 (3) 54-71.

QAA (2018) Enterprise and Entrepreneurship Education: Guidance for UK Higher Education Providers Available Here: https://www.qaa.ac.uk/docs/qaas/enhancement-and-development/enterprise-and-entrpreneurship-education-2018.pdf?sfvrsn=15f1f981_8

Rugby Team Impact Framework (2008) Available here: http://www.vitae.ac.uk/CMS/files/1.Rugby%20Impact%20Framework_33.pdf Accessed 10/11/2010

Watermeyer, R., Crick, T., Knight, C. & Goodall, J. (2021). COVID-19 and digital disruption in UK universities: Afflictions and affordances of emergency online migration. *Higher Education*, *81*, 623-641.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14538

First-Generation College Students with Disabilities Attending a Four-year College: How Did They Get There?

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Abstract

Postsecondary education is essential for all students. Despite an increase in high school graduation rates and an increase in postsecondary enrollment overall, students with disabilities are less likely to enroll in a four-year postsecondary program than their general education peers. They are also more likely to drop out and not complete their degree than their general education peers. Using Espinoza's research on pivotal moments as the framework, this qualitative study used a combination of a case study approach and grounded theory to answer the research questions. In-depth interviews were conducted with ten current first-generation college students with disabilities. This study suggests that first-generation students with disabilities can benefit from pivotal moments.

Keywords: *Pivotal Moments; first-generation; students with disabilities; four-year university.*

1. Introduction

Workers who have higher levels of education typically have higher wages and higher employment rates independent of their disability status (National Center for Education Statistics, 2018). According to the U.S. Bureau of Labor Statistics Current Population Survey for 2020, workers with a bachelor's degree had median weekly earnings of $1,305, compared with $781 for workers with a high school diploma (Torpey, 2021). The unemployment rate for bachelor's-level workers was 5.5 percent, compared with 9.0 percent for those with a high school diploma (Torpey, 2021). The need for higher education impacts the livelihood of people with disabilities, who are attending college at a lower frequency and experience lower employment rates than people without disabilities (National Center for Education Statistics, 2018). Only 19% of high school graduates with disabilities attended a four-year college in 2015-16, according to the National Center for Education Statistics (2018). Students with disabilities are less likely to enroll in a four-year postsecondary program. They are also more likely to drop out and not complete their degree than their general education peers (Newman et al., 2011). This study aimed to explore how first-generation college students with disabilities experienced relationships with institutional agents in their educational careers that set them on the trajectory to college. The study also aimed to explore how these relationships affected the student's help-seeking behaviors.

2. Literature review

The study of social capital and how it relates to postsecondary transition could increase the effectiveness of transition planning and services for youth with disabilities and others who are marginalized (Trainor, 2008). Social and cultural capital have *not* been part of the special education vernacular (Trainor, 2008). Analyzing transition through the theoretical lens of social and cultural capital is important when examining issues of inequitable results experienced by individuals who belong to marginalized groups. Educational institutions and the agents working within them are often viewed as gatekeepers, reproducing socio-economic status (Bourdieu, 1973; Espinoza, 2011). Meaningful access to the general education curriculum is important in the education of students with disabilities, and this access may provide cultural and social capital. For example, an academic trajectory carries capital of higher value because it provides access to a college degree and degree attainment, which is associated with higher-paying employment (Trainor, 2008). Educators encourage students to take programs of study and academic courses to prepare them for the challenges of postsecondary education (Espinoza, 2011). They can expose students and their families to information and resources about higher education.

The framework for this research study is *pivotal moments*. According to Espinoza (2011), an educational pivotal moment is "a significant intervention initiated by a college-educated adult

who intentionally reaches out to a student to provide the student with the guidance and support to reach an academic goal" (p. 33). The pivotal moments theory has three components: 1) trusting relationships, 2) mentoring and advocacy, and 3) transmission of knowledge.

Timing of the pivotal moment can impact a student's success in college (Espinoza, 2011). Early pivotal moments, which occur before college, lead to good adjustments to higher education, positive experiences, the development of help-seeking behaviors, and academic success (Espinoza, 2011). Whereas students who experience late pivotal moments, which occur after the start of college, report difficulty adjusting to higher education, negative experiences, fewer help-seeking behaviors, and limited academic success (Espinoza, 2011).

3. Methodology

This qualitative study used a combination of a case study approach and grounded theory to answer the research questions. Using the two methods allowed the researcher to analyze the data using the pivotal moments framework while simultaneously looking for new and emergent themes driven by the data. The sample consisted of ten first-generation college students, and the sampling method used was a purposeful sample. For this study, participants needed to meet specific criteria to be included in the sample. The criteria include:

1. Being a registered student at the selected university
2. Currently in their sophomore year or higher
3. Having a documented disability (registered with the disabilities services office)
4. Being a first-generation college student
5. Being age 18 or over

The selected university for this study was a public university located in Southern California. One-hour-long in-depth interviews were conducted with all ten participants. Eight of the interviews were conducted in person, and two were conducted over the phone. The interviews were recorded with a digital recorder. The interview questions were semi-structured and followed a specific sequence, and open-ended questions were used to allow participants to tell their stories. Each interview session began with a script that reviewed and asked for informed consent. The interview recordings were transcribed, and the transcriptions were compared to the recordings and checked for accuracy. Pseudonyms were assigned to participants and used on the transcripts. The recordings were kept on the recording device locked in the interviewer's office for one year and then destroyed.

4. Results

All ten participants in this study attended a public university in Southern California. Four participants were aged 20-29, three were 30-39, one was 40-49, and two were 50-59. Half of the participants were male. Five participants were Caucasian, three Hispanic, one African-American, and one Asian. The participants represented a variety of disabilities, including specific learning disabilities, emotional/behavioral disabilities, visual impairment, hearing impairment, other health impairment, gifted, speech and language impairment, and orthopedic impairment. Of the ten participants, six spent the majority of their school years in the special education setting, and the other four spent their entire education in the general education setting. Three participants were sophomores, three were seniors, and four the participants were in Graduate school. All participants identified their family's socio-economic status as low or working class. Additionally, four participants receive assistance from the Department of Rehabilitation. See Table 1 for the demographic profile of the participants.

All ten participants reported experiencing a pivotal moment at different times in their educational careers. See Table 2 for the participants' pivotal moments timing, college adjustment, and help-seeking skills. Of the seven who experienced an early pivotal moment, three were in elementary school, and four were in high school. The other three participants experienced late pivotal moments in college. The timing of their pivotal moments impacted the participants in several ways. Of the seven participants who experienced an early pivotal moment, four reported having an easy adjustment to college and felt prepared. Two participants had a more difficult college adjustment, and one had multiple problems adjusting to college. When asked about help-seeking skills, of the seven, four reported having help-seeking skills before college, two developed them in college, and one was still struggling with help-seeking skills.

The three participants who experienced late pivotal moments had difficulty adjusting to college. Two of the three did not feel prepared academically. One did not mention academic preparation but did struggle to navigate the system and build a support network. All three of these participants had to learn how to navigate college independently. They also struggled to acquire help-seeking behaviors.

Several factors seemed to influence the participants' college preparedness, adjustment, and help-seeking skills: the participant's disability type, number of pivotal moments, and timing. In contrast, there were no notable differences based on gender.

Table 1. Demographics

Pseudonym	Age	Gender	Ethnicity	Disability
Jessica	39	Female	Caucasian	Specific Learning Disability
Jacob	50	Male	Caucasian	Visual Impairment
Diego	20	Male	Hispanic	Orthopedic Impairment
Carlos	29	Male	Hispanic	Emotional/ behavioral disability/ Learning Disabilities
Nick	20	Male	Caucasian	Orthopedic Impairment/ Traumatic Brain Injury
Stephanie	21	Female	Caucasian	Orthopedic Impairment
Ashley	39	Female	African-American	Specific Learning Disability/ Gifted
Jesus	31	Male	Hispanic	Speech or Language Impairment/ Other Health Impairment
Debra	54	Female	Caucasian	Hearing Impairment
Alice	44	Female	Asian	Emotional/ behavioral disability

Table 2. Pivotal Moments Timing and College Adjustment and Help-Seeking Skills

Participant	Early/Late	Quantity	Timing	College Adjustment	Help seeking Skills
Jacob	Early	Multiple	Elementary	Prepared	Acquired
Diego	Early	Multiple	Elementary	Prepared	Acquired
Stephanie	Early	Multiple	High School	Prepared	Acquired
Ashley	Early	Multiple	High School	Prepared	Developed in college
Nick	Early	Individual	High School	Some problems	Acquired
Jessica	Early	Individual	Elementary	Some problems	Developed in college
Carlos	Early	Multiple	High School	Multiple problems	Still struggling
Debra	Late	Multiple	Community College	Multiple problems	Developed in college
Jesus	Late	Multiple	Four-Year College	Multiple problems	Developed in college
Alice	Late	Individual	Four-Year College	Multiple problems	Still struggling

The three participants who experienced late pivotal moments had difficulty adjusting to college. Two of the three did not feel prepared academically. One did not mention academic preparation but did struggle to navigate the system and build a support network. All three of these participants had to learn how to navigate college independently. They also struggled to acquire help-seeking behaviors.

Several factors seemed to influence the participants' college preparedness, adjustment, and help-seeking skills: the participant's disability type, number of pivotal moments, and timing. In contrast, there were no notable differences based on gender.

5. Discussion

Students with disabilities face unique obstacles in their transition to postsecondary education, and yet, they want to pursue the same educational opportunities as their general education peers (Newman et al., 2011). Research on pivotal moments found that relationships with institutional agents could put first-generation students on the path to a four-year college (Espinoza, 2011). This study has added the element of students with disabilities to the pivotal moments theory to connect social and cultural capital with the postsecondary transition for youth with disabilities (Espinoza, 2011; Trainor, 2008). Participants who experienced multiple early pivotal moments had the easiest time adjusting to college and acquiring help-seeking skills. This supports the pivotal moments theory which states that students who experience early pivotal moments also experience good adjustments to higher education and develop help-seeking skills (Espinoza, 2011). The outcomes of participants that experienced late pivotal moments also mirrored the pivotal moments theory. They experienced difficulty adjusting to college and difficulty developing help-seeking skills.

Two findings are important to note. Both students with emotional behavior disabilities (EBD) reported multiple problems adjusting to college and were still struggling with help-seeking skills. This was not a surprise as a defining characteristic of EBD is an inability to build or maintain satisfactory relationships with others (Individuals with Disabilities Education Improvement Act, 2004). Another finding is that two participants who experienced late pivotal moments developed help-seeking skills in college and eventually experienced successful outcomes.

First-generation college students with disabilities can benefit from pivotal moments. This finding is vital to the academic trajectory of first-generation college students with disabilities. With the support of pivotal moment educators, students with disabilities who have multiple obstacles to overcome can successfully obtain a college degree.

References

Bourdieu, P. (1973). Cultural reproduction and social reproduction. In R. Brown (Ed.), *Knowledge, education, and cultural change* (pp. 71-112). London, England: Tavistock Publications.

Espinoza, R. (2011). *Pivotal moments: How education can put all students on the path to college.* Cambridge, MA: Harvard Education Press.

Individuals With Disabilities Education Improvement Act. (2004). Public Law 101-476.

National Center for Education Statistics. (2018, May). Table 311.10. Number and percentage distribution of students enrolled in postsecondary institutions, by level, disability status, and selected student characteristics: 2015–16 [Data table]. In *Digest of education statistics*. U.S. Department of Education, Institute of Education Sciences. Retrieved January 25, 2022, from https://nces.ed.gov/programs/digest/d20/tables/dt20_311.10.asp.

Newman, L., Wagner, M., Knokey, A. M., Marder, C., Nagle, K., Shaver, D., …Schwarting, M. (2011). *The post-high school outcomes of young adults with disabilities up to 8 years after high school. A report from the national longitudinal transition study-2 (NLTS2)* (NCSER 2011-3005). Menlo Park, CA: SRI International.

Torpey, E. (2021, June). Education Pays, 2020. *Career Outlook,* U.S. Bureau of Labor Statistics.

Trainor, A. A. (2008). Using cultural and social capital to improve postsecondary outcomes and expand transition models for youth with disabilities. *The Journal of Special Education, (42)*3, 148-162.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14235

Tandem.MINT – Taking advantage of the pandemic

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Abstract

Being able to interact in an international environment has become more and more important in the field of STEM disciplines. To offer STEM students the option of acquiring intercultural skills and improving their language competence, Tandem.MINT was created as an innovative language and cultural learning program explicitly for STEM students to allow a specified approach, catering to the needs of this particular group. In the beginning, the tandem was offered in a face-to-face manner, enabling local as well as international students to support each other in enhancing their language and intercultural competences. Due to the pandemic, Tandem.MINT was moved online, allowing cooperation with international universities, thus broadening the pool of participants. Evaluations showed that both the face-to-face version and especially the e-tandem are well received by the participants and increased language as well as intercultural competences significantly.

Keywords: *STEM education; engineering education; tandem language learning; internationalization at home; intercultural competence; e-learning.*

1. Introduction

Internationalization, intercultural competence and knowledge of foreign languages has become more and more important in times of global interconnectivity. While this is true for all academic disciplines, the imperative for STEM disciplines may even be more significant. On the one hand, more companies employing graduates from STEM disciplines are involved in multi-cultural contexts, requiring engineers as well as scientists across all STEM disciplines to collaborate with colleagues and stakeholders from all over the world (Johri & Jesiek, 2014). On the other hand, STEM disciplines play a vital role in finding solutions to supranational issues like climate change, pollution etc. that we are facing as a world society (Jones, 2018). Thus, it is no longer optional to focus exclusively on the content of the subject; incorporating the development of intercultural and foreign language skills as well as the understanding of global perspectives has become a necessity.

For a long time, student mobility was seen as the golden standard when it comes to acquiring intercultural competences and foreign language skills. Downey et al. (2006) showed that students of engineering sciences are assisted by a whole variety of different formats and measures to develop such competencies, including studies abroad, international projects, work placements, field trips, and integrated class experiences. Knight et al. (2019) argue that intentionally designed, short-term, faculty-led study abroad experiences have the potential to expand the number of engineering students who have international experiences. In addition, well-implemented short-term programs have shown to be valuable to increase students' global competency (Chieffo & Griffiths, 2009).

However, the overall expense of international student mobility is immense (Johri & Jesiek, 2014) and it tends to exclude students from lower income backgrounds or those involved in other responsibilities apart from their studies (Ackers 2010, Rodrigues 2012). In addition, the world-wide COVID-19 pandemic has brought global mobility to a halt, requiring universities to find solutions that allow students to acquire intercultural competences and language skills while at home. One such option is the unique tandem project Tandem.MINT at Ruhr-Universität Bochum (RUB) - a language tandem exclusively designed for STEM students (MINT being the German acronym for STEM), catering to their needs in acquiring language and intercultural competences specific to their disciplines.

2. Concept of Tandem.MINT

Tandem.MINT is an innovative language learning program that was established at Ruhr-Universität Bochum in 2018 as specified language program to promote Internationalization At Home. It was developed by two publicly funded projects, ELLI2 and InSTUDIESplus in cooperation with experts in language pedagogy from the University Language Center (ZFA) and is designed specifically for STEM students who want to improve their foreign language

skills and obtain intercultural competences. Tandem language learning has been offered by the ZFA for many years and is an established part of higher education at most universities across Germany (Spänkuch, Dittmann et al. 2019). However, when it comes to language learning, STEM students have different needs and aspirations than students of the humanities and social sciences. Their main focus is not mastering a language to achieve near native-like competences, but being able to use it in a professional context in order to communicate effectively with fellow students and colleagues from other language backgrounds (Paretti, McNair et al. 2014). In Tandem.MINT, the general concept of the tandem as a peer-learning offer is taken up: each term, pairs of two students of local and international background are invited to explore the language of their respective partner and immerse themselves in another culture by taking turns in conversing in the foreign language. Topics and materials can be freely chosen by the tandem partners, enabling them to work with authentic texts that are of interest to both of them. Unlike in a language course, the level of oral interaction is much higher, more authentic (Brammerts 2003) and can be specifically tailored to the requirements and wishes of the participants: the tandem partners work in a reciprocal and autonomous way (Lewis & Peters, 2019; Brammerts, 1996), and spend more time actually speaking the other language. Both speakers can explicitly help their partner become aware and avoid recurring mistakes by negotiating preferred ways and strategies of correcting each other (Lewis & Peters, 2019). Inhibitions speaking the language are lowered as well, since both partners are in the same situation and are at similar levels in their target languages: to participate, the applicants need to speak their target language at level B1 or higher[1]. Pairing STEM students creates the advantage that the tandem can also be used for a subject-specific exchange, enhancing specified vocabulary and allowing to compare and discuss laboratory work and other work procedures in different countries, going through job offers and applications for STEM related professional contexts and so on. Tandem.MINT combines autonomous student-led conversation sessions with moderated workshops, addressing topics for all participants. An accompanying online class on the e-learning platform Moodle is used for communication, enabling the exchange of ideas with participants and coordinators of the program (Ulbrich & Strenger, 2019).

One major issue with tandem learning is the discrepancy between the languages that are requested as target languages and the languages offered by international students at RUB. English is usually high in demand (Strenger & Schiffmann, 2020), while international STEM students wishing to improve their German often come from a very diverse set of language backgrounds including languages that are not taught in Germany (e.g. Bangla, Telugu, Igbo, Malayalam) or are rarely requested (e.g. Arabic, Turkish, Farsi). To circumvent this, participants of other native tongues but with a high command of English (at least C1) were also paired with English learners, which can be an advantage. Native speakers often lack

[1] According to the Common European framework of references for languages (CEFR)

explicit knowledge about grammatical constructions that are acquired through structured language instruction. They mostly rely on their intuition to determine whether something is correct or incorrect, but are unable to explain why exactly this is the case. Non-native speakers may thus be at an advantage when it comes to helping others improve their grammar.

3. Moving online

In the beginning, Tandem.MINT was designed to pair two students who both study at RUB to use the potential of a whole variety of international languages and create more connections between the students. The participants were free to meet face to face on- or off-campus on a weekly basis to have authentic interactions. Since then, the number of applications and matches were constantly on a high level, even increasing. This can be seen in Figure 1.

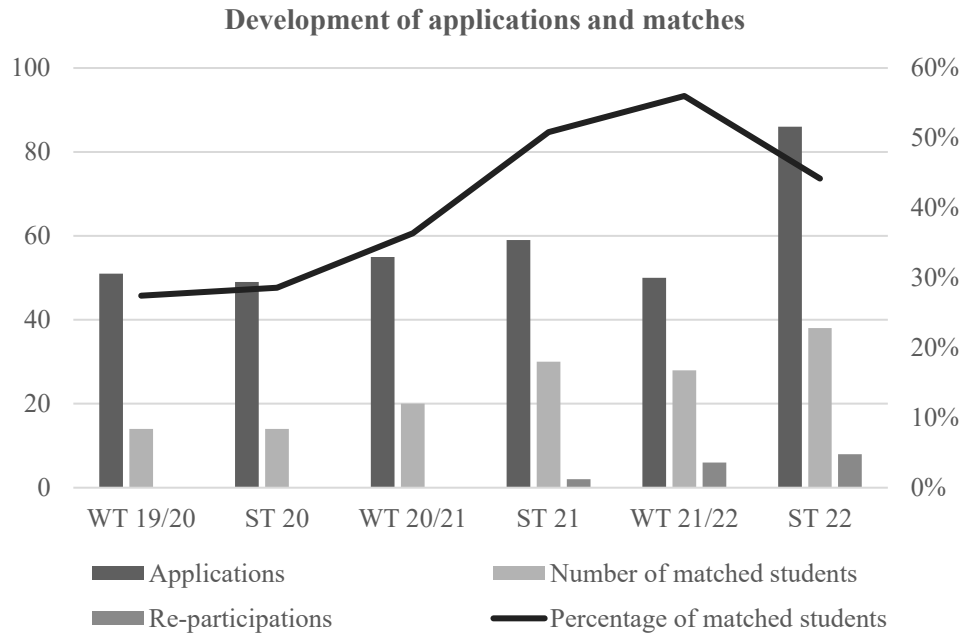

Figure 1: Development of applications and matches

In the last term before the pandemic (winter term 2019/20), 51 students applied to the program, but only seven pairs (14 participants) could be matched: three English-German (with non-native speakers fulfilling the English part), three Spanish-German pairs and one Chinese-German pair (all native speakers of the respective languages).

The COVID-19 pandemic spreading across the globe in early 2020 was both a challenge and a chance for Tandem.MINT. Students who wanted to go abroad or were accepted at RUB as

incoming exchange students were not able to travel. All classes had to be held online, meeting on campus was no longer an option. Thus, the tandem program had to be recreated ad hoc as a digital format, which was new territory because the personal aspect of meeting with the partner in person is usually an essential part of the tandem concept. However, it showed that an e-tandem offered possibilities that a face-to-face tandem could not: Students could participate regardless of their location, offering the chance to broaden the pool of native speakers of languages high in demand. In hindsight, this global situation with its local impact laid the groundwork for later cooperation opportunities with international partner universities.

In the summer term 2020 when the tandem had to be changed spontaneously from a face-to-face version to an e-tandem, the number of applicants was similarly high as in the previous semester (49 applicants). The concern that students would withdraw their application was unfounded, again allowing seven pairs (14 participants) to enter the program. English was again the language with the highest demand, but the English part was also fulfilled by non-native speakers once more. The other pairs (one German-Italian, one German-Chinese and one German-Spanish pair) consisted of native speakers only.

3.1 Cooperation partners

In the winter term 2020/2021, Tandem.MINT was planned as an e-tandem program right from the beginning. By taking advantage of the opportunity to offer it online only, it was possible to open it up to a cooperation with a foreign partner university, since the participating students did not have to be physically present at Ruhr-Universität Bochum anymore. A first cooperation was designed and implemented with the Department of Engineering at Virginia Tech (VT), Blacksburg, USA, making it possible to offer more English native speakers as potential partners to the German RUB students.

The lack of new international incomings did not pose a problem and not only did the number of applicants increase but so did the number of possible matches: 55 students wanted to participate and it was possible to match 12 pairs. Unfortunately, two pairs withdrew their application because they were matched with non-native speakers. However, for the first time four out of seven English-German pairs were made up of native speakers for both languages and only three Germans had to be paired with non-natives who spoke English at a C1 or even a C2 level. The other three pairs (German-Russian, German-French and German-Spanish) consisted of native speakers.

The cooperation with VT proved to be very successful: In the two following semesters, a steady number of applications from VT came in, and four VT students even applied for a second round. While the cooperation with VT has been limited to the department of engineering so far, there are plans to expand the tandem to include students from other STEM

disciplines and with further language combinations at VT, starting in the winter semester 2022/23.

3.2 Advantages and challenges

The number of applicants rose to 59 in the second round that was advertised as an online tandem from the beginning (ST 21). The coordinators of the program assumed that the reason for this was the lack of personal interaction between students due to the pandemic situation and the missing possibilities to meet new people on campus. This was confirmed in the reflection session, which is a mandatory part and provides a first evaluation of the program. In the third online round (WT 21/22), application numbers dropped down to 50, presumably due to general fatigue with online classes – again, the students confirmed this in the reflection session. However, due to new incoming students, it was possible to match 14 pairs (28 participants) even in this semester. Fortunately, the registration numbers increased significantly in the current semester (ST 22) and 19 pairs could be formed out of 86 applications.

The tandem has been evaluated by a pre- and post-survey. However, the post-survey often overlaps with many simultaneous course evaluations in other classes, leading to a general evaluation fatigue. Thus, the most valuable feedback comes from the reflection session and the final reports the students have to hand in to receive a certificate of participation. One recurrent complaint with the online format is the lack of personal face-to-face interaction, something that was out of the hands of the coordinators for the first three online semesters. In the fourth round, students were free to meet in person but expressed the wish for an organized meeting on campus with all participants. This will be considered in the coming semesters (always in line with the rules and regulations regarding COVID-19 set by the university) – although it would exclude all students from abroad if no hybrid option is offered.

Another complaint was the coordination of the individual tandem meetings because of the time differences. However, the benefit of being paired with an American native speaker seems to outweigh this particular setback.

4. Conclusion

Tandem.MINT is a very successful program and well-received by the targeted group. It has become a valuable source for improving language skills and intercultural competences, which has been confirmed by the students. The tandem in its digital form seems to be very attractive to students, as the large number of applications in the previous semesters showed. While it is not a requirement to write a final report, the number of students who hand it in to receive a certificate of participation has risen steadily as well, showing that the participants stay in the program to the end. Additional personal feedback via email confirmed that even those who did not write the final report for the certificate still benefit from the program and simply

participated out of personal interest. Re-applications both from RUB and VT students show a high level of commitment and enthusiasm regarding the program. As found by post-survey evaluations, the main aim is not receiving academic credit but the personal gain in the areas of language skills and intercultural competency. Originally designed as concept to enhance international activities, the interest in Tandem.MINT as an intercultural and language learning program is rising, in particular within the rounds that were run digitally. The extensive matching process aims at making the students' competences available to each tandem, making use of the high intrinsic motivation of the participants. Students understand and accept the program as a beneficial addition to their main course of study. Since the cooperation with VT has proven to be a success, establishing further cooperations with international partner universities, e.g., within the framework of the European University Initiative, is currently being explored.

References

Ackers, L. (2010). Internationalisation and Equality. *Recherches Sociologiques et Anthropologiques*, *41*(1), 83–103. https://doi.org/10.4000/rsa.189

Brammerts, H. (1996). Tandem language learning via the Internet and the International E-Mail Tandem Network. In D. Little & H. Brammerts, *A guide to language learning in tandem via the Internet,* 9─22. Dublin: Trinity College Dublin.

Brammerts, H. (2003). Autonomous Language Learning in Tandem: The Development of a Concept. In T. Lewis & L. Walker, Autonomous Language Learning in Tandem, 27-36. Sheffield: Academy Electric Press.

Chieffo, L., & Griffiths (2009). Here to Stay: Increasing Acceptance of Short-Term Study Abroad Programs. In R. Lewin (Ed.), *The Handbook of Practice and Research in Study Abroad,* 365–380. New York: Routledge. https://doi.org/10.4324/9780203876640-30

Downey, G. L., Lucena, J. C., Moskal, B. M., Parkhurst, R., Bigley, T., Hays, C., Nichols-Belo, A. (2006). The Globally Competent Engineer: Working Effectively with People Who Define Problems Differently. *Journal of Engineering Education*, *95*(2), 107–122. https://doi.org/10.1002/j.2168-9830.2006.tb00883.x

Johri, A., & Jesiek, B. K. (2014). Global and International Issues in Engineering Education. In A. Johri & B. M. Olds (Eds.), *Cambridge Handbook of Engineering Education Research,* 655–672. New York: Cambridge University Press. https://doi.org/10.1017/CBO9781139013451.040

Jones, E. (2018). Internationalising curricula in STEM disciplines: Why, what and how? In A. Ittel & A. Meyer N. Perreira (Eds.), *Internationalisierung der Curricula in den MINT-Fächern: Konzepte, Initiativen, Maßnahmen,* 9–23. Bielefeld: WBV.

Knight, D. B., Davis, K. A., Kinoshita, T. J., Twyman, C. A., & Ogilvie, A. M. (2019). The Rising Sophomore Abroad Program: Early experiential learning in global engineering. *Advances in Engineering Education*, *7*(3).

Lewis, T., & Peters, H. (2019) Sprachen lernen im Tandem: Prinzipien & Kompetenzerwerb. In E. Spänkuch, T. Dittmann, B. Seeliger-Mächler, H. Peters & A. Buschmann-Göbels

(Eds.). *Lernprozesse im Tandem - ermöglichen, begleiten, erforschen: Beiträge zur internationalen wissenschaftlichen Tandem-Tagung in Greifswald 2017,* 11-32. Giessen: Giessen University Library Publications.

Paretti, M. C., McNair, L. D., & Leydens, J. A. (2014). Engineering Communication. In A. Johri & B. M. Olds (Eds.), *Cambridge Handbook of Engineering Education Research,* 601–632. New York: Cambridge University Press. https://doi.org/10.1017/CBO9781139013451.038

Rodríguez González, C., Bustillo Mesanza, R. & Mariel, P. (2011). The determinants of international student mobility flows: an empirical study on the Erasmus programme, *Higher Education, 62*, 413–430. https://doi.org/10.1007/s10734-010-9396-5

Spänkuch, E., Dittmann, T., Seeliger-Mächler, B., Peters, H., & Buschmann-Göbels, A. (Eds.) (2019). *Lernprozesse im Tandem - ermöglichen, begleiten, erforschen: Beiträge zur internationalen wissenschaftlichen Tandem-Tagung in Greifswald 2017.* Giessen: Giessen University Library Publications.

Strenger, N., & Schiffmann, L.-K. (2020). Why Disciplinary Culture Matters: Lessons Learned from 7 Years of Internationalization in Engineering Education. In *Proceedings of the 2020 IEEE Global Engineering Education Conference (EDUCON): Date and venue: 27-30 April, 2020, Porto, Portugal,* 222–226. Piscataway, NJ: IEEE. https://doi.org/10.1109/EDUCON45650.2020.9125357

Ulbrich, N., & Strenger, N. (2019). Internationalization @ home in Engineering Education: Enhancing Social Capital in English-taught Master´s Programmes. In *5th International Conference on Higher Education Advances (HEAd'19)*. Valencia: Universitat Politècnica València. https://doi.org/10.4995/HEAD19.2019.9391

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14514

Validation of a High-Stakes Test: GA IESOL Listening Unit

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Abstract

The purpose of this study is the validation of the GA Classic IESOL examination at CEFR level B2 (Reading, Listening, Writing and Speaking), as a criterion-referenced achievement test, using the multi-trait, multi-method approach. The data analysed at the moment pertain to the Listening unit and have been studied to examine the content validity, reliability of the scores and unidimensionality of the construct. The Listening unit consists of three tasks (22 items) in four different versions (D-E-F-G). Four separate statistical analyses were performed and all revealed excellent values of internal consistency. As for unidimensionality of the construct, excellent values were revealed for versions E, F and G and acceptable for version D. Similar analyses on the reading test are planned, with the aim of reaching a multitrait-multimethod analysis of the examination as a whole.Further steps of the study will be the IRT equating procedure of the four versions.

Keywords: *listening ability; language assessment; international examinations, validity, reliability.*

1. Introduction and Aims

Gatehouse Awards IESOL Classic exam is an internationally recognised exam of English as a foreign language, designed to assess all four language skills or abilities: reading, listening, writing and speaking, and consists of four units, each of them testing one of the abilities. The awarding body, as well as the examination, is recognised by Ofqual (The Office of Qualifications and Examinations Regulations)[1], a non-ministerial department that regulates qualifications, examinations and assessments in England. The exams are delivered in a number of countries, through the national distributors and approved examination centres.

The aim of the study is the validation of the GA Classic IESOL examination at CEFR level B2 (consisting of Reading, Listening, Writing and Speaking), as a criterion-referenced achievement test, using the multi-trait, multi-method approach (Fiske & Campbell, 1959; Bachman & Palmer, 1982). The data available at the moment pertain to the Listening unit and have been analysed to examine the content validity, reliability of the scores, as well as the unidimensionality of the construct.

2. Listening Ability as the Listening Test Construct

Most if not all internationally recognised examination boards test listening as part of their IESOL examinations. The listening unit is most often administered as a separate test. This division is likely to have been based on the first models for describing language proficiency, which distinguished skills (reading, listening, writing and speaking) from components of language (Bachman, 1990). According to Buck (2001), a description of listening ability can be used as the basis for defining the listening construct, especially when we believe that the test performance is an indicator of an underlying competence.

When it comes to foreign language testing, interest in test objectivity and internal consistency first appeared during the psychometric-structuralist era (Weir, 2005), which started in the 1960s when the first multiple-choice tests were used, as a result of the need to deliver a large number of exams each year. Theories of communicative competence and performance only appeared in the 1970s and helped overcome the shortcomings of these tests, which focused mostly on psychometric characteristics. This is when terms such as ‘authenticity’, ‘context’ and ‘criterion-referenced’ were first mentioned in relation to foreign language assessment (Morrow, 1981; Fulcher, 2000). A large number of different types of tests proposed over the years have stayed, and the existing tests most often combine the different types of items and testing approaches proposed over the years (Morrow, 1981).

[1] https://www.gov.uk/government/organisations/ofqual

The fact remains that whichever test type is used, there needs to be a well-defined test construct, which in the case of listening tests would be a description of the listening ability, since it is the ability of the test-takers that we are most often interested in (Buck, 2001). After the Council of Europe first recommended the Common European Framework of Reference as a standard of language proficiency in 2001, English language awarding bodies defined the listening ability as a listening test construct in accordance with the CEFR definition of listening and its levels. Specifically, the GA IESOL Classic B2 listening unit is mapped to the CEFR and its definition of the listening ability at the B2 level. CEFR provides global scales for each of the six levels of foreign language proficiency (A1, A2, B1, B2, C1 and C2), as well as illustrative scales for each of the abilities. The competences that successful B2 candidates need to demonstrate, as detailed in the GA Classic IESOL Specification[2], in the four domains of the CEFR (public domain, personal domain, educational domain, and occupational domain) reflect the illustrative descriptor for listening comprehension (Council of Europe, 2000, p. 66) and are as follows:

- can understand standard spoken language on both familiar and unfamiliar topics,
- can follow the essentials of lectures, talks and reports,
- can understand animated conversation between native speakers,
- can understand the main ideas of propositionally and linguistically complex speech on both abstract and concrete topics,
- can follow complex lines of argument, provided the topic is reasonably familiar,
- can understand speech delivered in a standard dialect and at normal speed.

Listening comprehension ability encompasses different types of listening (Wilson, 2008). One can listen for gist or for general idea of what is being said, or for specific information, which is when we only need to understand a very specific part. Furthermore, we can listen in detail, when, for example, we need to find errors and cannot afford to miss anything. Finally, there is inferential listening, called that way as it may involve inferring, which is what we do when we want to know how the speaker feels (Wilson, 2008, p. 10). For each of the items in the listening unit, candidates are required to employ one of the types of listening.

Content domain specification, that is examination specification, being considered a necessary requisite for the test construct and content validity (Bachman, 2002; Brown 1996) is provided in detail and includes functions and notions, grammar, discourse markers, topics and key language items for the B2 level.

[2] https://www.gatehouseawards.org/wp-content/uploads/GA-Qualification-Specification-Classic-IESOL-A1-C2-V3-1.pdf

3. Method and Participants

The B2 level listening unit consists of three tasks, with a total of 22 items. In Task 1, candidates listen to a conversation between two speakers and answer six multiple-choice questions (A, B or C) about the content of the conversation. The candidates hear the recording twice. In Task 2, candidates listen to a monologue (e.g., news, talk, presentation or instructions) and answer 8 multiple-choice (A, B or C) questions about the content of the recording. In Task 3, candidates listen to three different speakers presenting their opinions on the same subject. Candidates then match eight statements to the correct speaker. The candidates hear the recording for each of the tasks twice and are given one minute to read the questions before the recording is played.

The data set used for this study originates from the online examinations held from October 2020 to November 2021. Four forms of the listening test were administered in that period (VD, VE, VF and VG) and for each of the forms analyses have been performed. A total of 597 candidates completed a randomly assigned version: 145 candidates completed form VD, 147 form VE, 162 form VF and 143 candidates completed form VG.

Examination tasks and items are designed by trained writers, after which they are reviewed by two other trained item writers. At this stage, the item can be accepted without further changes, revised in line with the feedback provided by reviewers or rejected. At this stage, the accepted items enter the live question bank, after which test forms are designed.

4. Data Analyses

The approach to validity employed in ESOL Classic examinations is consistent with Messick's "unitary" view of validity (1995) and the principle that the validity of a test resides in the test scores and score interpretations. In addition, it is also in line with Weir's view that different types of evidence are needed to demonstrate the validity of test scores. These different types of evidence are seen as complementary and not as alternatives (Weir, 2005). While the definition of the construct addresses content validity, the statistical analyses performed address the issues of reliability, criterion-related and construct validity.

The forms were calibrated with respect to the difficulty parameter *b*, to verify the fit to the Rasch model and to identify items that might need to be amended or replaced. xCalibre 4.2 was used for the calibration. The following were estimated / calculated in this phase: the discrimination index of the items, R (Point Biserial Correlation), which expresses the correlation of an item with others of the same test version, assuming $R > 0.20$ as the lower limit value, and the main fit indices, such as the standardised residual (zResid), Infit and Outfit. According to Hambleton et al. (1991) and Agresti and Finlay (2012), items that are acceptable are the ones that have a zResid in the range of -2 to 2 and not significant, and Infit

and Outfit values between 0.80 and 1.20. In the analysed forms, only one item with an inadequate zResid value was identified. As explained in Botta (2021) the Infit index (InMSQ, Infit Mean Square) is a fit statistic that tends to assume high values when there are misfits due to students who respond correctly to difficult items but not to easy items, or alternatively to easy and difficult items, it is consequently high even in items with low discrimination. Index values greater than 1 indicate misfit to the model and undermine the validity of the measure. Values lower than 1 indicate a local deficit in stochastic variability; low but not extreme values do not disturb the significance of the measure. Values greater than 1 indicate underfit, the real data are not very predictable from the model and generally lower than that estimated by it, while values lower than 1 indicate overfit, the real data are higher than that estimated by the model. In our case, as can be seen in table 1, items with a high Infit index are very rare. The more frequent ones, which, however, do not influence the validity of the measurement significantly, are items with low mean-squares. We can therefore say that, despite a low number of items, as a whole, the examination versions fit the model.

Table 1. Data analyses summary

Form	Number of Items	Number of Candidates	b_{min}	b_{max}	Cronbach's Alpha	Number of Items with discrimination R < 0,20	Number of Items with Infit > 1,2
VD	22	145	-1.64	2.78	0.807	3	1
VE	22	152	-1.12	2.82	0.818	3	3
VF	22	162	-1.39	2.10	0.843	2	1
VG	22	143	-1.82	1.46	0.727	7	0

Since this IRT model, as well as many others (Bachman, 1990) assumes that the items in the test measure a single or unidimensional ability or trait, EFA (Exploratory Factor Analyses) were performed to evaluate the dimensionality of the data, to confirm that the listening unit item responses form a unidimensional construct according to the Rasch model. As explained by Botta (2021) and Barbaranelli and Natali (2005) for unidimensional constructs, Cronbach's alpha value needs to be high, however, the opposite is not always true. This means that a high value of Cronbach's alpha is not the only indicator of unidimensionality and does not guarantee the unidimensionality of the construct on its own.

EFA were conducted on the data set, one for each version. Considering that all the items are dichotomous, with two possible item scores: correct (1) and incorrect (0), MPLUS 7.1 software was used for EFA (Muthén e Muthén, 1998-2010), which uses a specific procedure for the analysis of categorical data. For all four forms of the test, the analyses performed confirm the hypothesis of a single factor.

Table 2. EFA Results for each of the four versions

Version	RMSEA	RMSEA CI INF	RMSEA CI SUP	RMSEA Probability <= 0.05	CFI	TLI	Ratio between first & second eigenvalue (L1 / L2)	Number of items loading 0.30
VD	0.062	0.049	0.075	0.067	0.843	0.826	3.115	1
VE	0.029	0.000	0.047	0.978	0.963	0.959	3.612	2
VF	0.023	0.000	0.041	0.995	0.986	0.985	5.126	1
VG	0.016	0.000	0.039	0.997	0.977	0.975	2.630	3

As we can see, only version D has marginally acceptable goodness of fit values, while the other three versions have excellent values of RMSEA (Root Means Square Error of Approximation, Steiger & Lind, 1980; Steiger, 1990), CFI (Comparative Fit Index) and TLI (Tucker and Lewis Index). An RMSEA lower than 0.05 indicates a low error of approximation and shows that the model can relatively predict the data accurately, while values in the range of 0.05 to 0.08 indicate an acceptable level of error of approximation are considered an indication of fair fit. As regards CFI and TLI, values greater than 0.95 indicate relatively good model-data fit, while a CFI and TLI lower than 0.90 indicate a poor model-data fit. Furthermore, in all four forms, there are only few items with low factor loading while the scree plot confirms that there is only one factor in the data set.

Considering it is a criterion-referenced test, it is also evident that the distribution of students' skills and item difficulty tend to be misaligned so we can assume that a large part of students decide to take the examination once they have prepared themselves appropriately and thoroughly for CEFR B2 level, which is awarded to the candidates who reach 55% in each of the units, listening included.

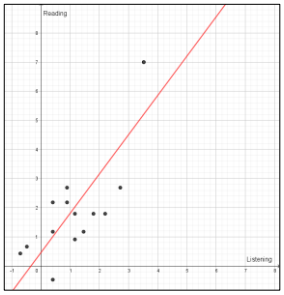

Figure 1. Correlation Listening – Reading Theta

With regard to criterion-related validity, a correlation analysis with reading tests was performed. The subsample of subjects who took the same reading test, (N = 16), was extracted for the F version. A comparison of the values of the ability parameter (θ) in listening and in reading, revealed a correlation coefficient equal to 0.811, as illustrated in Figure 2.

5. Conclusion

As already stated, the purpose of this study is the analysis and validation of a set of B2 level English language tests (listening, reading, writing and speaking). Validation of a test is essential whenever a new one is designed, especially when it comes to high-stakes examinations such as internationally recognised certifications. However, as both Messick (1992, as cited in Weir, 2005) and Weir (2005) maintain, not many test makers actually provide validity evidence or perform validation studies.

Validation is a continuous process meant to start together with the examination design. Schilling (2004) and Weir (2005) underline the importance of verifying the validity a priori, during the construct description phase, stressing that the more accurate the description of the construct one intends to measure, the more significant and reliable the validation statistical analyses will be and can consequently be used in the interpretation of the test results.

For this reason, it was decided to analyse the four versions of the examination in question in terms of the validity of content and construct, to verify their internal consistency and reliability. Four separate statistical analyses were performed and revealed excellent values of internal consistency for all four versions. As for unidimensionality of the construct, excellent values were revealed for versions E, F and G and acceptable for version D. The unidimensionality identified in the construct allows us to exploit all the properties of invariance that the Rasch model makes available and, since the sample was randomly selected and versions randomly assigned to the candidates, the identified differences between the four groups of candidates can be attributed to chance.

One of the next steps of the study will be the IRT equating procedure of the four versions. Similar analyses on the reading test and other units are planned, with the aim of reaching a multitrait-multimethod analysis of the examination as a whole.

References

Agresti, A. & Finlay, B. (2012). *Metodi statistici di base e avanzati per le science sociali. Milano:Pearson*

Bachman, L. F. (1990). *Fundamental considerations in language testing.* Oxford: Oxford University Press.

Bachman, L. F. (2002). Some reflections on task-based language performance assessment. *Language Testing, 19*(4), 453-476.

Bachman, L. F., & Palmer, A. S. (1982). The construct validation of some components of communicative proficiency. *TESOL Quarterly, 16*(4), 449-65.

Barbaranelli, C. & Natali, N. (2005). *I test psicologici: teorie e modelli psicometrici*. Roma, Carocci editore SpA

Botta, E. (2021). *Sperimentazione di un modello adattativo multilivello per la stima delle abilità in matematica nelle rilevazioni su larga scala*, Roma: Nuova Cultura

Brown, J. D. (1996). *Testing in Language Programs.* Upper Saddle River, NJ: Prentice Hall Regents.

Buck, G. (2001). *Assessing listening*. Cambridge: Cambridge University Press.

Campbell, D.T. & D.W. Fiske., D.W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin* 56, 2:81-105

Council of Europe (2001). *Common European Framework of Reference for Languages: Learning, teaching, assessment.* Retrieved from: http://www.coe.int/t/dg4/linguistic/source/framework_en.pdf

Fulcher, G. (2000). The 'communicative' legacy in language testing. *System 28*(4), 483-497.

Hambleton, R. K., Swaminathan, H. & Rogers, H. J. (1991). *Fundamentals of Item Response Theory*, Sage Publ.

Messick, S. (1992). Validity of test interpretation and use. In M.C. Alkin (ed.), *Encyclopedia of Educational Research* (6th edition). New York: Macmillan.

Messick, S. (1995). Standards of validity and the validity of standards in performance assessment. *Educational Measurement: Issues and Practice, 14*(4), 5-8.

Morrow, K. (1981). Communicative language testing: revolution or evolution? In Brumgit, C. J. and Johnson, K. (Eds), *The communicative approach to language teaching* (143-57). Oxford: Oxford University Press.

Muthén, L. K. & Muthen, B. O. (1998-2010). *Mplus User's Guide. Sixth Edition,* Los Angeles, CA: Muthén & Muthén

Schilling, S. G. (2004). Conceptualizing the validity argument: An alternative approach. *Measurement*, *2*, 178-182.

Steiger, J. H. & Lind, C. Statistically based tests for the number of common factors, *Annual meeting of the Psychometric Society*, Iowa City, IA, 1984.

Steiger, J. H. (1990). Structural Model Evaluation and Modification: *An Interval Estimation Approach, Multivariate Behavioral Research 25*(2), 173-180.

Weir, C. J. (2005). *Language testing and validation: An Evidence-Based Approach.* Basingstoke: Palgrave Macmillan.

Wilson, J. J. (2008). *How to teach listening*. Pearson Longman.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14678

Service-Learning Courses as the Way to Promote Gender Equality and Inclusion in the Higher Education

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Abstract

In the epoch of COVID-19, it is essential to gather social memory of this unprecedented event and to preserve the voices of mothers whose lives the pandemics had significantly disrupted. Remote work affected mothers, and it is an alarming trend that many achievements for women equality for career building are now jeopardized by the ongoing childcare crisis triggered by COVID-19. My service-learning courses require my students to conduct interviews of female faculty and staff members of Oklahoma City University (where I teach) and then reflect on significant challenges which the COVID-19 pandemic imposed on women. In my presentation, I will address the philosophy behind offering such a course and assignments which students complete for this course.

Keywords: *Experiences outside the classroom; gender equality; motherhood.*

1. Introduction

In the epoch of COVID-19, it is essential to gather social memory of this unprecedented event and to preserve the voices of mothers whose life the pandemics had significantly disrupted. To promote civic engagement of my students in understanding the impact of the pandemic on gender equality in the higher education, I have transformed two of my courses, *History 1103*, *U.S. History since 1876*, and History 1303, *World history since 1500*, to courses including a service-learning component. These courses traditionally have a high enrolemnt. Service-learning projects in these courses allow to build a platform for saving the voices of mothers employed at OCU during the pandemics. My service-learning courses require my students to conduct interviews of female faculty and staff members of Oklahoma City University (where I teach) and then reflect on significant challenges which the COVID-19 pandemic imposed on women. In my presentation, I will address the philosophy behind offering such a course and assignments which students complete for this course.

2. How the Pandemic Affected Female Faculty Members

Even in families where both spouses work in academia, caretaker responsibilities and responsibilities of educating children when schools are online are disproportionally on the shoulders of women. Remote work affected especially mothers, especially those raising their children alone, and / or raising children with disabilities. It is a truly alarming trend that many achievements for gender equality in terms of the number of women at workforce and women's opportunities for career building are now jeopardized by the ongoing childcare crisis triggered by COVID-19. Even in families where both spouses work in academia, caretaker responsibilities and responsibilities of educating children when schools are online are disproportionally on the shoulders of women. Statistically, the number of submissions to academic journals from female authors had dramatically declined, when, on the contrary, male authors have increased their submissions to academic journals. COVID-19 has redefined the learning process forcing the female faculty to develop online instruction in the middle of the semester, to transform traditional on-campus courses to online courses, and to juggle constantly professional responsibilities and responsibilities of taking care of their children when schools moved to on-line learning, or when their children were sent---very often—abruptly to quarantine. The worst aspect of this problem is that women are so overwhelmed by ongoing crisis that many of them do not have any time, energy, and resources to express their concerns and to act as the active advocates for finding solutions for this crisis. Service-learning components in my undergraduate courses helped students to become aware of child care crisis and to preserve the voices and testimonies of women who balance the responsibilities of motherhood and their commitment to excellence in teaching, research, and service to the professional world.

3. Service-learning components and learning outside the classroom

For service-learning, students have composed groups (from 2 to 4-5 students) that allowed them to develop skills to work in teams, to collaborate, and to bring their diverse interdisciplinary perspectives in conducting research on women. After consulting scholarship on oral history, students had articulated questions for interviews. One of the key purposes of this history course is to teach students how to gather primary sources for research and how to interpret, analyze and to create a narrative based on such primary sources. By conducting interviews, transcribing them and interpreting them students had deepened their understanding of history and the craft of historians. Then the students had approached a faculty member or a staff member. After conducting interviews, they needed to submit transcribed interviews. Then groups needed to present in class on overall problems which mothers face in the US. Groups also developed analytical papers on motherhood in the U.S. before and during COVID. This project helped students to become aware of a necessity for serious reforms in child care, public health system and support of working mothers. As a transcription of interviews is a time consuming process (it can take up to seven-ten hours to transcribe an one hour-interview), every student in my course will be involved in gathering such primary sources and every student will provide at least ten hours (and more) of service for OCU.

In addition, the goal of our community partner, Archives of OCU located at Dulaney-Browne Library, is to preserve the institutional memory of OCU. This experiential learning contributes to the creation of institutional memory of OCU during COVID-19. Students have acquired a better understanding of the key role of the archives of OCU in preserving the institutional memory of OCU and the broader role of OCU as the essential resource for providing intellectual and social support for the community and for promoting diversity and inclusion in the State of Oklahoma. As the world has been experiencing the deep crisis of the pandemic, OCU has been the source of support – intellectual, social, emotional- for its students, faculty, and staff and community by continuing its mission of supporting faculty coming from diverse perspectives. As our learning community is encountering the challenges of COVID-19, the public image of OCU and its history for the next generations will greatly gain and benefit from preserving and recording the everyday struggles and everyday heroism of women, our colleagues whose responsibilities of both caregivers and educators have risen exponentially during the pandemics and when no traditional venues for support (child care) was either available or safe because little is known about ways COVID-19 affects children. The archives and public memory of OCU need to preserve the voices of women-mothers during COVID-19 also because the pandemics make it so difficult for women to have energy and strength, time and resources to have their voices recorded, heard and not forgotten.

The learning outcomes of the service component are students' new skills in conducting an interview and, broadly, their learning of the methods of oral and public history. Another set

of the learning outcomes are the development of students' skills in speaking, writing, critical thinking, interpreting and synthesizing material, understanding interdisciplinary approaches in examining society as this project will require them to read peer-reviewed work in history, philosophy, women's study, gender theory, sociology, and feminism. Learning outcomes are assessed by the quality of their transcribed interview and a paper which will be graded, also with a help a rubric. The service-learning component will also develop students' broad understanding of gender equality, demands of combining motherhood and of a professional career, necessity for self-advocacy and struggle for women's rights.

4. Civic Engagement and Commitment to Gender Equality

I have accumulated a collection of over fifteen transcribed interviews with the faculty and staff members of OCU the most of which will be deposited in our University's library archives. When students compose questions, they engage themselves in a dialogue with the faculty and, very importantly, develop emphathy towards multiple responsibilities which the female faculty have. Many students who interviewed female faculty and staff members were astounished to realize how many obligations the mothers have. The students had expressed their new sense of appreciation of that the female faculty and staff members still make their teaching and the priority and that students had never felt the duties of motherhood took away attention from students. The students shared that they would no longer take for granted how much the faculty is doing for them and that conducting the interviews was the an eye-opening experience for them. It is the essential lesson that the students will take from the service-learning course. These days many critiques point to "empathy fatigue" when the faculty had to do all kinds of adjustments during the COVID-19 and when students would rely on their faculty for all kind of emotional and psychological support. The project had revealed to the students that the students need to have a great deal of understanding and empathy to the faculty as well.

This service-learning project taught my students many skills, including the art of composting meaningful questions which invite for open-ended responses. Below are questions from one of the interviews: "If you had, like, a sort of game plan once COVID hit, what was your plan to make your family situation work out, and your home situation, kinda go smooth and as successful as possible once COVID hit? … Did you ever find yourself … kind of just finding yourself in a situation where you would try new things, and it seems like nothing else was going to work?... And one last final question from me, if you had to go back and experience quarantine again, what would you do differently? Like how would you approach it, and whatwould you do the same? Are there any positive changes that you've had to make to your lifestyle from COVID that you think you might keep when the quarantine is over? Like, from the extra time that you guys have together, or anything like that, that you've enjoyed from COVID? What ways have you discovered have been useful in kind of helping your child

understand what's going on in the uncertainty of everything?" (interview conducted on March 3, 2021 for History 1103.) When conducting the interviews, students would learn that the pandemic made especially difficult the duties of taking care of children because schools switched to a remote format in the middle of the semester. When in the field of the higher education we associate this switch with zoom and with an opportunity to provide synchronous instruction, in some public schools teachers would only send assignments and would respond via e-mail to students and parents' questions. It means that explaining a subject to children especially, if students were in elementary or middle schools would be on the shoulders of mothers (mostly.) In addition, several female faculty and staff members have shared that their husbands would remain working outside of their homes and would not be able to contribute much to educating their children when schools were in remote format. One of the faculty members confessed that it was exceptionally stressful to combine all obligations in the absence of a help from relatives who, due to lockdown, would not be able to provide any kind of relieve to mothers.

Female faculty and staff members also shared their frustations with the increased social expectations from American mothers. One of the interviees has confessed that despite the immense advances of feminism and ways how household duties are now expected to be divided between spouses, when her relatives and friends were visiting her house during lockdown, she felt guilty that her son, a toddler, would not have a perfect order in his room. Still, in 2020, unspoken assumptions were that it is women's responsibility to keep the house look impeccable – no matter what kind of the COVID-19 pandemic, the unprecedented public health catastrophe, may happen outside of the very house at this very moment. At the top of it, as children were spending all their time at home, it was a near improbable task to keep the house very tidy. Children would also require much more time commitment as far as meal preparation and cooking would concern. Because they were not in schools anymore, mothers would have to indulge children's growing appetite for it is a very well known fact that the pandemic made people eat more to alleviate constant anxiety, fear and uncertain future. One of female faculty members shared that children would demand much more attention from their parents and would become much "clinger." Interviees would also express their frustration with the proliferation of social media content on "perfect" mothers who would re-design their homes to make an inviting learning space for their children, would make videos of cooking extraordinarily difficult meals, and would develop multi-layered activities for children. All these picture perfect stories, photos and videos could make any mother who was juggling her professional duties and duties of motherhood feel quite lagging behind. For at the top of these idyllic and often sentimental images of happy mothers lies a very disturbing reality of being a mother in the U.S.

In the U.S., even before the COVID disrupted the lives of mothers, mothers have less legal rights and protections than in many other prosperous countries in the world. First of all, there

is no universal free medical insurance in the U.S. as it is the case for many other countries. From the moment a woman starts to expect the child, she is becoming dependent on medical insurance either through her employer or her spouse. There are no laws protecting mothers' rights at a workplace in the U.S.. Historically, women-mothers and, especially, single mothers are often expected to let go first during economic recession. There is an ongoing shortage of child care facilities in the U.S, and women seeing to balance their professional careers and motherhood need to be pay a very careful attention to crafting their public image: to put it bluntly, motherhood is a liability in the U.S. Women have to be very careful about projecting their public image at the workplace and remembering that "motherhood is not an excuse" for whatever comes to her life whether it is a sudden 10-day quarantine on which a child can be put in his/her school with no notice due to exposure to COVID (and I am referring now to my own personal experience as the mother of a student in an elementary school in Fall 2021) or expectations that an employee can easily attend an evening or weekend activity. It is the theme which Andrea O'Reilly is exploring in her multiple books on motherhood.

Service-learning projects help student to develop historical skills of gathering and interpreting primary sources and creating a historical narrative. The service-learning component of the courses reflects and incorporates my courses objectives in the following way. Among key learning objectives of the courses is to examine "how the marginalized and disaffected have struggled to ensure that America fulfills its promise" (J.Roark) of equality, citizenship, and political participation. The experience of women and mothers represents an essential component of the courses. In addition, the important learning objective of the courses is to introduce students to the recent research methods of oral, public and digital history and to develop their digital literacy.

References

Fairlie, R. W., Couch, K. A., Xu, H., & National Bureau of Economic Research. (2021). *The Evolving Impacts of the COVID-19 Pandemic on Gender Inequality in the U.S. Labor Market: The COVID Motherhood Penalty*.

International Conference on Higher Education Advances, Domenech, J., Merello, P., & Poza, E. (2021*). 7th International Conference on Higher Education Advances (HEAd'21), Valencia, Spain, June 22-23, 2021.* Valencia: Universitat Politècnica de València.

O'Reilly, A. (Ed.). (2014). *Mothers, mothering and motherhood across cultural differences : a reader*. Demeter Press.

O'Reilly, A. (2010). *Twenty-first-century motherhood : experience, identity, policy, agency*. Columbia University Press.

Roark, J. L., Johnson, M. P., Furstenberg, F., Cohen, P. C., Stage, S., Hartmann, S. M., & Igo, S. E. (2020). *The American promise: A history of the United States*.

Cui, R., Ding, H., & Zhu, F. (2022). Gender inequality in research productivity during the covid-19 pandemic. *Manufacturing & Service Operations Management*, *24*(2), 707–726. https://doi.org/10.1287/msom.2021.0991.

Sheffield, E. C. (2011). *Strong community service learning: Philosophical perspectives*. New York: P. Lang.

Starostina, N. (2015). *Between memory and mythology : the construction of memory of modern wars*. Cambridge Scholars Publishing. Retrieved April 25, 2022.

Starostina, N. A. (Ed.). (2014). *Memory and mythology : modern war and the construction of historical memory, 1775-2000*. Academica Press.

Starostina, N. (2015). The construction of a new émigré self in 20th-century russian paris in short stories by nadezhda teffi. *Canadian Review of Comparative Literature / Revue Canadienne De Littérature Comparée*, *42*(1), 81–93. https://doi.org/10.1353/crc.2015.0001.

Starostina, N. *Personal collection of interviews of female faculty and staff members* (in the process of transition to Dulaney Browne Library's of Oklahoma City University.) (Starostina's personal contact information:

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14354

SPOC and flexible language learning with Moodle: the experience at the University for Foreigners of Perugia

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Abstract

Engaging learners with targeted pathways in a language course can present many challenges in both selecting learning contents and assessing student skills. In this context, Learning Management Systems (LMSs) represents a big opportunity, by offering solutions capable of reaching a wide range of needs and characteristics. This paper describes some examples in creating a Small Private Online Course (SPOC) of Italian language for academic purposes at the University for Foreigners of Perugia, focusing on the tools available on the Moodle platform to help students to achieve their goals and to support teachers in gathering information on the learning dynamics and interventions to be implemented. The aim is to disclose perspectives on the developments of language education and on the potential of the Moodle LMS as a flexible learning environment, outlining some future lines of research.

Keywords: *SPOC; language learning; flexible learning; Moodle; Italian for academic purposes.*

1. Introduction

In the last decade, with the growing diffusion of the Internet and application programs, we have witnessed a significant increase in the use of Information and Communication Technology in training. In particular, a phenomenon that has attracted the attention of researchers is represented by MOOCs (Massive Open Online Courses), that have made a valuable contribution to the dissemination and democratization of knowledge thanks to the offer of free training potentially reachable by an unlimited number of users (UNESCO, 2002). These courses had an exponential success and it is precisely in 2012 that the three most influential were bors: Coursera, edX and Udacity. Many universities worldwide have collaborated and continue to collaborate with the three and with other platforms in order to make culture accessible to a great audience. Indeed, scalability allows universities on one hand to make investments to spread education, on the other hand to acquire a considerable visibility, allowing even geographically distant students to approach and potentially enroll more consciounsly in the on-site courses. However, research has shown that just a small proportion of participants go on to complete the courses and that there are many issues to face to foster the cross-cutting competencies of the students. As stated by Lane and Kinser (2012), most of the massive courses are based on a trasmissive model, and the risk of "McDonaldization"of education is high; furthermore, in the teaching practice in academic contexts does not seems to have big results: compared to the traditional teaching model, the number of students in a MOOC is infinitely broader and managing the questions and answers and the forum space becomes a very difficult challenge to face (Guo, 2017).

In 2013, Armando Fox, a professor of Computer Science and Electrical Engineering at the University of California at Berkeley, coined the acronym SPOC referring to the online courses used with on-campus students as a supplement to face-to-face learning, arguing that such training improve teachers skills and students productivity, self-confidence, engagement and outcomes (Fox, 2013). In the context of language learning, the potential of SPOCs is supported by several studies (Chen, 2019; Li et al., 2019), as they can offer students' access to authentic, interactive and motivational educational material through which they can explore new forms of language, learn about the culture of the target language and in general practice and acquire language skills, respecting individual learning styles and supporting face-to face and online learning and interaction.

SPOCs use online features as course materials in college classrooms: by assigning lessons as homework, teachers are free to spend traditional lesson time answering students' questions, monitoring their learning and the key factors that could hamper the training process (Dringus & Ellis, 2005; Ferguson, 2013), customizing the pace and grading system according to the needs of the students. Moreover, this kind of courses support blended learning and flipped classroom learning, which variously combine online resources and technology with personal

engagement between faculty and students, and can prevent hidden guests bacause students are called to log in the platform with the real identity.

The main objective of this study is therefore to outline the tools of Moodle LMS useful for students and teachers to enhance learning opportunity in a language course, describing our experience in the design and implementation of an online Italian course for academic purposes designed as a localized instance of a traditional MOOC (Kaplan & Haenlein, 2016).

2. Methodology

Undoubtedly, there may be greater difficulties in carrying out the activities required by the academic context in a language very different from individual mother tongue. Furthermore, it is important to underline that the language for academic purposes has specific peculiarities linked to textual, morphosyntactic, pragmatic and cultural norms. Hence, we have devised an online Italian language course for academic purposes, open to the whole University for Foreigners of Perugia community, in order to support the skills of our students, organizing our work in 3 different phases that will be described in the following.

2.1. Design of the course

The dynamics related to the context in which students interact were examined, and we opted for the creation of contents to be integrated into open and flexible paths that allow learners to start a gradual self-training path, providing online resources to support individual learning. This solution is designed to support on one hand the learning of students that for various reasons are unable to attend lessons, and on the other hand students who attend lessons regularly, adopting methods and strategies typical of self paced learning, flipped classroom, blended learning and cooperative learning. Furthermore, The University for Foreigners is by its very nature an international university and in this sense the pedagogical approach may favor a better general understanding for students who come from other countries, that may have the opportunity to personalize their learning and be more motivated, due to the flexibility of use of the contents that the type of course offers (Sbardella *et al*., 2019).

The course is conceived as an innovative activity of orientation and preparation of students to face the challenges of communication in the university environment. Linguistic-communicative skills and general study skills related to the different subject areas are gradually developed, strengthening the specialized lexicon, textual skills and sectorial communication skills. The aim is to provide pragmatic, sociocultural and linguistic tools useful for managing the communication of disciplinary contents and for addressing and constructing various textual types by developing particular communication skills typical of the academic context, such as: summarizing, describing, augmenting, classifying, exposing, concluding, which represent the six learning units on which the course is structured.

The course has a 8 weeks duration and remains open for about three months after its conclusion; 2 to 3 hours of commitment are foreseen for each module and an access key is provided at the time of registration. It consists of the learning units mentioned above, introduced by a first section, which explains the aims of the course and presents general information on the various activities proposed. A specific section is designed to allow students to familiarize with the interactive tools of the platform and to break the ice, starting the activities launched by a Padlet, in which all the members of the community can introduce themselves and exchange mutual information.

The path suggested after the introductory phase is outlined in several steps, but students will be able at any time to personalize their learning by developing one content rather than another, choosing the path more suitable to their needs. In each thematic area, an itinerary is developed that provides the exploration of textual files, in-depth studies and exercises, while the last section is devoted to assessment activities. For each unit, a final test is proposed, presenting respectively: a self-assessment form, with questions on the perception of what has been learned, where the answer must be expressed according to a Likert scale, a final test, and a final task, that requires a peer evaluation. The peer evaluation choice is due to the fact that during this process, students take an active role: by analyzing the work produced by one or more colleagues, they inevitably reflect on their work, strengthening their disciplinary knowledge while observing different ways to accomplish the same task (Boud & Soler, 2015; Boud & Molloy, 2013).

2.2. Implementation in the Moodle platform

The educational path is provided within the Moodle platform, that allows students to carry out the activities foreseen by the course also in parallel with the classroom lessons, customizing learning spaces and times and making use of online support on demand. Moodle provides support for teaching activities through a very broad and articulated set of tools. It is an easy-to-use platform where navigation is fluid and immediate. The default appearance of Moodle is easily customizable, and its open source approach allows for continuous improvements to meet the current and evolving needs of its users, as well as greater security for their personal data. It is a an organized system built on a set of tools oriented to five macro-contexts: the administration of user enrollment in the course, the management and delivery of contents, the management of evaluation activities, the management of communicative and collaborative processes the management of evaluation processes.

By implementing the course, we took into account the usability, the attractiveness of the graphic aspect, the ease of the operational tools and the articulations of the educational path, caring that each language skill could be exploited and achieved. Among the different features, the quiz-making function has been analyzed. Moodle's functions provide the possibility to create different types of quizzes. In our specific context, the relevant quiz types are: Multiple

choice, True/False, Matching, Drag and Drop, Description, and Cloze. A broad range of options allowed us to arrange the items in random order, to set up the time frame for availability, to pre-set feedback, to control the display of the correct answers, to determine how many times students may take the quiz and to establish the score.

In order to elicitate learners' previous knowledge, we decided to use the choice activity, that allows to set options through which students can select from a series of possible answers. The system remembers the choice and at the end of the path the students can go back and check if their previous knowledge was correct.

To facilitate the autonomous understanding and implementation of the proposed teaching activities, each communicative situation offers online support tools, such as in-depth sheets and glossary activity. The hypertextual architecture provides a transversal use of the educational path, allowing a personal approach to learning and a guide to the implementation of the activities and exercises. At the end of each activity, the system allows to automatically obtain the correction, the solution of the exercises and the score attained by the user.

Forums are the main peer communication tool within the course, and were created to encourage interaction, discussion and to develop a sense of community. These spaces are used to allow participants to get in touch each other, discuss the contents or in depth study of the course, giving continuity to a problem encountred during face to face sessions, and to extend activities, e.g. proposing problems that students can evaluate in order to develop debate, critical thinking and suggest solutions. In other words, it is a space created to allow a continuous comparison within a community of learners oriented towards the development of collective intelligence, understood as the amplification of the human capacity to co-construct knowledge online (Levy 1996).

The assessment is organized with a first feedback activity used as a self-evaluation tool. For each of the six units, students are required to answer questions on the degree of confidence perceived in the different linguistic-communication skills. Subsequently, a quiz with multiple choice items is provided, which includes the topics already covered in the reference unit. Finally, a workshop activity is planned and oriented towards peer evaluation. Through five different phases, students move from one phase to another. The five phases are: setup, submission, assessment, grading evaluation, closure. Students are required to put in place a strategy to produce an original text in line with the reference unit, and their work will be evaluated by their colleagues. At the same time, they will have to evaluate the work of peers with a comment, thus showing the assessment knowledge developed.

2.3. Learning Analytics

Moodle allows the use of Learning Analytics (LA), i.e. the measurement, collection, analysis, and interpretation of data about students and their contexts. The exploitation of the software

algorithms is fundamental as it provides valuable information on what really happens in the learning processes, and offers teachers detailed indications on possible ways of intervening to make improvements, in order to understand and optimize both learning and the environments in which it takes place (Gašević et al., 2015).

Within LMS, such as Moodle, students have access to teaching materials, interact in a forum, submit assignments, perform activities such as viewing schedules, assessments and information, creating video or audio content, taking advantage of course content and generating at the same time a large amount of valuable data for evaluating their commitment and progress. The analysis of such data is a relevant process, allowing to provide learners with a personalized experience meeting their needs: it is in fact possible to obtain information on their learning habits, adapt content based on progress and provide real-time feedback that allow them to monitor their progress, thus promoting adaptive learning (Long & Siemens, 2011). LA also provides indications on which students need additional support to achieve their goals during the training process: the analysis of activities related to participation may help to identify the least motivated students in a given area (Siemens, 2013).

Teachers may have access to important information on the types of resources with which students interact more frequently, managing to evaluate which types of interventions are most functional to the various educational goals. In addition to providing data on progression and predictive indicators of students' problems, LA may also be useful to identify indicators of more complex phenomena such as the construction of knowledge, the sense of belonging to a learning community, creativity, and self-learning (Macfadyen &. Dawson, 2010). All this information will be exploited, at the end of the course, for measuring the impact of the learning activities and of the entire learning pathway.

3. Preliminary results and discussion

The course is still ongoing, and preliminary data show that all the academic community, i.e both the students who learn in pace and the students who are attending in presence are engaged, appreciating the digital resources and actively participating in the online virtual environment. The main result of our work is the development of a set of digital tools taking into account the benefits of flexible and personalized learning. As stated in the previous sections, each learning unit contains tools provided by the Moodle LMS geared to enhance interactivity and autonomous exploration. In the quiz activity, automatic feedback has been set based on the answers given by the students, with the aim to provide a guided analysis that will help them to deepen their favorite content and to autonomously analyze language functions. Forums have been exploited for guided written productions and to address sociopragmatic aspects in the academic context, and the participation and the quality of the various interventions contribute to determining the final score. Other tools, such as choice

and feedback activities, have been used respectively to elicit previous knowledge and to self-assess outgoing competences to foster students awareness about their skills. The final peer evaluation will provide students with the opportunity to test themselves in the role of evaluators, enhancing one of the most important cross-cutting skill, i.e. the ability to create, use and apply evaluation criteria to make decisions.

4. Conclusions

As part of the development of open educational content delivered online, the creation of innovative and integrated models adapted to the different needs and characteristics of students is key to fostering learners' skills. Based to this stong conviction, we deem it appropriate to deepen the knowledge of SPOCs and its impact on training, investigating the effects on the channels of students participation, their motivation and satisfaction in terms of didactic and academic outcomes. In this paper we described the first stages of our course, presenting some initiatives aimed at enhancing the linguistic and communicative skills of our students in the academic context exploiting the functionalities of the Moodle LMS. In a future perspective, LA will allow us to have detailed data, which will be used to evaluate and eventually improve the quality of the learning experience.

References

Boud, D., & Molloy, E. (2013). Feedback in Higher and Professional Education. Understanding it and doing it well. Abingdon: Routledge.

Boud, D., & Soler, R. (2015). Sustainable assessment revisited. Assessment & Evaluation in Higher Education, 41(3), 400-413. doi: 10.1080/02602938.2015.1018133

Chen, J. (2019). Exploration and application of SPOC-based blended teaching mode in comprehensive English course. Journal of Phsyics.: Conf. Ser. 1237(2):022115. doi: 10.1088/1742-6596/1237/2/022115

Dringus, L. P. & Ellis, T. (2005). Using data mining as a strategy for assessing asynchronous discussion forums. Computers & Education, 45(1), 141-160. doi: 10.1016/j.compedu.2004.05.003

Ferguson, R. (2013). Learning analytics: drivers, developments and challenges. International Journal of Technology Enhanced Learning, 4(5), 304–317. doi: 10.1504/IJTEL.2012.051816

Fox, A. (2013). From MOOCs to SPOCs, Communications of the ACM, 56(12), 38-40. doi: 10.1145/2535918

Gašević, D., Dawson, S., & Siemens, G. (2015). Let's not forget: Learning analytics are about learning. TechTrends, 59, 64-71. doi: 10.1007/S11528-014-0822-X

Guo, P. (2017). MOOC and SPOC: which one is better? Eurasia Journal of Mathematics, Science and Technology Education, 13(8):5961-5967. doi:10.12973/eurasia.2017.01044a

Kaplan, A. M. & Haenlein, M. (2016). Higher Education and the Digital Revolution: About MOOC, SPOCs, Social Media, and the Cookie Monster. Business Horizons, 59(4), 441-450. doi: 10.1016/j.bushor.2016.03.008

Lane, J. & Kinser, K. (2012). Moocs and the McDonaldization of Global Education. Chronicle of Education. Retreived on January 30th 2022 from http://chronicle.com/blogs/worldwise/moocs-mass-education-and-the-mcdonaldization-of-higher-education/30536

Levy, M. (1996). L'intelligence collective. Pour une anthropologie du cyberspace, Paris, La Découverte.

Li, M., Qi X., Song, M., & Li, Y. (2019). The Feasibility Study of Blended English Teaching Based on SPOC. Proceedings of the 4th International Conference on Contemporary Education, Social Sciences and Humanities, 329, 4. doi: 10.2991/iccessh-19.2019.133

Long, P. & Siemens, G. (2011). Penetrating the fog: analytics in learning and education.

Educause Review, 46(5), 31-40. doi: 10.17471/2499-4324/195

Macfadyen, L. & Dawson, S. (2010). Mining LMS data to develop an early warning systems for educators: A proof of concept. Computers & Education, 54(2), 588-599. doi: 10.1016/j.compedu.2009.09.008

Sbardella, T., Santucci, V., Biscarini, C., Spina, S., Bolli, G. (2019). Raising Lifelong Learning Skills Using Learning Technology at the University for Foreigners of Perugia. Proceedings of the 2nd International Conference on Education Technology Management ICETM 2019, 54-57. doi: 10.1145/3375900.3375920

Siemens, G. (2013). Learning Analytics: The Emergence of a Discipline. American Behavioral Scientist, 57(10), 1380-1400. doi: 10.1177/0002764213498851

UNESCO. (2002). Forum on the Impact of OpenCourseWare for Higher Education in Developing Countries. Retreived on January 30th 2022 from: https://unesdoc.unesco.org/ark:/48223/pf0000128515

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14668

Pedagogy and new humanism at the time of Covid

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Abstract

Schools, society as a whole, have been deeply affected by the emergence of Covid19. The shift to distance teaching and learning has exacerbated many pre-existing vulnerabilities and inequalities in education systems. This paper argues for the urgency for school systems to accept new challenges in training, organising inclusive environments towards the promotion of collective social and critical capacities, in synergy with the digital within a school that broadens its horizons, its classrooms, capable of bringing in human riches, assuming the richness of the student as a unique and unrepeatable subject who develops thanks to the relationship with the other, capable of transformative resilience, which looks at the human becoming by virtue of the encounters of places, including virtual ones, that are experienced in the course of life. A school pervaded by a new humanism, the only true wealth.

Keywords: *Covid-19; Distance Teaching and Learning; Inequalities; School Organization; Teacher Education; New Humanism.*

1. Liquid learning in contemporany society

The reflections contained in this contribution are aimed at laying the foundations for rethinking training, where the contribution of digital technology cannot be considered only as an instrumental competence, but must also be seen in a pedagogical key with respect to the new emerging humanism.

These considerations are generated by the rapid changes inherent in our society and by the progressive consolidation of the liquid society, widely predicted by the Polish sociologist Zygmunt Bauman, which today is called upon to reflect organically on the effects that liquidity, unpredictability, the unexpected, disorder and pandemic produce in terms of the formation of the individual. The trust in the effectiveness of so-called traditional educational paths has been progressively abandoned and the urgency of transforming teachers into skilled equilibrists has been accepted, between the needs of aggregation and reciprocity characterised, according to Bauman, by the fact that "*change is the only permanent thing and uncertainty is the only certainty, nothing is forever" (Bauman & Leoncini, 2017).* (Bauman & Leoncini, 2017).

The emergency situation linked to the pandemic caused by Covid-19 accelerated the process of change in the school, requiring the immediate activation of 'distance learning' (DAD)[1], a raft in the middle of the storm, through which educational continuity could be maintained, which represented a challenge, an opportunity to develop a didactic of proximity and closeness to the needs of each student, without exception.

The digital school, which only two years ago seemed utopian, has become an emergency. It has engaged teachers and learners in a relationship mediated by DAD (Distance Learning) and DDI (Integrated Digital Learning).

If these are resources that have supported and continue to support the urgent needs of the school world at the present time, they should also be taken into account in the near future, when the links of this great pandemic emergency are loosened.

[1] "Ordinarily DAD is defined as a teaching practice and methodology aimed at replacing all orpart of the teaching activities normally delivered in presence. It uses techniques and tools that have already been developed and tested in the field of distance learning and e-learning". FIDAE (Federationof Institutes of Educational Activities), thanks also to the collaboration with the national standardization body UNI, intended to create a reference practice ("Guidelines for the management system of distance and blended teaching in schools of all levels") in which the parameters of distance and blended teaching in the perspective of innovation linked to new technologies are indicated. We take most of the technical notions on digital from that text.

From the methodological point of view in schools, the proposal has been that of a structured and digitally coordinated teaching method where learning in presence, irreplaceable from the educational point of view because of the depth of the trace it leaves on the student, and learning at a distance, as an integration or deepening of the infinite possibilities that knowledge offers today, coexist. This allows students to break out of the space-time constraints that characterises daily school routines and 'fly' towards a logic of lifelong learning linked to digital technology.

Learning beyond the confines of the classroom does not imply that the student stays at home; digital teaching can be valid without necessarily thinking of it at a distance, but considering it within a learning process in those specific phases and sequences in which it is useful to give space to the autonomy and personal work of the student, to exploit the opportunities of blended learning, which uses different learning environments at the same time and not alternatively.

In this way, the pandemic gives us the idea of an educational perspective that develops in learning environments other than the traditional classroom. It is no longer the perimeters of the walls that circumscribe the place where learning takes place; this becomes a broader and more inclusive experience that can take place in other places, other spaces, other environments. If the focus is on learning, the aim of the research is to find the environment that best supports it in its different meanings: motivation, transmission, internalization, action.

This focus involves revisiting school spaces, which become agora, laboratory zones, individual study zones, outdoor zones and virtual spaces capable of ensuring integration, complementarity and interoperability.

It is thus possible to envisage a school of the future with open doors where it will be possible to use classrooms:

- mobile devices, *mobile devices*, by individual pupils (notebooks or tablets);
- network infrastructure allowing *wireless* connection of both mobile and fixed devices in the classroom;
- virtual spaces for sharing work (*drop-box, google drive, google classroom, Teams...*) used both individually and in groups;
- printed documentation materials (textbooks, reference materials, bibliographical material), and *online* (digital books, internet resources etc.).

The use of these resources will make it possible to implement approaches based on laboratory and problem-based teaching that encourage the manipulation of abstract concepts and

facilitate the construction of meanings, making students the authors of their own learning process.

2. Digital technologies and the new humanities

In the renewed school environment, it will be necessary to think of the digital environment as an educational environment, to inhabit it in a conscious and responsible manner. To this end, it will be necessary to work on *media education and media literacy.*

Media literacy, as defined by the National Leadership Conference on Media Literacy, is the process of enhancing "the ability to access, analyse, evaluate and produce messages in all media communication formats" (F. Cerretti, D. Fellini, R. Giannatelli, 2006). Giannatelli, 2006) that lead to look at media literacy in relation to the ability to read, find interesting content, access information; understand the meaning of the message, analyse data; express a critical judgment on the text, evaluate; tell about one's experiences and express one's thoughts with the different possible languages, produce information/messages (F. Cerretti, D. Fellini, R. Giannatelli, 2006).

This focus is also advocated in the European Key Competences of 2006 and 2018, which emphasize:

"Digital competence is the *confident and critical use of Information Society Technologies (IST) for work, leisure and communication. It is underpinned by basic ICT skills: the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet*'.

It is therefore important *to* use the network and devices responsibly and consciously, since there are many positive implications in terms of the pliability of the tools, their interaction, their creation of more motivating paths, their bringing us closer to others, building bridges and relationships, even if they are virtual, but there are also many dangers that its incorrect use could entail (cyberbullying, hikikomori, candy girls, pedophilia, online grooming, sexting, Fomo, online games, etc.).

We need education to develop research and intervention lenses useful for observing the adolescents of our time in these particular areas of risk and marginality. It will be opportune to look at the international observatory that examines the neurobiological changes of adolescents and post-millennials today exposed to numerous socio-cognitive, emotional, affective changes especially in order to the prolonged exposure to technologies that make them potentially more dysregulated.

In this regard, the Guidelines for the teaching of civic education, adopted in application of Law No. 92 of 20 August 2019, have entrusted schools with the task of working on students to build digital citizenship, understood as "*an individual's ability to make conscious and*

responsible use of virtual means of communication. Developing this ability at school means, on the one hand, enabling the acquisition of useful information and skills to improve this new and deeply rooted way of being in the world, and, on the other, making young people aware of the risks and pitfalls that the digital environment entails".

Schools can and must educate children and adolescents to this awareness and responsibility at all stages of their education. To this end, students' need for knowledge is not satisfied by simply accumulating information in the various fields, but only by fully mastering the individual subject areas, with the elaboration of their multiple connections. A new alliance between science, history, the humanities, the arts and technology is therefore decisive, capable of outlining the prospect of a new humanism where schools will be entrusted with the tasks of:

- teaching how to recompose the great objects of knowledge (the universe, the planet, nature, life, humanity, society, the body, the mind, history) in a complex perspective, aimed at overcoming the fragmentation of the disciplines and integrating them into new overall frameworks;

- promoting the knowledge of a new humanism with respect to the ability to grasp the essential aspects of problems; to understand the implications for the human condition of new developments in science and technology; to evaluate the limits and possibilities of knowledge; to live and act in a changing world;

- spreading the awareness that the major problems of the current human condition (environmental degradation, climate chaos, energy crises, unequal distribution of resources, health and illness, the encounter and confrontation of cultures and religions, bioethical dilemmas, the search for a new quality of life) can be tackled and resolved through close cooperation not only between nations, but also between disciplines and cultures.

Defining this overall picture is the task of both scientific education (who am I and where am I in the universe, on earth, in evolution?) and humanistic education (who am I and where am I in human cultures, societies, history?).

In this sense, a further European reference paradigm is represented by the DigCompEdu document, whose objective is to "*provide a coherent model that allows teachers and trainers to check their own level of 'digital pedagogical competence' and to develop it further. This model is not intended to replace the tools defined at national level, but to enrich and extend them. Its added value consists in providing a guide for the development of educational policies at different levels, a conceptual model allowing the different actors of the education and training system to create concrete tools, suitable to respond to their needs, a common and coherent language to promote discussion and exchange of good practices and areference*

point for Member States to validate the approach and the completeness of their tools and frameworks in this field".

Therefore, pedagogical aspects centred in the direction of a sustainable (Giovannini, 2018 and resilient (Malavasi, 2020) education emerge, especially for the enhancement of the capacity to "learn to learn": the educational relationship, peer communication and intergenerational dialogue. More specifically, the document *Time for transformative resilience: The COVID-19 emergency*, dedicated to the different *goals* of the UN 2030 Agenda, drafted by a group of ASviS, Italian Alliance for Sustainable Development (Benczur et al., 2020), describes the concept of transformative resilience, presenting it as a new paradigm able to contribute to the achievement of the highest level of well-being for the person, starting from the constant commitment of different sectors and contexts (from family to territory), through forms of partnership for the cultivation of the common good.

If education has traditionally been conceived as a patient and laborious in-depth work on oneself and on knowledge, how can we educate and instruct those young people who have been accustomed to thinking that learning should coincide with entertainment and take place in a spectacular way, quickly, with little effort (Prada, 2012, p. 149)? How can we reconcile the tendentially slow pace of education with the frenzy that characterises contemporary lifestyles? What knowledge should be passed on to the new generations if, due to the speed of change, the knowledge possessed at any given time becomes obsolete within a few years? How can we insist pedagogically on the development of people's life projects when the precariousness of existential and working conditions and the inscrutability of the future have taught us that life can no longer be planned (Prada, 2012, pp. 148-149)? How to renew the world of education in the light of the affirmation of new digital technologies, which have caused the decline of literacy culture and its specific teaching-learning models based on a Gutenbergian approach (Mizzella, Ferri & Scenini, 2009)? How to re-examine the role of university, school and educational services in a complex, fragmented, chaotic, globalised, multi-ethnic, hi-tech society? Does it still make sense in such a context to focus pedagogical discourses and educational practices exclusively on man as has been done until now?

All these questions call for careful reflection on the identity of the pedagogue in the current scenario[2].

[2] The term 'pedagogical' refers to the vast and heterogeneous archipelago of theories, practices and discourses that constitutes the field of education as a whole.

3. Conclusions

Referring not only to the world of schooling, Alessandro Baricco summarises the relationship with the digital as follows: "We founded (the digital civilisation) then we started to hate it and now we are making peace with it [...] we will find ourselves with a friendly civilisation that we will be able to correct because we will do so without resentment" (Baricco, 2020). The expression "without resentment" indicates the path of a lucid reflection that goes towards the future, choosing the path of integration and not that of polarisation: not the digital as an alternative to the educational relationship in presence, but in synergy, without fearing that the reflexive and conscious introduction of the digital into social dynamics, and in particular into the educational one, will lead to the alteration of our humanity and the loss of sincere and deep relationships. Through the digital medium, in the pandemic period and beyond, if we think of the distances that have been broken down in recent years by the power of digital media, we have paradoxically rediscovered human relationships, as well as an important stimulus to rethink a new humanism. If tomorrow's historians look at this time as a bottleneck in history, it is up to our generationto decide what to pass on to the other side (not so much what content, but what anthropological, aesthetic, and civic values are essential) and in what way. I believe that thinking about well-being and digital culture in these terms could be a task to be entrusted to'humanists' (in the broadest sense, not disciplinary), to pedagogues, because technology is the opportunity that puts the human being at the centre, and school is the place where this reflection can be based on intergenerational collaboration, which is the main way to the well-being of today and tomorrow.

References

Baricco, A. (2020, 25 March), *Virus, è arrivato il momento dell'audacia*, in la Repubblica Bauman, Z., & Leoncini, T. (2017). *Born liquid. Transformations in the third millennium* (T.Franzosi, Trad.). Milan: Sperling & Kupfer.

Benczur, P., Campolongo, F., Cariboni, J., Giovanni, E., & Manca, A. (2020), *Time for transformative resilience: The COVID-19 emergency*, Brussels: Publications Office of the European Union European Commission. (2020). JRC Publications Repository. *Time for transformative resilience: the COVID-19 emergency* from: https://publications.jrc.ec.europa.eu/repository/handle/JRC120489

Ceretti, F., Felini, D., Giannatelli, R. (eds.), *Primi passi nella media education, curricolo dieducazione ai media per la scuola primaria*, Erickson, Trento, 2006.

Giovannini, E. (2018), *L'utopia sostenibile,* Rome-Bari: Laterza Malavasi, P. (2020), *Teaching the human,* Milan: Vita e Pensiero

Milito D., Tataranni A. (2018) *Didattica innovativa nell'era digitale*, Rome: Anicia Mizzella, S., Ferri, P., & Scenini, F. (2009), *Nuovi media e Web 2.0*, Milano: Guerini

Prada, G. (2012), *Ma chi ha ti insegnato l'educazione? Parents on the educational scene*, Milan: FrancoAngeli

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14599

An AI-based lesson planning software to support competency-based learning

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Abstract

Teaching is a complex and cognitively demanding process and a very creative task. A lesson must be carefully prepared to ensure effective, purposeful teaching. Nowadays, lesson plans are also often created using standard software, such as learning or content management systems. It is obvious that this complex process of lesson planning can be supported by specialized software systems that not only facilitate routine tasks but also encourage reflection. This paper explains the idea and concept of a lesson planning software based on artificial intelligence technologies to support competency-based learning. Through the software, teachers should be able to generate individualized learning content easily and intuitively without losing their pedagogical freedoms. Through various user scenarios, the possibilities of the software are demonstrated and explained. Finally, this paper aims to raise awareness of such intelligent learning environments and how they enable an automated development of learning content along the lifelong education chain.

Keywords: *Digital education; Lesson planning; Artificial intelligence; Competency-based learning.*

1. Introduction and problem definition

The requirements for competency-based and student-centered teaching are enormously high and diverse, which is reflected in a high workload when planning lessons. Together with various non-teaching commitments of teachers, this means that the actual workload of the majority of teachers is significantly above their target. A study by the University of Göttingen (Mußmann, 2020) found that teachers work an average of 48.5 hours/week. However, the share of actual teaching activity is only 35%. According to the study, 27% of teachers' working time is spent preparing for and following up on lessons, 7% on travel and 31% on other non-teaching activities. The abundance of non-teaching activities in particular means that the preparation and follow-up of lessons suffers, which has a negative impact on the quality of lessons and is in clear contrast to the high-quality standards expected from teachers. According to the study, this divergence between demands and reality is reflected in a very high level of stress for teachers, for whom significantly higher staff burnout values were recorded than in other occupational groups (Mußmann, 2020).

The abrupt switch to distance learning in March 2020 due to the COVID19 pandemic once again highlighted existing deficiencies and the need for action with regard to digitalization and the use of digital media and formats in teaching, not only in Germany. The pandemic years have shown that digital education and in particular good quality learning materials and digital teaching strategies are very important (Daniel, 2020). The quality of the teachers' classroom delivery and consequently the students' learning opportunities depend on the quality of the lesson planning (Li et al., 2009). Therefore, planning is considered an essential component of teacher education (Kang, 2016). However, several studies have examined the difficulties teachers face in lesson planning: they have been found to be unable to design tasks that are valid and satisfying for students (Ainley, 2012); to be unclear about the different learning objectives (Liyanage and Bartlett, 2010); to have no idea how to begin lesson planning (Schmidt, 2005); and to find it difficult to draw from their knowledge of the subject when planning lessons (Bigelow and Ranney, 2005).

As teachers plan their lessons in advance, they need to be able to access lesson planning tools and implement and review their plans. However, as there are not many such planning tools available to support teachers' work process, the creation of high-quality digital learning resources is very difficult and time-consuming (Strickroth, 2019). This paper gives an overview of the development process and the features of the digital, web-based platform called CLEVER that aims to close this gap by providing teachers and trainers a tool for creating competency-based digital and analog teaching resources with the help of artificial intelligence (AI).

The remainder of this paper is structured as follows: Section 2 explains key terms necessary for further understanding of this paper. Section 3 introduces the AI-based software tool

CLEVER and explains its purpose, architecture and possible user scenarios. The paper ends with conclusions and an outlook on further work in section 4.

2. Key Terminology

2.1 Competency based learning

Competency can be defined as the set of knowledge and skills that the student is expected to master and understand after completing the learning process (González and Wagenaar, 2003). Competency-based learning is a pedagogical approach that focuses on the mastery of measurable learning outcomes. The evaluation of student progress is based on whether students demonstrate mastery of predetermined competencies (Albanese et al., 2008). Although competency-based learning has its roots in the early 20th century and mastery learning, it became more widely spread in the 1970's (Henri et al., 2017). The instructional approach set itself apart from others by allowing the students to progress in their own pace and ensuring that the students mastered all the predetermined learning outcomes before moving on to the next level. Competency based learning approach aims to create flexibility and allow students to progress as they demonstrate mastery of learning content, regardless of time, place, or pace of learning. It emphasizes student-centered strategies that highlight the need for personalization of the learning process (Henri et al., 2017).

2.2 Artificial intelligence in education

Nowadays, AI has become omnipresent and AI systems are already being used in many areas such as the automotive industry, banking, medicine and social media (Popenici and Kerr, 2017). Consequently, the lives of many people are already directly or indirectly affected by AI technologies. The growing availability of data due to the constant connection to the Internet, as well as the constantly increasing processing power of computers to handle the large amounts of data, offer new opportunities for the development of AI systems (Fukas et al., 2021). The situation is similiar in the education sector. Schools are using more digital devices and learning platforms to simplify organization. Companies are striving to develop AI systems that support teachers and learners in various educational situations. The potential applications of AI systems are also stimulating a discourse on different forms of teaching and learning. In particular, new possibilities in the personalization of learning content through AI increasingly raise questions about the choice of the form of instruction (Popenci and Kerr, 2017). Student and school assessment, grading and scoring of papers and exams, and personalized intelligent teaching represent just a few exemplary scenarios for AI in education. In summary, AI-enhanced education includes smart education, innovative virtual learning, and data analytics and prediction (Chen et al., 2020).

3. Towards an AI-based software tool for creating competency-based learning content

As mentioned in the introduction, there is a remarkable gap between the very high expectations towards teachers regarding the quality of their competency-based digital learning scenarios and the level of available support provided to them in the planning and conducting of lessons in the context of the abruptly changed circumstances due to the ongoing COVID19 pandemic. The authors are proposing an AI-driven software tool to scaffold the work process of teachers and trainers and make it less time consuming, so that they could focus on the important parts of the teaching process while the software takes over the time consuming but mundane tasks in the material creation phase.

3.1 The design process of the platform

The user research and design process started with a desk research followed by participatory design workshops where teachers and university lecturers helped the design team to map the main pain points in the usal process of preparing learning content. This was done in several collaborative design sessions where the designers moderated the mapping of user journeys and ideation for finding better solutions to the identified bottlenecks.

Based on the participatory design sessions, the designers drafted the first wireframes that were introduced to the stakeholders. This started a cyclical design process where the prototypes were specified and improved over several months in many design-proposal-feedback iterations. As soon as the prototype was mature enough, first user testing sessions were carried out to validate the design ideas and get feedback regarding general usability from target group representatives who were not involved in the design process.

3.2 Development and software architecture

At the same time, the development team started to choose the tools for the technology stack and to set up the initial services. The software architecture of the platform composes of four levels: (1) Didactic Guidance, (2) Content Management, (3) Platform Services and (4) Data and Services. Figure 1 provides a graphical overview of the software architecture. The individual levels are explained in more detail below.

Didactic Guidance

The didactic guidance layer contains the support that the platform offers to the user in two different ways. On the one hand, the platform provides a structure that guides the user through the preparation process of the learning materials. The content creation in the authoring tool enables the user to structure the lesson into different phases. The lesson phases include the five E-s: engage, explore, explain, elaborate and evaluate (Bybee et al., 2006). Each lesson planning also starts with the selection or definition of the competencies that the teacher would

like to foster with this material. The platform already includes the curricula that are relevant for the users work as part of the setup for a specific institution or user. However, it is also possible to flexibly define new competencies, if needed. These steps ensure that the user pays attention to the lesson structure and is guided by a competency-based approach.

The AI based recommendation system builds on the structural elements of the platform, taking into account the lesson phase and the selected competencies as well as user preferences and previous activities on the platform. This way, the CLEVER platform provides an AI-based recommendation system that helps the user choosing existing content from the platform library or creating new content. The content can be added to a lesson in three different ways: (1) by uploading or embedding existing external content; (2) by selecting previously created content from the CLEVER platform library; or (3) by creating new content with the help of the platform authoring tool, that provides a number of different format-templates (e.g. a timeline, hotspot image, word-puzzle, interactive story etc).

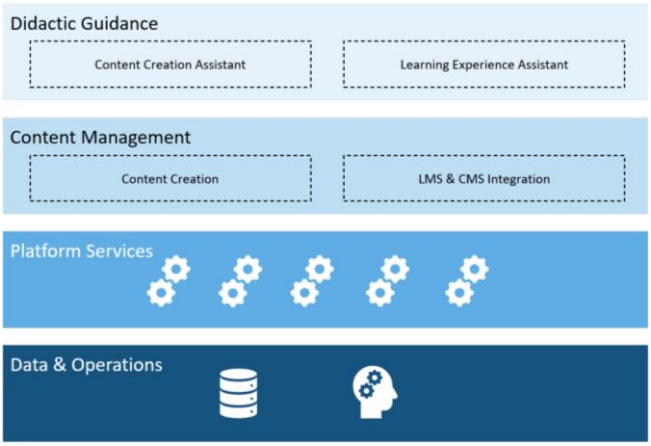

Figure 1. Overview of the CLEVER software architecture. Source: Own illustration.

Content management

Level two contains the functions for creating, managing and using content, which are also offered by conventional Learning or Content Management Systems (LMS/CMS).

Platform Services

This level provides the necessary basic services that are required to develop the functionalities. These include, for example, authentication, user profiles, roles & rights or persistence. The services are organised in a service architecture and operated as Docker containers.

Data & Operations

This level contains all the technical functions necessary for a trouble-free and scalable operation of the platform. In the context of high availability and system reliability as well as load distribution, a containerisation concept is used.

3.3 The CLEVER platform use-scenario

The platform has two main use scenarios. The first scenario evolves around creating new content. In this case, the user starts with a blank authoring tool, where they first choose or define the competencies that they would like to address with their lesson or learning material. Thereafter they start adding content to each lesson phase by either uploading/embedding external content, choosing content from the recommendations provided from the CLEVER platform library or creating new learning elements by using templates recommended by the AI. In each phase of the lesson, the user can describe the student-teacher interactions, add notes about the materials or technology that they want to use to carry out the planned activities, specify the duration of the activities and the social arrangement (e.g. individual work, group work, etc.).

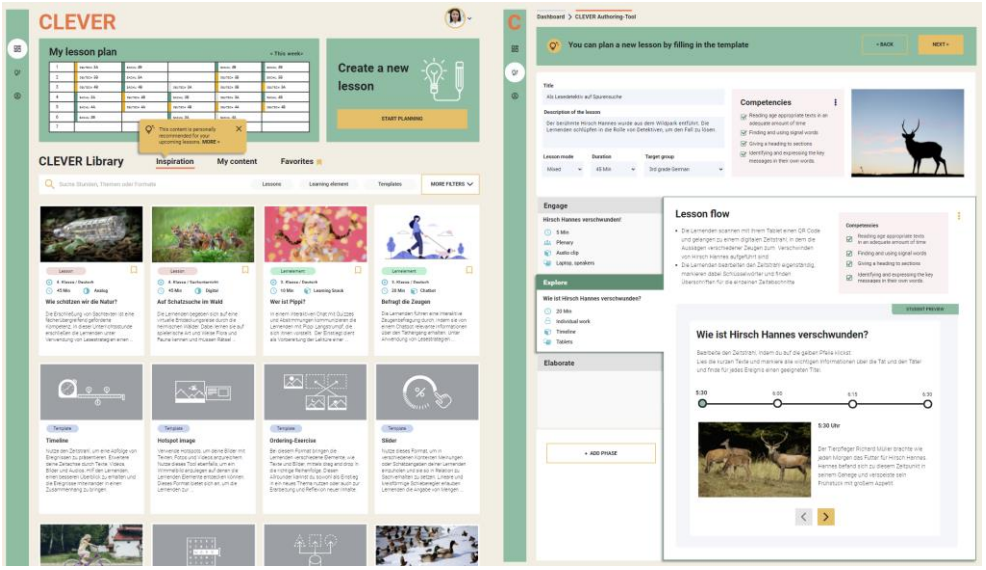

Figure 2. The CLEVER platform dashboard (left) and the authoring tool (right). Source: Own illustration.

When the user has defined the competencies, phases and added content to the corresponding lesson plan, they can finish the lesson planning by getting a summary overview of the lesson plan as well as the preview of the materials that will be later made available for the students. The user can decide, how they make the materials available to the lesson participants – the

CLEVER platform provides options to export the content for both digital or in-classroom lessons.

The second main use scenario evolves around using and editing existing lesson content from the CLEVER platform library. The user can search and filter the library based on keywords, topics, subjects, and curricula or competencies. If the user finds a relevant existing lesson, they can use it straight away or decide to edit it. In the latter case, they might want to change the content of just one of the lesson phases by adding or embedding a custom learning element.

5. Conclusions and further work

The CLEVER software is currently in the last phase of development and will be tested in a final step within the framework of a scientifically accompanied evaluation and piloting process together with teachers from different types of schools in Germany. The evaluation foresees several iterations in which the software pilot is tested by potential end users over a defined period of time. After this test phase, several interviews are to be conducted with the testers to obtain additional, richer and more realistic information about the handling and use of CLEVER. This extensive evaluation process will ensure a successful transfer of the software into school practice.

This paper aims to introduce the idea and concept of the AI-based lesson planning software CLEVER. The focus lies on the specific support of teachers in the planning of didactically valuable lessons. The special innovative character of CLEVER is defined by the use of various AI technologies. These technologies provide teachers with precise recommendations on how their teaching units can be prepared according to didactic principles by taking into account many aspects of lesson planning such as diverse teaching methods, mix of diffenrent social arrangements and media as well as competency orientation. In addition, the AI-supported planning process helps teachers to reflect on their lesson design, evaluate possible options and thus build up self-confidence for the practical implementation of the lesson. Hence, for the first time, the CLEVER software as an intelligent learning environment enables an automated development of learning content along the lifelong education chain - from primary school to in-company training and further education. At the end, teachers always decide for themselves which suggestions from the software they accept. This way, the current possibilities of digitalization are used without restricting the teachers' self-determination and freedom of decision. Thus, CLEVER is not only the name of the software, but also, in a figurative sense, the name for the intelligent interaction of digitalization and education along the lifelong education chain.

Acknowledgments

The authors would like to express their sincere thanks to the German Federal Ministry of Education and Research (BMBF), which is the funding agency for the project "CLEVER, FKZ: 01PP19001A" underlying this research paper.

References

Ainley, J. (2012). Developing purposeful mathematical thinking: A curious tale of apple trees. *PNA*, *6*(3), 85-103.

Albanese, M. A., Mejicano, G., Mullan, P., Kokotailo, P., & Gruppen, L. (2008). Defining characteristics of educational competencies. *Medical education*, *42*(3), 248-255.

Bybee, R. W., Taylor, J. A., Gardner, A., Van Scotter, P., Carlson Powell, J., Westbrook, A., Landes, N. (2006). The BSCS 5E Instructional Model: Origins and Effectiveness.

Bigelow, M. H., & Ranney, S. E. (2005). Pre-service ESL teachers' knowledge about language and its transfer to lesson planning. In: Bartels, N. (ed.). *Applied linguistics and language teacher education*. Boston: Springer, pp. 179-200.

Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *Ieee Access*, *8*, 75264-75278.

González, J. & Wagenaar, R. (2003). Tuning Educational Structures in Europe: Informe Final. Fase Uno. Universidad de Deusto, Bilbao.

Daniel, S. J. (2020). Education and the COVID-19 pandemic. *Prospects*, *49*(1), 91-96.

Fukas, P., Rebstadt, J., Remark, F., & Thomas, O. (2021). Developing an Artificial Intelligence Maturity Model for Auditing. *Proceedings of the 29th European Conference on Information Systems,* June, 14-16 2021, Marrakech, Morocco, Research Paper 133.

Henri, M., Johnson, M. D., & Nepal, B. (2017). A review of competency-based learning: Tools, assessments, and recommendations. *Journal of engineering education*, *106*(4), 607-638.

Henri, M., Johnson, M. D., & Nepal, B. (2017). A review of competency-based learning: Tools, assessments, and recommendations. *Journal of engineering education*, *106*(4), 607-638.

Kang, H. (2017). Preservice teachers' learning to plan intellectually challenging tasks. *Journal of Teacher Education*, *68*(1), 55-68.

Li, Y., Chen, X., & Kulm, G. (2009). Mathematics teachers' practices and thinking in lesson plan development: a case of teaching fraction division. *ZDM*, *41*(6), 717-731.

Liyanage, I., & Bartlett, B. J. (2010). From autopsy to biopsy: A metacognitive view of lesson planning and teacher trainees in ELT. Teaching and Teacher Education, 26(7), 1362-1371.

Mußmann, F., Hardwig, T., Riethmüller, M., Klötzer, S., & Peters, S. (2020). Arbeitszeit und Arbeitsbelastung von Lehrkräften an Frankfurter Schulen 2020. Göttingen, Germany.

Popenici, S. A., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. *Research and Practice in Technology Enhanced Learning*, *12*(1), 1-13.

Schmidt, M. (2005). Preservice string teachers' lesson-planning processes: An exploratory study. *Journal of Research in Music Education*, *53*(1), 6-25.

Strickroth, S. (2019). PLATON: Developing a graphical lesson planning system for prospective teachers. *Education Sciences*, *9*(4), 254.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14618

When technology meets educational sciences: Combining virtual reality and microteaching to train pre-service teachers' kindergarten classroom management strategies

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Abstract

In our study, we asked 19 pre-service teachers (PSTs) about their experiences with and perceptions of a microteaching-supported virtual reality (VR) kindergarten classroom where they practiced and experimented with different classroom management strategies (CMS). We analyzed quantitative and qualitative responses to gain insight into the perceived usefulness of this learning environment for CMS development and transfer to internship practices. The quantitative results show that practicing in the VR classroom supported mastery of CMS and helped PSTs to manage behaviors at their internships. The qualitative data suggest that the microteaching approach can support transfer of CMS practiced in the VR-kindergarten classroom to in-situ classroom management situations, possibly because of the opportunity to collaboratively engage in reflexive practices. Moreover, PSTs raised valuable suggestions to further improve the microteaching structure to strengthen the effect of peer feedback. The results of this study underline the importance of purposefully grounding VR applications in proven instructional theories.

Keywords: *Pre-service teacher education; classroom management strategies; development; transfer; virtual reality; microteaching.*

1. Introduction

On a daily basis, teachers must think about ways to manage their classrooms to create a positive learning environment that stimulates students' social and academic learning. Effective classroom management entails restoring order by timely recognition of disruptive behaviors and selecting and applying suitable classroom management strategies (CMS) to prevent, stop, or discipline behaviors (Borich, 2011; Korpershoek et al., 2016). However, deciding which CMS is most effective to address specific behaviors is one of the foremost concerns to many teachers. Especially beginning and pre-service teachers (PSTs) have difficulties deciding when behaviors need to be managed, determining which anticipative (i.e., preventive), deflective, or reactive strategy will be most effective, and recognizing when it is time to switch to another strategy (e.g., Emmer & Stough, 2001; Putman, 2009).

Ideally, PSTs develop effective CMS during their internship. However, many PSTs feel that the kindergarten-classroom internship, in particular, does not offer enough possibilities to practice or try out different types of CMS. PSTs find it challenging to apply CMS theories to dynamic kindergarten practices and sometimes feel pressured to adopt their mentor's strategies, even if they feel uncomfortable doing so (Zeichner et al., 1981). Moreover, internships in Dutch teacher-training programs are often confined to specific days or parsed in a relatively short period in which only a limited number of disruptive behaviors can be observed and managed. Hence, kindergarten internships leave little room for PSTs to purposefully experiment with different CMS to find their teacher voice.

Simulation-based learning environments such as virtual reality (VR) have potential for learning complex professional skills (Chernikova et al., 2020). A Head-Mounted Display simulates an immersive experience and creates a realistic and authentic learning environment that encourages active exploration and interaction (Renganayagalu et al., 2021). We implemented an interactive VR-kindergarten learning environment in which PSTs of our Academic Teacher Training Program can interact with kindergarteners and respond to a variety of pre-programmed disruptive behaviors ranging in complexity levels, enabling PSTs to experience more disruptive behaviors as compared to an internship. Moreover, it is possible to rerun complex situations, allowing PSTs to experiment with different CMS and helping them understand the reciprocity between behaviors and CMS. This technological affordance seems to perfectly lend itself to a proven instructional technique in teacher education called *microteaching*. In its original form, microteaching involves designing and delivering a small part of a lesson to peers, observing each other teaching, and giving and receiving feedback to improve specific teaching skills (Mergler & Tangen, 2010). Applying a validated didactical structure such as microteaching to VR is relatively new: Most studies evaluating the educational potential of VR have primarily focused on technological aspects of educational designs or VR affordances (e.g., Pantelidis, 2009). Using a mixed-methods design we examined: *How do PSTs perceive the usefulness of a microteaching-supported*

VR-learning environment for developing kindergarten-specific CMS and transfer of CMS to the in-situ kindergarten internship?

2. Methods

2.1. Participants, Design, and Procedure

From September to December 2021, 19 PSTs (17 women, M_{age} = 20.17 years) participated in a microteaching-supported VR curriculum. Parallel to the curriculum, PSTs were based at a kindergarten internship. The goal of the VR curriculum was to offer PSTs a safe learning environment in which they could practice and experiment with different CMS in response to a variety of kindergarten-specific behaviors. PSTs started with a theoretical lecture on classroom management and filled out an online pre-measurement questionnaire (September). Groups of four PSTs visited our university's VR-lab three times for a VR microteaching session. During these sessions, PSTs took turns and individually guided a whole-group activity while managing 20 virtual kindergartners engaging in various (potentially) disturbing behaviors. As is common during microteaching sessions, the other three PSTs live observed the session and noted down feedback. After each session, PSTs discussed their performance and received feedback. The feedback was then put into practice during a second 'run'. The VR sessions gradually build up in terms of the level of complexity of disruptive behaviors, duration, and microteaching focus (see Figure 1). During the first VR session (September), PSTs prepared and practiced with CMS relevant for starting up a lesson, such as meaningfully getting the attention of all kindergartners, a plenary opening, and switching to the busy-picture activity. The second VR session (October) centered on practicing CMS such as scanning and observing, timely recognition of and reacting to potentially disturbing behaviors. During the third VR session (November), PSTs were challenged to actively experiment with different CMS to discover which CMS works for them and to gain insight into the reciprocity between different behaviors and specific CMS. PSTs twice filled out a self-report questionnaire distributed through Qualtrics: once before the VR sessions (September) and once at the end of their kindergarten internship (in December).

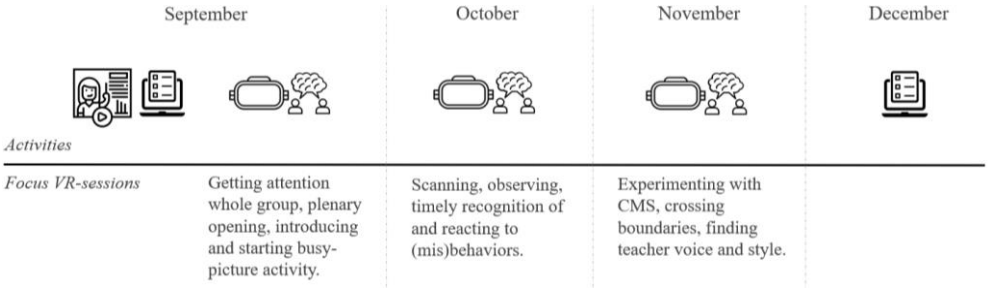

Figure 1. Timeline and focus didactical activities and questionnaires.

2.2. Measurement Instruments

In the pre-questionnaire, PSTs were asked to set a learning goal and noted their expectations of the curriculum. The post-questionnaire comprised slider- and open-ended questions. On the 100-point slider-scales, PSTs indicated the extent to which they thought five elements of the microteaching-supported VR curriculum contributed to CMS development and transfer. They then described to what degree their learning goals and expectations were met and were asked to reflect on the strengths (*'tops'*) and points for improvement (*'tips'*) for both the VR-kindergarten classroom learning environment and the microteaching didactical approach.

2.3. Analytical Approach

PSTs' responses to the slide-scale questions are visualized in boxplots (Figure 2) and interpreted based on the descriptive statistics. For analyzing PSTs' qualitative responses to the open-ended questions, we followed a Grounded Theory approach. Responses were categorized in an open-coding process (i.e., codes emerged from the data; Braun & Clarke, 2006), followed by a further in-depth thematic cluster-based exploration of the responses.

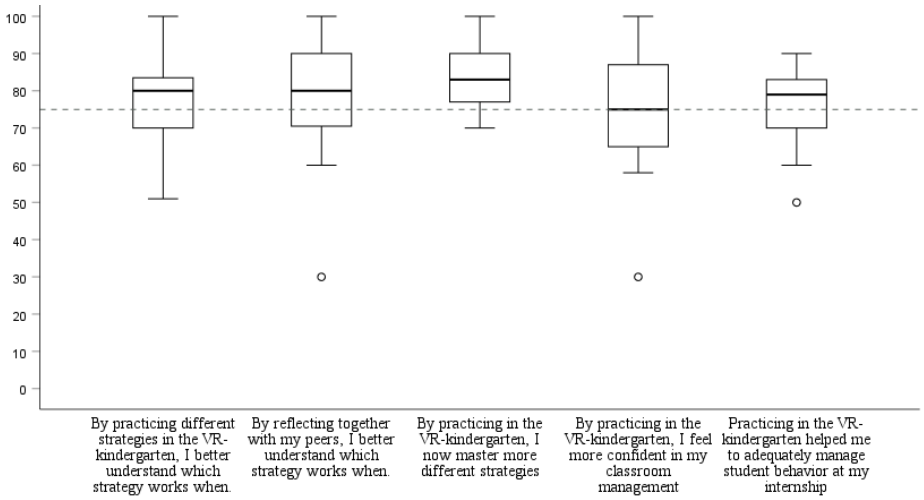

Figure 2. PSTs' quantitative perceptions of usefulness VR and microteaching for CMS development and transfer.

3. Results and Discussion

3.1. Quantitative Perceptions of the VR Environment and Microteaching Approach

Overall, the quantitative data indicate that PSTs were rather positive about the value of the VR-kindergarten classroom and microteaching approach for CMS development and transfer; the five items were all (on average) rated with 75 or higher on a 100-point (see Figure 2). The possibility of practicing in the VR classroom to master more different CMS was rated

highest (M = 84.11, SD = 9.33), followed by PSTs' perceptions towards the added value of reflecting with peers for better understanding which strategy works when (M = 78.58, SD = 17.12). The usefulness of practicing in the VR kindergarten for self-efficacy beliefs was rated relatively 'lowest' (M = 75.53, SD = 17.25). However, please note that the *absolute* differences between the mean ratings of the five items are minimal. These quantitative perceptions are further explored and interpreted through the qualitative data.

3.2. Qualitative Perceptions of Aspects Related to the VR Environment

PSTs' perceptions of the usefulness of VR for CMS development and transfer were captured in 172 codes. These codes could be categorized into six overarching themes: outcomes (27.32%), VR affordances (20.93%), training CMS (20.93%), VR technology (19.19%), reflection on teaching practices (9.88%), and other didactical aspects (1.74%). Hence, most remarks concerned the added value of VR in terms of learning outcomes. Here, PSTs most often mentioned that the VR environment is useful (12 times) and that it supports transfer to practice (10 times), CMS development (9 times), and self-efficacy beliefs (5 times). As one PST described: "*During my internship, I sometimes thought back to the VR-sessions and thought about how I approached a situation in the VR classroom and whether this would also be appropriate in an internship situation."* Regarding the VR affordances, PSTs noted that the kindergarten classroom provides them with a safe space (7 times) that facilitates experimenting with different strategies (7 times): *"What really surprised me is that I just tried everything I wanted, without any shame really. I felt at ease."* The benefits for CMS development mostly pertained to applying (8 times) or practicing (8 times) different CMS or trying new CMS (7 times). The VR environment also helped PSTs to reflect on their teaching practices, especially in terms of finding their teacher voice (10 times): *"Because I applied these strategies in the VR-session, I now know which CMS suit me, which ones I like and which ones I don't. I now know which strategies I feel comfortable with."*

PSTs' points for improving the VR kindergarten classroom concerned VR technology-related aspects (87.50%), other didactical aspects (9.38%), and learning outcomes (3.12%). In previous studies, improvement in terms of the VR technology primarily pertained to the software-related aspects and system performance (i.e., bugs and glitches, unrealistic behaviors, inadequate auditory input; Mouw et al., 2020), whereas in the current study PSTs' reflections on the VR technology were more related to strengthening the *didactical* potential of the environment. For example, PSTs most often expressed the wish for creating engagement through in-depth verbal interaction with the virtual kindergartners: "*The most difficult thing for me was that the interaction was limited, while in a real kindergarten, this is the most important thing."* PSTs also expressed a desire to vary the busy picture to improve authenticity and variation of practice: "*At the internship, you would not offer the same activity every week, and this (varying the busy picture) would make it more realistic."*

In sum, PSTs generally found the VR kindergarten classroom useful for CMS development and self-efficacy beliefs, and that the environment supports transfer to practice, possibly because it provides them a safe space that facilitates active experimenting with different CMS. Hence, even though PSTs also experienced some limitations (i.e., verbal interaction and the busy picture), it seems that these to-be-improved aspects *did not* lead to a training situation that was too disconnected from everyday classroom practice (Putman, 2009).

3.3. Qualitative Perceptions of Microteaching-Related Aspects

PSTs' perceptions of the usefulness of microteaching for CMS development and transfer were captured in 155 codes reflecting six overarching themes: Microteaching affordances (58.06%), outcomes (21.94%), reflection on teaching practices (7.74%), VR affordances (5.16%), training CMS (3.87%), and other didactical aspects (3.23%). PSTs generally held positive perceptions towards microteaching's didactical affordances and mentioned the added value of (peer)feedback provision and discussion (16 times), the possibility to observe peers (14 times), collaborative reflection (9 times), the opportunity to apply received feedback (9 times), and getting inspired by others (8 times). In terms of outcomes, PSTs most often mentioned that the microteaching structure is very useful (18 times) and pleasant (6). PSTs reflections on the affordances of microteaching often included a reflection on outcomes. For example: "*Exchanging feedback provided a lot of guidance and it made my self-confidence grow."* In the category reflection on teaching practices, PSTs most often (10 times) mentioned reflexive practices (i.e., reflecting on, becoming aware of, and/or changing specific teaching behaviors) as an added value: *"Because you receive in-depth feedback about what you could do differently, you will pay attention to that in the future. You also think more carefully about the choices you make in your classroom management."* In terms of other didactical aspects, PSTs found the didactical build-up and focus of the VR sessions worth mentioning (4 times).

PSTs also raised points for improving the microteaching approach. Most of the 28 codes pertained to other didactical aspects (75%), followed by microteaching affordances (17.86%), and outcomes (7.14%). Feedback on the didactical aspects mostly concerned ways to strengthen the effect of peer feedback (5 times) or to improve the feedback-provision structure (4 times): "*One tip would be to ensure that everyone takes the feedback they received home. Not everyone took a picture of the (joint) feedback form, and this way valuable feedback was sometimes forgotten."* For the affordances of microteaching, the importance of a safe social climate was twice mentioned: "*Sometimes I felt uncomfortable with having my peers observing me. (…) it gives me the idea that I did something wrong."*

In sum, it seems that peer-related aspects of the microteaching approach that stimulated reflexive practices were particularly valued as *didactical* affordances; PSTs highly appreciated the opportunity to observe their peers' teaching practices and to practice specific

CMS, receive feedback and reflect on these practices, and subsequently try out the feedback received. At the same time, PSTs felt that the didactical approach should be further improved to strengthen the effect of peer feedback, for example by fine-tuning the feedback forms.

4. Conclusion and Future Directions

In this paper, we aimed to gain insight into PSTs' experiences with and perceptions of a microteaching-supported virtual reality kindergarten classroom in terms of usefulness for CMS development and transfer to their internship practices. All in all, our findings seem to suggest that combining the best of both worlds, that is, applying a *didactical* approach to a *VR* environment, has much potential to support the development of complex teaching skills such as classroom management. The quantitative data showed that practicing in the VR classroom supported mastery of CMS and helped PSTs to think about how to manage behaviors at their internship. Moreover, collaboratively reflecting with peers supported their understanding of which strategy works when. PSTs' qualitative reflections suggest that a microteaching approach can support the transfer of CMS practiced in an in-vitro VR-training situation to in situ classroom management situations, possibly because of the opportunity to engage in in-depth collaborative reflexive practices. PSTs also reflected on possibilities to further improve the microteaching structure to strengthen the effect of peer feedback.

Following Radianti et al. (2020)—who argue that one of the issues impeding integration of VR in higher education is that most applications lack grounding in learning and instructional theories—we stipulate that a purposeful implementation of VR in teacher education should start by carefully examining how existing instructional theories are best adapted when designing a *VR*-learning environment. To this end, we recommend more thoroughly evaluating the didactical affordances of microteaching, for example, by systematically variating different components of the microteaching structure (i.e., providing peer feedback only versus a combination of teacher and peer feedback, using feedback structures, et cetera) and to empirically assess the independent effects of microteaching and the VR environment on CMS development. Another direction worth further exploring is the integration of eye-tracking in VR-learning environments. Research shows that being able to identify classroom behaviors accurately and rapidly is important for developing effective CMS (Van den Bogert et al., 2014). As such, gazing patterns can be an extremely important source of information. We postulate that visualizing gazing patterns *in real-time* could steer more targeted (peer) feedback provision as peers can then see what is (not) observed or dealt with in the virtual classroom, which could deepen the discussion and stimulate reflexive practices.

Our study indicates that combining the best of both worlds, that is, technology and educational sciences, can be very fruitful. By providing PSTs with a VR-learning environment in which they can freely practice real teaching skills in an authentic, yet safe

setting, we can help them in finding their own teacher identity and their teacher voice. In the future, we hope to provide our students with more opportunities where they can finetune their CMS in a VR kindergarten to optimally prepare them for their professional teaching careers.

References

Van den Bogert, N., Van Bruggen, J., Kostons, D., & Jochems, W. (2014). First steps into understanding teachers' visual perception of classroom events. *Teaching and Teacher Education, 37*, 208–216. doi:10.1016/j.tate.2013.09.001

Borich, G. (2011). *Effective teaching methods: Research-based practice*. Pearson.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101. doi:10.1191/1478088706qp063oa

Chernikova, O., Heitzmann, N., Stadler, M., Holzberger, D., Seidel, T. & Fischer, F. (2020). Simulation-based learning in higher education: A meta-analysis. *Review of Educational Research, 7*, 499–541. doi:10.3102/0034654320933544

Emmer, E. T., & Stough, L. M. (2001). Classroom management: A critical part of educational psychology, with implications for teacher education. *Educational Psychologist, 36*(2), 103–112. doi:10.1207/S15326985EP3602

Korpershoek, H., Harms, T., De Boer, H., Van Kuijk, M., & Doolaard, S. (2016). Meta-analysis of the effects of classroom management strategies and classroom management programs on students' academic, behavioral, emotional, and motivational outcomes. *Review of Educational Research, 86*(3), 643–680. doi:10.3102/0034654315626799.

Mergler, A. G., & Tangen, D. (2010). Using microteaching to enhance teacher efficacy in pre-service teachers. *Teaching Education, 21*(2), 199–210.

Mouw, J. M., Fokkens-Bruinsma, M., & Verheij, G.-J. (2020). Using Virtual Reality to promote pre-service teachers' classroom management skills and teacher resilience: A qualitative evaluation. In J. Domenech, P. Merello, E. de la Poza, & R. Peña-Ortiz (Eds.), *Proceedings of the 6th International Conference on Higher Education Advances* (pp. 325–332). Universitat Politècnica de València. doi:10.4995/HEAd20.2020.11049.

Pantelidis, V. S. (2009). Reasons to use virtual reality in education and training courses and a model to determine when to use virtual reality. *Themes in Science and Technology Education, 2*(1-2), 59–710.

Putman, S. M. (2009). Grappling with classroom management: The orientations of preservice teachers and impact of student teaching. *The Teacher Educator, 44*(4), 232–247.

Radianti, J., Majchrzak, T., Fromm, J., & Wohlgenannt, I. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. *Computers & Education, 147*. Article: 103778. doi:10.1016/j.compedu.2019.103778

Renganayagalu, S. K., Mallam, S. C., & Nazir, S. (2021). Effectiveness of VR head mounted displays in professional training: A systematic review. *Technology, Knowledge and Learning, 26*, 999–1041. doi:10.1007/s10758-020-09489-9

Zeichner, K. M., & Tabachnick, B. R. (1981). Are the effects of university teacher education "washed out" by school experience? *Journal of Teacher Education, 3*, 7–11.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14718

Learning ecology theory as a tool to support student digital competences in higher education

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Abstract

The need for digitally competent graduates is well established and articulated in the New Skills Agenda for Europe (European Commission, 2016) and the European Digital Education Action Plan 2021-2027 (European Commission, 2021). The Enhancing Digital Teaching and Learning (EDTL) project seeks to enhance graduate digital attributes by providing professional development to academics to embed digital technologies across the curriculum (Flynn et al., 2020). Two key challenges to this work are: a lack of data on the specific digital competences required in the workplace; and a lack of clarity on the contexts in which students develop digital competences. This paper examines these challenges by reflecting on the results of a small-scale research study on the competences required in the workplace in Ireland, through the lens of learning ecology theory. The paper proposes that learning ecology theory can be a useful tool to support student digital competences in Higher Education Institutions (HEIs).

Keywords: *Digital competences; graduate attributes; learning ecologies; formal learning; informal learning.*

1. Introduction

The impetus for developing digitally competent graduates is articulated across a range of policy at European level, and in the context of this study locally in Ireland. The New Skills Agenda for Europe (European Commission, 2016) states that citizens require digital competencies to participate in an economy undergoing digital transformation. The European Digital Education Action Plan 2021-2027 (European Commission, 2021), has a dual focus of "fostering the development of a high-performing digital education ecosystem" and "enhancing digital skills and competences for the digital transformation." The 'Next Steps' report (NFETL, 2021), outlines recommendations for the future of Irish higher education, proposing that "the world of work, for staff and students, is digitally infused and requires a commitment to lifelong learning"

The Enhancing Digital Teaching and Learning (EDTL) project seeks to enhance the digital attributes of graduates by providing professional development to academics to develop digital competence for teaching (IUA, 2021). Providing professional development to academics and their subsequent usage of digital technologies exposes students to such technologies and supports digital competence development (Flynn et al., 2020). At one of the EDTL project sites, two key challenges were identified in relation to developing digitally competent graduates: the lack of data available on the specific digital competences required in the workplace; and a lack of clarity around the various contexts in which students develop digital competences. This paper explores these challenges by firstly reflecting on the data from a small-scale study which explores the digital competences required in the workplace, and secondly reflecting on the usefulness of learning ecology theory as a tool to plan for the digital competence development of students in a higher education institution (HEI).

2. Research on digital competences required in the workplace

2.1. Methodology

The research design was influenced by a University of Nottingham study on digital competences required by graduates in the workplace (Newall, 2020). A mixed methods approach was used to collect data from graduates of Dublin City University, Ireland, and employers linked to the University through career and placement initiatives. Separate surveys were designed for each participant group, focusing on the digital competences required in the workplace. The employer survey was circulated by the Careers Service to employers linked to the university and the graduate survey was disseminated by the Alumni Office to graduates from the previous three years.

The survey structure was mapped onto the Digital Competence Framework for Citizens (DigComp) (Carretero et al, 2017). The framework describes digital competence across five

distinct areas and acts as a reference guide for citizens in developing their competence and for embedding competence development in higher education curricula. The surveys' questions reflected the five areas of digital competences of the DigComp framework: Information & Data Literacy; Communication & Collaboration; Digital Content Creation; Safety; and Problem Solving. Each questionnaire contained a mixture of fixed response Likert style questions and open questions. The Likert questions used a seven-point scale from 'extremely important' to 'not at all important'. Open questions provided an opportunity to comment beyond the influence of pre-formulated answers. Quantitative data were analysed using Microsoft Excel, and frequencies of responses were calculated and presented in tabular form. Qualitative data were analysed using NVivo software, following Braun & Clarke's (2021) thematic analysis framework. In total, 9,000 recent graduates and 600 employers were invited to take part in the surveys. The response rate was low with just 62 graduates and 28 employers completing the surveys. As the surveys were circulated through third party units within the university, it was not considered appropriate to send reminders to invitees to take part. The surveys were circulated in February 2021 at the height of the Covid-19 pandemic, which may also have contributed to the low response rate, given the resulting stresses in the workplace. While the low response rate is a limitation of the study, the data does provide a useful insight into graduate and employer perceptions of digital competences required in the workplace.

2.2. Findings

Competences in two areas of the DigComp framework were perceived by both graduates and employers as most important: Area 1 (Information & Data Management); and Area 2 (Communication & Collaboration). In Area 1, the importance of skills relating to MS Excel emerged as a theme for both employers and graduates. Graduates perceived the level of MS Excel skills required as ranging from basic to advanced. However, employers were unanimous in suggesting an 'excellent' level of MS Excel skills are required.

In Area 2 (Communication & Collaboration) employers and graduates differed in relation to netiquette and managing digital identity, with 50% of graduate respondents compared to 72% of employer respondents viewing such competences as very/extremely important. Unsurprisingly, the qualitative data reflects an increased reliance on competences in collaborative and communication tools reflected in the following comment:

> Given the current climate all employees are required to engage on almost all work through digital mediums, VC, emails and other online collaboration tools. We are a multi-site company so this was true in normal times but not to the same extent. (Employer respondent 1)

Employers and graduates placed approximately equal importance for Area 3 (Content Creation). Creating digital content and using/repurposing digital content were considered

extremely/very important/moderately important by 75% of graduate respondents, with similar figures reported by employers. Understanding copyright and licenses for digital content was perceived as less important by graduates than employers, with 35% of graduates considering these competences very/extremely important compared to 55% of employers. Social media and marketing emerged as a theme from the qualitative data for content creation competences with 13 employers and 19 graduates mentioning social media, and marketing mentioned by 12 employers and 17 graduates. The importance of social media and marketing was not restricted to those in a specific marketing role, suggesting that social media and marketing are skills required across many roles reflected in the following comment:

> Comms/marketing is something we increasingly do "horizontally" (meaning every staff member is involved, rather than specific individuals), and social media is very widespread as well, so you want everyone to have good know-how on how to use content, understand copyrights/attribution. (Employer respondent #6)

Employers generally rated competences across all areas of the DigComp Framework as very/extremely important in comparison to graduate respondents. This was particularly significant for Area 4 competencies relating to safety, see figure 1 below.

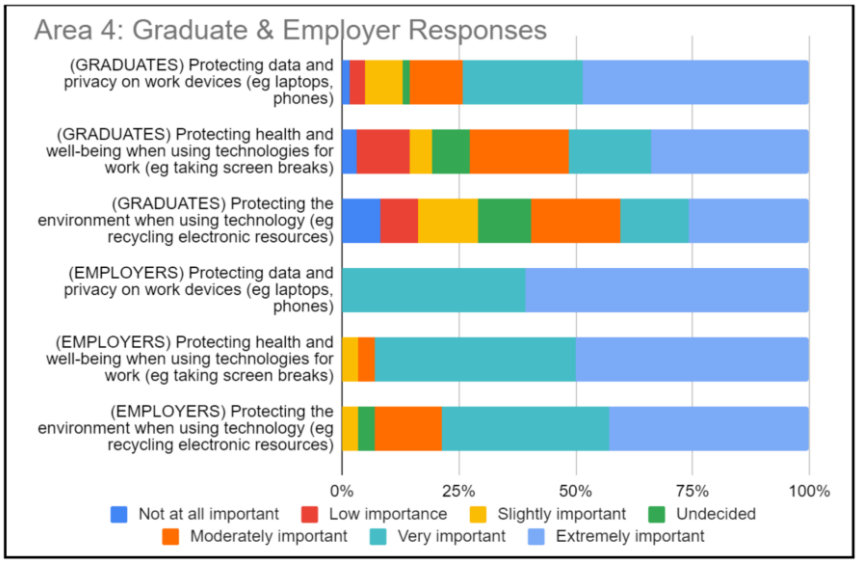

Figure 1. Graduate and Employer responses relation to Area 4 of the DigComp Framework

In respect of Area 5 (Problem Solving), employer respondents considered basic troubleshooting to be more important compared to graduate respondents, with 62% of employer respondents considering such competences as 'very/extremely important' compared to 35% of graduate respondents. Similarly, employers placed more emphasis on

identifying skills development with 65% of employer respondents citing this competence as 'very/extremely important' compared to 52% of graduate respondents.

Overall, this study reinforces the importance of digital competences in the workplace and offers insight into the nuances between graduate and employer attitudes to specific digital competences in the workplace. Employers and students agree that Area 1 (Information & Data Management) and Area 2 (Communication & Collaboration) of the DigComp framework are the most important competences in the workplace. However, the different values relating to specific competences in Area 3 (Digital copyright and licensing); Area 4 (safety); and Area 5 (problem solving) suggests that work is required to communicate the importance of such skills to students. In the next section, the authors reflect on the opportunities in higher education to support the development of digitally competent graduates with reference to the findings of this study.

3. Examining the data through a learning ecology lens

Student development is inherently linked to their programme of study—for example, medical students will develop digital competences for medical technologies. However, the development of broad, non-discipline-specific digital competences are not always clearly factored into curricula. In some HEIs, there may be departments or staff focused on student competence or skill development (e.g. University College Cork Skills Centre (2022)), but this differs between HEIs. Outside of structured institutional activities, students may also seek or create their own opportunities to develop digital competences. Using a learning ecology lens to conceptualise the range of contexts in which students can develop competences offers an opportunity for HEIs to plan for student digital competence development.

3.1. Learning ecology theory

Ecology theory arises from the biological sciences, where the term was first coined (Stauffer, 1957). Ecology is generally accepted as how living things interact with each other and with their environment. This theory was later applied in a range of contexts including the social sciences. Jackson's learning ecologies framework offers a way to visualise the range of opportunities for learning in relation to digital competences in both formal and informal learning contexts. The framework positions these opportunities as learner-led or institution-led.

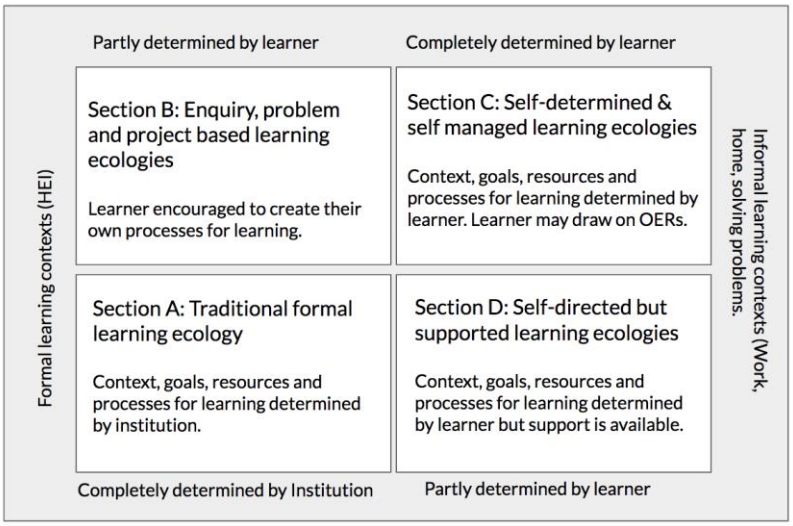

Figure 2. Adapted version of Jackson's (2013) learning ecologies framework

3.2. Reflecting on the research findings through a learning ecologies lens

The left side of the framework considers learners' formal contexts. Section A represents traditional education systems where the learning goals, resources, processes and outputs are determined by the institution through a curriculum and formal assessment. In this ecology, learning is primarily teacher-led and resources, goals and processes for student digital competence development are created by the teacher. For example, an e-portfolio assessment offers students an opportunity to develop skills in digital content creation, which aligns to DigComp Area 3. The research data revealed that employers value competences relating to digital content copyright more highly than graduates and a portfolio assessment could also engage students with digital content copyright.

Section B of the framework represents pedagogic practices that exist within the formal learning space whilst allowing learners to set their own goals and/or seek out their own resources. For example, a teacher could introduce an activity requiring student teams to identify, analyse and design a solution to a real-world problem. A teacher suggests tools and approaches to addressing this real-world problem, but the students have agency in terms of their solution. In this scenario, students have an opportunity to develop competences in digital communications by using messaging or project management tools to interact with teammates. In addition, students can develop competences around digital collaboration, by using shared folders and collaborative documents. These competences align with DigComp Area 2, an area of digital competences identified by both employers and graduates as very important in the research study.

The right side of the framework considers informal contexts. Some of these informal contexts can be within the HEI, e.g. co-curricular/extra-curricular endeavours. Section C of the framework represents contexts where learners may receive advice and guidance for their learning, but this ecology is largely self-directed. For example, the University may develop a digital competences resource bank similar to the All Aboard (2017) initiative. In collating resources, the University offers support and guidance to students around the validity of the resources, whilst allowing student autonomy over their learning by providing a range of resources. A resource bank can support the development of digital problem-solving (Area 5 of DigComp) by encouraging students to select an appropriate resource for their learning. Area 5 is highlighted in the research study as an important set of skills from the employer perspective. Initiatives which offer structured informal learning opportunities for digital competence development can also be provided by the university such as consultation time with experts, (e.g. 'DigiChamps' project at NUI Galway (EDTL, 2020)) or structured learning opportunities (e.g. 'LevUL Up' at University of Limerick (2022)).

Section D of the framework represents entirely independent contexts where learning occurs through self-interest projects. Within a HEI, students may be involved in sports clubs or societies where they can develop digital and other competences. For example, students may develop digital marketing or social media skills to promote their club/society events, which would align to DigComp Area 2 and possibly Area 3, if digital content forms part of this work. Social media and marketing skills are highlighted in the research as a set of skills which are used across a range of roles not just specific to marketing roles. Similarly, in maintaining club/society files and accounts students can develop digital competences around managing information or using spreadsheet tools such as Excel, aligning to DigComp Area 1. Excel skills are highlighted in the research data as important from both graduate and employer perspectives.

4. Conclusion

While this paper is limited in drawing on a very small-scale study relating to digital competences required in the workplace in Ireland, it does offer some insight into graduate and employer perceptions of digital competences required in the workplace. In examining the challenges of digital competence development for students through the lens of learning ecology theory, the paper frames learning ecology theory as a potential tool for HEIs in terms of planning the digital competence development of students. Recognising the variety of learners' ecologies can support HEIs in meeting policy commitments in relation to digitally competent graduates and ensure students are prepared to succeed in the workplace after graduation. Whilst HEIs already have an insight into the formal curriculum, by broadening the view of learning contexts through learning ecology theory, a HEI can also influence

students' competence development in other informal contexts and help students towards being more well-rounded digitally competent graduates.

References

Braun, V. & Clarke, V. (2021). One size fits all? What counts as quality practice in (reflexive) thematic analysis?, *Qualitative Research in Psychology*, 18:3, 328-352, DOI: 10.1080/14780887.2020.1769238

Carretero, S.; Vuorikari, R. and Punie, Y. (2017). *DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use*, doi:10.2760/38842

EDTL. (2020). *The DigiChamps Programme at NUI Galway*. Enhancing Digital Teaching & Learning in Irish Universities. https://edtl.blog/webinar-series/the-digichamps-programme-at-nui-galway/

European Commission. (2016). 'A New Skills Agenda for Europe'.https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52016DC0381

European Commission. (2021). *Digital Education Action Plan (2021-2027)*. https://ec.europa.eu/education/education-in-the-eu/digital-education-action-plan_en

Flynn, S. et al. (2020) 'Enhancing Digital Capacity in Teaching and Learning in Ireland: a national approach', in. 2020 European Learning & Teaching Forum, Utrecht: Europ. Univ. Assoc. https://eua.eu/resources/publications/912:enhancing-digital-capacity-in-teaching-and-learning-in-ireland-a-national-approach.html

IUA: Irish Universities Association. (2021). *Enhancing Digital Teaching and Learning*. http://www.iua.ie/ourwork/learning-teaching/digital-learning/

Jackson, N. (2013). The Concept of Learning Ecologies. In N. Jackson (Ed.), *Lifewide Learning, Education & Personal Development*. www.lifewideebook.co.uk. http://www.lifewideebook.co.uk/uploads/1/0/8/4/10842717/chapter_a5.pdf

Newall, E. (2020). *Preparing students for the digital workplace*. JISC. https://digitalcapability.jisc.ac.uk/case-studies/university-nottingham/

NFETL. (2021). *Next Steps*. National Forum for the Enhancement of Teaching and Learning in Higher Education. https://www.teachingandlearning.ie/vital/nextsteps/

Stauffer, R. C. (1957). Haeckel, Darwin, and Ecology. *The Quarterly Review of Biology*, 32(2), 138–144.

University College Cork. (2022). *Digital Skills*. Retrieved 11 February 2022, from https://www.ucc.ie/en/skillscentre/sessions/digitalskills/

University of Limerick. (2022). *LevUL Up: Student Digital Skills Development Programme.* Retrieved 11 February 2022, from https://www.ul.ie/ctl/students/levul-student-digital-skills-development-programme

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14566

The Digital Museum: Learning through Interaction and Reflection

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Abstract

This paper presents the digital museum as an effective tool for learning. Using the example of a digital museum created in February 2021, the authors use autoethnography to demonstrate how this virtual reality location served both hosts and visitors of an interdisciplinary seminar in higher education that took place during the first pandemic lockdown in the Netherlands. The creation, visitation, and reflective evaluation of the museum formed three phases of learning that benefitted curators and guests who represented various disciplines and levels within higher education. Though generated by the physical restrictions of pandemic education, this example underscores the didactic value of the digital museum as a post-pandemic educational medium.

Keywords: *Higher education; digital museum; curation; reflection; interdisciplinary.*

1. Introduction

Studies on the effects of the transition from physical to online education during the COVID-19 pandemic have been largely critical. Across all levels of education, emergency measures to provide digital instruction raised a range of concerns, from the handling of data (Cone et al., 2021) to educational inequality (Evans, 2021; Werfhorst, Kessenich, & Geven, 2020) and the psychological effects of distance learning (Sahu, 2020). Accordingly, educators have responded to lockdown limitations by seeking creative alternatives for face-to-face instruction. Restrictions have generated new mediums of instruction which demonstrate didactical value beyond the context of the pandemic. One such medium, the digital museum, transforms social distancing into an asset. Transcending the boundaries of place and proximity, the digital museum provides a virtual space for interaction, reflection, and collaboration.

This paper will present a curatorial perspective of the digital museum as an effective tool for learning. Using the example of a digital museum they created in February 2021 (Minnaert et al., 2021), the authors will demonstrate how this virtual location served both hosts and visitors of an interdisciplinary seminar in higher education that took place during the first Dutch lockdown. Through autoethnography, the authors draw on curatorial experience, digitally archived chats, and student blogs to analyze the effectiveness of the museum in three phases. The creation, visitation, and evaluation of the museum form these three phases of learning for both curators and guests, underscoring the didactic value of the museum as a post-pandemic educational medium.

2. Description of the Museum

The interdisciplinary research group Subjects in Interdisciplinary Learning and Teaching (SILT) at Utrecht University hosted an online session in March 2021 as part of a seminar series within the transdisciplinary research platform "Transmission in Motion." The purpose of the session, entitled "Designing for Serendipity," was to explore the phenomenon of serendipity in interdisciplinary encounters. The session aimed to discuss questions like: "Do interdisciplinary encounters foster serendipitous connections and insights? Is interdisciplinarity boosted by serendipity?" and finally, "Is it possible to design and facilitate serendipitous encounters?"

Due to the COVID-19 pandemic, the seminar session was scheduled to take place online, like all other educational and research activities affiliated with Utrecht University in the academic year 2020-2021. The research group SILT felt challenged by the limitations of the digital medium: a meeting with lecturers, artists, students, and researchers, numbering from twenty to fifty in attendance, through the Microsoft platform, "Teams." A year into the pandemic, people were weary of digital interaction. SILT members agreed that an interactive structure

was key, while acknowledging that a live call involving a larger group provided a minimal range of interaction.

One of the authors, Toine Minnaert, suggested the use of an external digital platform, *artsteps.com*. *Artsteps* is a website where users can build and share free, three-dimensional, virtual reality platforms. The SILT group decided to curate a virtual museum through *artsteps.com* for the participants of the "Designing for Serendipity" seminar. Because the research platform Transmission in Motion is transdisciplinary, participants of the seminar would be representative of various disciplines. By inviting them to the museum space, the SILT group hoped to foster trans-, multi-, and interdisciplinary interaction. The group specifically curated the content of "the Serendipity Museum" to stimulate discussion about serendipity, but also to allow visitors to experience it.

Minnaert designed the architecture of the digital museum. The museum building consisted of four color-coded exhibition wings, distinguished by wall color. The blue exhibit was curated according to the theme "serendipity and academic debate." The red exhibit was curated according to the theme "serendipity and immersion." The green exhibit was curated according to the theme "serendipity and randomness." Finally, the yellow exhibit was curated according to the theme "serendipity and coherence in the random." Though the SILT group curated the exhibits according to these themes, the theme in each exhibit was not advertised in the museum itself.

In preparation for the seminar, members of the SILT research group assembled artifacts for placement in the museum. As the museum's primary architect, Minnaert placed these objects in the corresponding exhibit space. The objects varied in type and medium: images, texts, videos, QR codes, and instructions to carry out an activity. Each artifact was placed on a wall in the wing for which it had been selected. Examples of the exhibited objects are a link to the website "Forgotify," a screenshot of a Tweet quoting Anthony Fauci, a YouTube video of artist Karel Appel painting a canvas, and instructions for a game with dice.

After a brief plenary introduction to the subject of serendipity, the seminar participants were given the external link to the digital museum and invited to enter the virtual reality space and look around. The SILT seminar hosts explained that while visitors were wandering, channels in the Microsoft Teams platform would also be open for discussions. SILT members waited in these channels, which were color and theme-coordinated according to the exhibition rooms: green, blue, red, and yellow discussion channels. After an allotted timeframe for wandering and breakout conversations, the participants were invited to return to the plenary channel of the Microsoft Teams platform to conclude with a general discussion.

3. Curatorial phase: learning through creating

Curation is usually connected to the action or process of selecting, organizing, and managing the items in a collection or exhibition. Some argue that curation is indispensable in the recognition of a work as a work of art, and that consequently, the curator is more important than the artist. Others object to this so-called curatorial turn, rejecting its neglect of the intrinsic value and quality of a work of art (O'Neill, 2015; Wolff & Mulholland, 2016). A more general application of a curatorial strategy asks whether the meaning or value of an artifact is dependent on the context in which it is presented.

Pascal Gielen (2004) has developed a model to analyze and categorize artistic selection processes. At the basis of this model are two dichotomies: 1) singular versus collective regime and 2) content-based versus context-based logic. A translation of these dichotomies into axes results in four quadrants, each describing a curatorial strategy with specific criteria to substantiate the choices. When applying a singular context-based strategy, for example, the choice for an artwork is based on the author or artist, whereas a collective content-based strategy leads to a choice based on genre or style.

The use of both a curatorial strategy and Gielen's model in the preparatory phase of the SILT seminar triggered a lively discussion amongst the SILT members about the artifacts they wanted to include. As Campos and de Fegueiredo (2002) rightfully point out, there is a difference between programming serendipity (which seems contradictory) and programming *for* serendipity. The latter was clearly the case in this museum; the SILT team curated a space that would allow for serendipity to take place. Instead of thinking about key authors and concepts and how they would contribute to the desired narrative, this approach triggered the curators to let go of the linear narrative and think of ways to visualize a discussion on serendipity. Initially, SILT members collected a range of interesting artefacts connected to serendipity. Following the decision to work with four themed areas, the search for artefacts focused to create a balance between the four areas. There was a clear bias towards academic sources in the preliminary stages, but with time, practical examples emerged to complement them.

Because the digital format of the museum allowed for the inclusion of a broad range of media, it could be seen as a tool for developing metaliteracy (Mackey & Jacobson, 2011) and hypertext for non-sequential writing (Nelson, 1965). The interface of the virtual museum made it necessary to think in spatial terms about the relations between the various artifacts – just like in a physical museum. For example, the curators translated the conceptual opposition of two leading academic authors by placing videos of two different scientists on opposing walls. Spaces were structured in such a way that some were easy to miss. This provoked a situation in which visitors were unable to see all the artifacts in the allotted time, emerging from the museum with different stories.

4. Practical phase: learning through 'wandering'

Artsteps offers the possibility to design a guided tour and to determine the narrative for the visitors. Instead of paving the way for guests, the curators decided to fully embrace the idea of serendipity: the hosts 'dropped' the visitors at the entrance of the museum and let them wander around on their own. Unlike other tools for digital curation (see e.g. Ungerer, 2016), the virtual museum transforms the visitor into a co-creator and their wandering into a core activity. From a theoretical angle, this wandering could be loosely linked to what Guy Debord describes as the dérive (Debord, 1958). The dérive is both a solo and collective encounter in which people interact with features of a terrain. The dérive emphasizes the immersive aspect of the encounter, which is supplemented by the collective experience of wandering. The museum formed an effective tool for a collective activity, because every individual was required to act. Leaning back was not an option.

As mentioned before, the connection between the artifacts in the various color-coded blocks was clear to the curators. The curators did not explain this to the visitors, but visitors indicated in the discussion afterwards that the color-coding helped them choose where to wander (e.g. focusing on one or two of the blocks). Navigational skills were required to locate some of the artifacts. For example, a few people did not find the entrance to a secluded area that displayed a nature walk film. Likewise, those who stayed inside the museum missed the wishing well and other artifacts that were located outside.

The idea of wandering was also literally incorporated into the museum: on one of the outside walls of the museum, Minnaert placed a poem originating from the project *De letters van Utrecht*, by which a poem is carved into cobblestones in the city of Utrecht. One must walk approximately 100 meters to read the text, which – like the poem on the wall of the digital museum – is impossible to see in its entirety. Most visitors discover it while wandering through the city center.

5. Evaluative phase: learning through reflecting

Drawing on the testimonies of seminar participants, the curators evaluated the effectiveness of the digital museum as a tool for learning. These testimonies were archived through two mediums: the online discussion channel in the Microsoft Teams seminar forum and the weblogs written by students. Student participants corroborated these last perspectives in six essays written for the Transmission in Motion blog website in the weeks following the seminar. In the essays, students reflected on serendipity, the artifacts, and the digital museum as an intermedial, hybrid location. Because the discussion chats and the blogs were facilitated after the museum visit, the testimonies were reflective in nature.

As explained earlier, seminar participants were simultaneously free to wander in the museum itself, but also to wander into MS Teams break-out channels for discussion. SILT members facilitated conversations in these color-coded channels, which corresponded to colors of the exhibition rooms. The participants recognized the correspondence between the color of the exhibition room and the color indicated in the title of the break-out channel. Consequently, they began to discuss their experience in the "green room," "blue room," "red room," or "yellow room," depending on the channel they had joined. Also, they discussed their overall experience while wandering through the museum.

In these discussions, the chat, and the student blog entries, participants reflected on both content and form. On the one hand, the participants reflected on the artifacts in the color-coded exhibition rooms. What was the object? Why was it placed in that particular room? What did the object have to do with serendipity? How were the objects in the room linked with each other?

> One of the first exhibits…I encountered was a video of a famous expressionistic Dutch painter, in which he (at least seemingly) at random put down paint on a canvas. The video sparked a discussion amongst those in the 'green room' where the video was being exhibited; could we really speak of serendipity here? Was Appel truly painting *at random*, or was he actually applying some technique he had developed previously? (Everts, 2021)

On the other hand, participants reflected on the greater experience of wandering through a digital museum. How did they navigate through virtual reality? What did it feel like to facilitate movement through an avatar and the click and drag of a mouse? What museum details did they notice in the spaces between the exhibition halls? What did they see outside, if at all? Many connected the digital medium directly to the experience of 'serendipity:'

> My experience…was positive, even with a few glitches in my navigational skills. One profound value from this design lab was, in fact, my poor navigational skills. Somewhat serendipitously, I could not visit and reflect on all parts of the exhibition. (Tidball, 2021)

Testimonies also referenced past experiences in physical museums. What was it like to wander through the virtual space individually, while unable to physically interact with other avatars? How did this experience resemble a physical museum visit? How was it different?

> Visiting this online museum functions in a completely different way from visiting an on-site museum: one cannot see what lies in front, cannot freely turn one's head to see the walls in one glance. In this case, doing so requires close collaboration with one's computer and trust in the digital technology – trust that it will guide her through space in which visibility is highly limited. (Jakubiec, 2021)

Stevens and Cooper (2009) define reflection as "the engine that moves the learning cycle further along its path to further learning, action, and reflection" (p. 24). This definition underscores the value of the post-visit discussions and blog entries.

The wandering phase of the seminar was highly individual, that is, experienced with limited verbal or textual interaction between participants. This limited interaction reduced the function of the digital museum as a social "contact zone" (Clifford, 1997, p. 204). The post-visit reflections fulfilled this function, extending the museum experience into the breakout and plenary locations, but also into the blog website. Collective reflection after the museum visits provided a space for social contact that transcended physical distance and academic discipline.

Moreover, collective reflection stimulated the process of critical thinking and comprehension. Reflection prevented the visitor from being 'stuck' in the experience without gaining any new understanding" (Stevens & Cooper, 2009, p. 24). Dewey describes the reflective process as a means to "transform a situation in which there is experienced obscurity, doubt, conflict, disturbance of some sort into a situation that is clear, coherent, settled, harmonious" (Dewey, as cited in Stevens & Cooper 2009, p. 21). The post-visit reflections allowed visitors to exchange and evaluate any queries regarding the exhibition content or the virtual reality space, and to gain clarity or new insights.

6. Conclusion

The digital "Serendipity" museum served as an effective tool for learning during an interdisciplinary seminar in higher education that took place during the Dutch lockdown in 2021. The creation, visitation, and evaluation of the museum formed three phases of learning for both curators and guests, underscoring the didactic value of the museum as a post-pandemic educational medium.

The curatorial phase led to creative insights on how to present and facilitate the phenomenon of serendipity. Instead of presenting a linear narrative, the curators created a space filled with potential narratives. The emergence of these narratives was contingent on the active participation of visitors, making them 'co-creators.' By individually wandering through the museum, each visitor had a unique and serendipitous experience. Some of the participants sought a dominant narrative or a clear cohesion, whereas others fully immersed themselves in the serendipitous experience. The presence of both types of wandering provided a fruitful basis for evaluation. Participant testimony reflected on both content (serendipity) and form (the virtual museum as a tool). These insights affirm the value of the digital museum as a creative, visual, and participatory medium for teaching and learning, with or without the context of pandemic education.

References

Campos, J. & de Fegueiredo, A.D. (2002). Programming for serendipity. *Proceedings of the 2002 AAAI Fall Symposium on Chance Discovery-the Discovery and Management of Chance Events, AAAI Technical Report FS-02-01.* http://dx.doi.org/10.2139/ssrn.1385402

Clifford, J. (1997). *Routes, Travel and Translation in the Late Twentieth Century.* Cambridge, MA: Harvard University Press.

Cone, L., Brøgger, K., Berghmans, M., Decuypere, M., Förschler, A., Grimaldi, E., Hartong, S., Hillman, T., Ideland, M., Landri, P., van de Oudeweetering, K., Player-Koro, C., Bergviken Rensfeldt, A., Rönnberg, L., Taglietti, D., & Vanermen, L. (2021). Pandemic Acceleration: Covid-19 and the Emergency Digitalization of European education. *European Educational Research Journal*. https://doi.org/10.1177/14749041211041793

Debord, G. (1958). Theory of the Dérive. *Internationale situationniste,* 2.20.05.

Evans, Y., Hutchinson, J., & Ameenuddin, N. (2021). Opportunity, Challenge, or Both? Managing Adolescent Socioemotional and Mental Health During Web-Based Learning. *JMIR mental health*, *8*(9), e26484. https://doi.org/10.2196/26484

Everts, D. (2021). *Serendipity and Kairos in Human and Machines*. Retrieved April 24, 2022, from https://transmissioninmotion.sites.uu.nl/serendipity-and-kairos-in-humans-and-machines-daniel-everts/

Jakubiec, J. (2021). *Serendipitous Working: Discovery and Respect.* Retrieved April 24, 2022, from https://transmissioninmotion.sites.uu.nl/serendipitous-working-discovery-and-respect-justyna-jakubiec/

Mackey, T.P., & Jacobson, T.E. (2011). Reframing information literacy as a metaliteracy. *College & Research Libraries 72(1)*, 62–78.

Minnaert, T., Hacopian, A., Domen, I., Kustritz, A., Sterk, F., van der Tuin, I., van Goch, M., van Lambalgen, R. & van Woerden, R. (2021). Transmission in Motion - Designing for Serendipity. Retrieved from https://www.artsteps.com/view/6013c91f3aef2a31ac5c4787

Nelson, T.H. (1965). Complex information processing: a file structure for the complex, the changing and the indeterminate. *ACM '65: Proceedings of the 1965 20th national conference*, August 1965, 84–100. https://doi.org/10.1145/800197.806036

Sahu, P. (2020). Closure of Universities Due to Coronavirus Disease 2019 (COVID-19): Impact on Education and Mental Health of Students and Academic Staff. *Cureus* 12(4): e7541. doi:10.7759/cureus.7541

Stevens, D.D. & Cooper, J.E. (2009). *Journal Keeping. How to Use Reflective Writing for Effective Learning, Teaching, Professional Insight, and Positive Change.* Sterling, VA: Stylus.

Tidball, N. (2021). *Eco Art and Serendipity*. Retrieved on April 24, 2022, from https://transmissioninmotion.sites.uu.nl/eco-art-and-serendipity-naomi-tidball/

Ungerer, L. M. (2016). Digital Curation as a Core Competency in Current Learning and Literacy: A Higher Education Perspective. *International Review of Research in Open and Distributed Learning, 17(5)*, 1–27. https://doi.org/10.19173/irrodl.v17i5.2566

van de Werfhorst, H. G., Kessenich, E., & Geven, S. (2020, August 18). The Digital Divide in Online Education. Inequality in Digital Preparedness of Students and Schools before the Start of the COVID-19 Pandemic. https://doi.org/10.31235/osf.io/58d6p

Wolff, A. & Mulholland, P. (2013). Curation, curation, curation. *Proceedings of the 3rd Narrative and Hypertext Workshop (NHT'13)*, Paris, France, May 1-3, 2013, 1-5. https://doi.org/10.1145/2462216.2462217

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14460

Assessment criteria for work-integrated learning in a generalist postgraduate university programme

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Abstract

Work-integrated learning (WIL) such as placements and internships are becoming increasingly common in generalist (i.e. not profession-oriented) postgraduate university programmes. Nevertheless, the justification for work-integrated learning in such programmes is not obvious. While various purposes have been proposed, this paper draws on the university's traditional role in producing and disseminating research-based knowledge. The paper suggests that in generalist study programmes, learning objectives and, hence, assessment of work-integrated learning can profitably be molded on time-tested practices in academic scholarship. Central in this respect is the ability to reflect on the relationship between theory and practice. Adopting this ability as an intended learning outcome (ILO), the paper argues that generalist programmes should embrace work-integrated learning. Specifically, the paper advances a set of assessment criteria that offer a flexible yet rigorous basis for assessing work-integrated learning in generalist postgraduate university programmes.

Keywords: *Work-integrated learning; Work-based learning; Placement; Internship; Constructive alignment; Assessment.*

1. Introduction

Universities are increasingly implementing work-integrated learning, not only in profession-oriented education but also in the generalist programmes (Billett, 2009). Work-integrated learning can take many forms, including internships, work placement and master's theses written in conjunction with an organisation external to the university. However, whereas the purpose of practice is relatively straightforward in the professional study programmes, i.e. to prepare future practitioners of The Profession, the purpose of practice in generalist study programmes is less obvious. The reason is that generalist programmes train future experts with no specific position, profession or sector in mind. Accordingly, in the generalist programmes university teachers can struggle to formulate appropriate learning objectives for students' work-integrated learning (Yorke, 2011). Arguably, this challenge intensifies as one moves from the undergraduate to the postgraduate level. A generalist master's programme is typically research-based and theory-oriented. How then, in Biggs' (2014; Biggs & Tang, 2011) language, can a university professor align intended learning outcomes (ILOs), teaching and learning activities (TLAs), and assessment tasks (ATs) relative to work-integrated learning in a generalist postgraduate programme?

More specifically, this paper asks: *"What are appropriate assessment criteria for work-integrated learning in a generalist postgraduate university programme?"* There are three reasons for focussing on the assessment element of *constructive alignment* (Biggs, 2014; Biggs & Tang, 2011). First, the assessment is a critical part of any learning activity at a university, including work-integrated learning. Students expect assessments to be consistent, objective and based on explicit evaluation criteria. More than that, assessment determines students' learning: *"Assessment, rather than teaching, has a major influence on students' learning. It directs attention to what is important. It acts as an incentive for study. And it has a powerful effect on what students do and how they do it."* (Boud & Falchikov, 2007). Second, to meet students' expectations of transparent assessment, and to remain in line with the idea of constructive alignment, the teaching staff must formulate intended learning outcomes and develop accompanying assessment criteria. At present, however, little practical guidance is available regarding the assessment of work-integrated learning (Ajjawi et al., 2020; Yorke, 2011). The present paper addresses this shortcoming. Third, while the academic literature on work-integrated learning is traditionally biased towards profession-oriented programmes, this paper claims that the intended learning objectives and, hence, the assessment criteria are likely to be different in the generalist programmes. This contextual aspect is often missing in published research on work-integrated learning. Accordingly, with its emphasis on assessment, this paper extends theory with respect to the constructive alignment of work-integrated learning in generalist postgraduate university programmes specifically.

2. Literature

2.1. Work-integrated learning

To the detriment of academic development, researchers apply a great variety of names for essentially the same thing: work placements, internships, practicum, practice-based learning, cooperative education, *etc*. In part, this proliferation of terms is due to divergent national traditions, regulations and political priorities that make each country's context unique. Nonetheless, there is a pressing need to develop theoretically significant taxonomies that distinguish between different study programmes, types of placement, categories of hosting organisations, and other factors that have an impact on students' learning outcomes. Here, we apply the term work-integrated learning (WIL). Symptomatically, this literature too lacks consistence in what it actually refers to. For example, authors commonly see WIL primarily as a learning activity to foster work-readiness and employability (Jackson, 2015; Rowe & Zegwaard, 2017; Tran & Soejatminah, 2016). In contrast, we align ourselves with Smith (2012, p. 247), who states that: *"WIL is not the same as work experience or work-based learning, neither of which require students to specifically learn, apply or integrate canonical disciplinary knowledge."* And further: *"This idea emphasises that combination, assimilation or connection of theory and practice are the core intellectual activities for students"* (p. 251). The present paper develops this argument to suggest that, in a generalist postgraduate university programme, work-integrated learning is not primarily motivated by employability but by the opportunity to test theory against practice.

2.2. Practice as data collection

In the words of Dubois and Gadde (2002, p. 555), *"the main objective of any research is to confront theory with the empirical world"*. This formulation resonates with Smith's (2012, p. 251) emphasis above that "*combination, assimilation or connection of theory and practice are the core intellectual activities for students"*. Extending the parallel between academic research and work-integrated learning, we here adopt the view that practice in a generalist postgraduate university programme serves the purpose of illuminating theory. Accordingly, the student's understanding is cemented as the student applies theoretical knowledge to an empirical setting. Collecting data in the workplace by means of personal observation, interviews or written documentation permits the students to draw conclusions and to relate their own findings to the theory found in textbooks and academic journals. Do their findings corroborate theory? Do they differ? Can the student explain how and why?

An academic research project can be understood as learning under a set of established quality criteria to ensure sound methodology and robust findings. The researcher's learning experience while contemplating extant literature, and collecting and analysing data, is in essence very similar to that of the student. The students, too, familiarize themselves with

previous research (be it in the form of a textbook or original journal articles) and – yes! – internships and work placements allow them to collect data and relate these data to appropriate theories, akin to what the researcher does.

Accordingly, generalist postgraduate university programmes should embrace work-integrated learning as an integral part of a research-based and theory-oriented curriculum. Indeed, such programmes should highlight "the ability to reflect on the relationship between theory and practice" as a key intended learning outcome (ILO) for work-integrated learning (Billett, 2009; Duignan, 2003; Smith, 2012). Hence, whereas scholars in the past have identified diverse motivations for work-integrated learning, such as active learning (Jackson, 2015), employability (McNamara, 2013), and the appropriation of generic (transferable) skills (Hayes & Cejnar, 2020), the vantage point in this paper is to align the teaching/learning activity (TLA) of practice with the intended learning outcome (ILO) of being able to reflect on the relationship between theory and practice.

In line with the above, this paper assumes a view of *practice as data collection*. In other words, the assumption is that we can assess work-integrated learning against the same quality criteria that apply to academic research. This idea is spelled out below, together with a set of suggested assessment criteria for work-integrated learning in a generalist master-level university programme in the social sciences and, arguably, in a wide range of other disciplines.

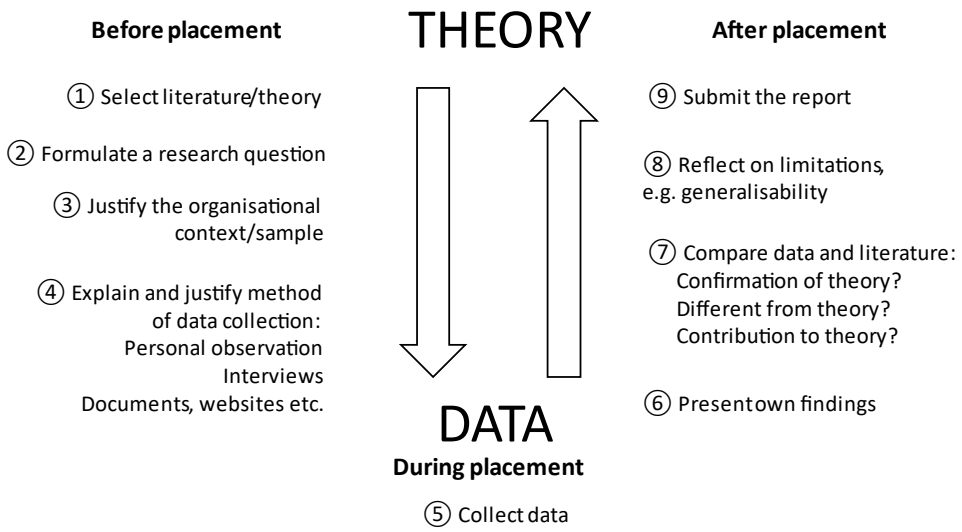

Figure 1. Practice as data collection. Source: The author.

4. Practice as data collection

Having laid the intellectual foundation above, Figure 1 *Practice as data collection* sums up the contribution of this paper. The diagram presents nine steps that can serve as assessment criteria for an internship report, a placement reflection paper, a work-integrated master's thesis or a similar assessment task (AT). The steps in Figure 1 are aligned with the intended learning outcome (ILO) "reflect on the relationship between theory and practice". The ILO and the assessment criteria are indicative only, and should be adjusted and refined to match the requirements of the individual course or study programme. Similarly, the steps can be further developed into detailed grading criteria or rubrics to specify how various levels of learning correspond to individual grades.

In Figure 1, the relationship between theory and data takes centre stage. In Step 1, the student should acknowledge the stream of literature or the theoretical model used as analytical lens. In Step 2, the student formulates a research question to guide data collection at the workplace. Step 3 requires the student to justify why the hosting organisation in question is relevant to the theoretical lens and the research question. The student must next (Step 4) account for the choice of method for data collection. In Step 5, the student describes how data collection was carried out and notes any methodological challenges that were encountered. Step 6 demands that the student identify his or her findings and present these in a suitable manner. In Step 7, crucially, the student reflects on the relationship between own findings and the academic literature. Step 8 involves considering the limitations of one's own work, such as the generalisability of one's findings to other organisational contexts. Finally, Step 9, the student hands in the report for assessment.

As illustrated in Table 1, the nine steps enjoy broad support in the established methods literature as standard quality criteria for academic enquiry.

5. Concluding remarks

This paper addresses a knowledge gap concerning intended learning outcomes (ILOs) and suitable assessment criteria for work-integrated learning at the university level. The topic is relevant as universities are increasingly expected to offer work-integrated learning, not only in the profession-oriented programmes but also in the generalist study programmes, including at the postgraduate level. Nonetheless, few guidelines exist to aid course and programme coordinators in this area. Based on the notion of *practice as data collection*, this paper advocates the use of academic quality standards as assessment criteria for work-integrated learning, notably in generalist (i.e. not profession-oriented) postgraduate programmes. Although much remains in terms of conceptual refinement and testing, this study represents an early attempt at answering the question: *"What are appropriate assessment criteria for work-integrated learning in a generalist postgraduate university programme?"*

Table 1. Support for the nine steps in the academic methods literature

Step	Assessment criteria	Reference
1.	Select literature/theory	*"…a paper using a case as illustration might more usefully present the case after the theory…"* Siggelkow (2007, p. 22)
2.	Formulate a research question	*«Defining your research question(s) is probably the most important step to be taken in a research study…»* (Yin, 2018, p. 11)
3.	Justify the organisational context/sample	*"…it is often desirable to choose a particular organization precisely because it is very special in the sense of allowing one to gain certain insights that other organizations would not be able to provide."* Siggelkow (2007, p. 20)
4.	Explain and justify method of data collection	*«A research design is a statement written, often before any data is collected, which explains and justifies what data is to be gathered, how and where from.»* (Easterby-Smith, Thorpe, Jackson, & Jaspersen, 2018, p. 93)
5.	Collect data	*«All six sources discussed here are commonly found in case study research: documentation, archival records, interviews, direct observations, participant-observation and physical artifacts.»* (Yin, 2018, p. 113)
6.	Present own findings	*«One of the most common issues that qualitative researchers face is how to condense highly complex and context-bound information into a format that tells a story in a way that is fully convincing to others.»* (Easterby-Smith et al., 2018, p. 234)
7.	Compare data and literature	*«[The research] should synthesize by bringing into dialogue theory and data in a way that translates into a cohesive argument.»* (Easterby-Smith et al., 2018, p. 6)
8.	Reflect on limitations, e.g. generalisability	*«…essentially [the conclusions] need to summarize the nature of the research, the main findings or contributions, provide an indication of the limitations of the work, and make suggestions for future research directions.»* (Easterby-Smith et al., 2018, p. 374)
9.	Submit the report	*«For Bachelor of Business Administration (BBA) and Master's courses, the required dissertations are often longer than project reports (perhaps 10,000 to 20,000 words), and are the product of individual rather than group efforts.»* (Easterby-Smith et al., 2018, p. 384)

References

Ajjawi, R., Tai, J., Huu Nghia, T. L., Boud, D., Johnson, L., & Patrick, C.-J. (2020). Aligning assessment with the needs of work-integrated learning: the challenges of authentic assessment in a complex context. *Assessment & Evaluation in Higher Education, 45*(2), 304-316. doi:10.1080/02602938.2019.1639613

Biggs, J. (2014). Constructive alignment in university teaching. *HERDSA Review of Higher Education, 1*|, 5-22.

Biggs, J., & Tang, C. (2011). *Teaching for Quality Learning at University* (4th ed.). Maidenhead, England, U.K.: Open University Press/McGraw-Hill.

Billett, S. (2009). Realising the educational worth of integrating work experiences in higher education. *Studies in Higher Education, 34*(7), 827-843.

doi:10.1080/ 03075070802706561

Boud, D., & Falchikov, N. (2007). Introduction: Assessment for the long term. In D. Boud & N. Falchikov (Eds.), *Rethinking Assessment in Higher Education: Learning for the Longer Term* (pp. 14-26). London: Routledge.

Dubois, A., & Gadde, L.-E. (2002). Systematic combining: an abductive approach to case research. *Journal of Business Research, 55*(7), 553-560.

doi:https://doi.org/10.1016/S0148-2963(00)00195-8

Duignan, J. (2003). Placement and adding value to the academic performance of undergraduates: reconfiguring the architecture - an empirical investigation. *Journal of Vocational Education & Training, 55*(3), 335-350.

doi:10.1080/13636820300200233

Easterby-Smith, M., Thorpe, R., Jackson, P. R., & Jaspersen, L. J. (2018). *Management & Business Research* (6th ed.). Thousand Oaks, CA, U.S.A.: SAGE Publications, Inc.

Hayes, M., & Cejnar, L. (2020). Evaluating alternative work-integrated learning opportunities: Student perceptions of interdisciplinary industry-based projects. *Journal of University Teaching & Learning Practice, 17*(4), 6-12.

doi:http://dx.doi.org/10.14453/jutlp.v17i4.7

Jackson, D. (2015). Employability skill development in work-integrated learning: Barriers and best practice. *Studies in Higher Education, 40*(2), 350-367.

doi:10.1080/03075079.2013.842221

McNamara, J. (2013). The challenge of assessing professional competence in work integrated learning. *Assessment & Evaluation in Higher Education, 38*(2), 183-197.

doi:10.1080/02602938.2011.618878

Rowe, A. D., & Zegwaard, K. E. (2017). Developing graduate employability skills and attributes: Curriculum enhancement through work-integrated learning. *Asia-Pacific Journal of Cooperative Education, 18*(2), 87-99.

Retrieved from https://hdl.handle.net/10289/11267

Siggelkow, N. (2007). Persuasion with case studies. *Academy of Management Journal, 50*(1), 20-24. doi:10.5465/amj.2007.24160882

Smith, C. (2012). Evaluating the quality of work-integrated learning curricula: a comprehensive framework. *Higher Education Research & Development, 31*(2), 247-262. doi:10.1080/07294360.2011.558072

Tran, L. T., & Soejatminah, S. (2016). 'Get Foot in the Door': International students' perceptions of work integrated learning. *British Journal of Educational Studies, 64*(3), 337-355. doi:10.1080/00071005.2015.1128526

Yin, R. K. (2018). *Case Study Research and Applications* (6th ed.). Thousand Oaks, CA, U.S.A.: SAGE Publications, Inc.,.

Yorke, M. (2011). Work-engaged learning: towards a paradigm shift in assessment. *Quality in Higher Education, 17*(1), 117-130. doi:10.1080/13538322.2011.554316

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14391

The academic mobility in pandemic times: the impact on Sapienza University of Rome students' lives

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Abstract

According to the European Commission statistics, taking a mobility period abroad may prove to be an important experience not only by an academic point of view but also by a personal perspective. In this sense, the impact of studying in another European and extra-European University can be seen in the increasing technical skills, individual competences and attitudes that, in most cases, helps students in finding their first-job more easily after the graduation. Following these premises, this case study research wants to explore, thanks to the availably of primary data collected in 2021, the impact of the academic mobility on Sapienza University of Rome students' personal development. In this respect, data on the mobility impact will be analyzed taking into account the type of the mobility experienced by students. Due to the Covid-19 pandemic indeed, mobilities could also take place in virtual and blended modality.

Keywords: *Erasmus+; internationalization; higher education; personal development; outgoing students; Italy.*

1. Introduction

In the last decades, an ever greater number of students experienced a mobility period abroad within the higher education system: indeed, the expression "academic mobility" (or student mobility, in a narrower sense) refers to the possibility, for students, to move to other institutions abroad for thesis research or study purposes. In this respect, the exams taken at the partner University will be fully recognized upon the students' return at the home University.

Thanks to this opportunity, as underlined by the European Commission in the Report *Erasmus+ Higher Education Impact Study* (2019), the students who completed an Erasmus+ mobility period for studying or training in another University improved their professional and occupational skills with benefits in inter-personal and inter-cultural competences too. In this sense, the aim of the mentioned research, based on almost 77.000 survey responses with reference to the years 2014-2018, was to assess the impact of academic mobility on staff, students and higher education institution, so demonstrating how the mobility experience increases not only the students' employability but also personal and individual features such as self-confidence, social openness, cultural viewpoint (Almeida, 2020; Pustulka and Winogrodzka, 2021).

Indeed, as far as the employability and trasversal abilities is concerned, European Commission put in evidence that around 80% of Erasmus+ graduates found their first job after graduation in less than three months while 72% of them reported that Erasmus+ had been useful in finding their first job. On the other side of the coin, that is the personal enhancement, European Commission emphasizes how the mobility process, in addition to the transmission of new teaching methods and learning practices (two out of three Erasmus+ students started to use new learning methods during their stay abroad), facilitates in fostering social cohesion and in accepting different social values since about 95% of interviewed students agree that mobility period taught them to better get along with people of other nations and to improve their ability to take cultural differences into account. Therefore, there is evidence to suggest that spending a mobility period abroad helps to reduce discrimination, intolerance, xenophobia and racism (Devlin *et al.*, 2017).

For this reasons, following these theoretical premises, the aim of this study is to investigate the mobility impact on the personal sphere of Sapienza University of Rome's students.

2. Mobility flows and mobility effect: Sapienza University of Rome' case

Following the European Commission' statistics, Italy is one of the main countries that experienced increased mobility flows over the years. Analyzing these data more in detail, it is possible to note that, in 2020, 93.688 participants in 1.087 Italian projects benefited from mobility in higher education, vocational education and training, school education, adult learning and youth for a total grant amount of €175.56 million (European Commission,

2021a). In this context, Sapienza University of Rome is characterized by being, together with the Alma Mater Studiorum – University of Bologna and the University of Padua, among the top three sending institutions (European Commission, 2020) and this is the reason why it was decided to carry out a case study, that can be useful for understanding specific educational contexts (Hamilton and Corbett-Whittier, 2013), in this specific University. Besides this, Sapienza University of Rome constitutes one of the most important Italian higher education institution in Italy: indeed, founded in 1303 by Pope Boniface VIII, it is the oldest University in Rome and the largest University in Europe and, at the present time, it is composed by 11 faculties, 58 departments with a total of 3.341 academics and 116.928 students enrolled. As regards the international dimension of this University, that is the topic of this paper, Sapienza University of Rome records 10.008 enrolled international students and 3.700 Erasmus students every year, thanks to the 1.085 agreements signed with partner university in 86 countries. In this respect, students who decide to do a mobility period abroad, could benefit of a wide choice of mobility programmes offered by Sapienza University of Rome, such as the Erasmus+ Programme countries (E+ UE) for study and traineeship, the double degree agreements, the bilateral agreements for student exchange with non-EU universities and the Erasmus+ International Credit Mobility.

Hovewer, in line with the results described in the *Erasmus+ Higher Education Impact Study* (2019), also in this case all these programmes support students in gaining skills in order to improve their professional development and deepen their understanding of other cultures (Suárex-Ortega and Risquez, 2014; Teichler, 2017). This issue has been shown by the output obtained by a quantitative web survey launched in november 2021 to all the Sapienza students (outgoing students) who did a mobility period abroad during the academic year 2019-2020. In this respect, it is of fundamental importance highlighting that not all of the students, due to the Covid-19 pandemic restriction, had the possibility to spend a physical mobility period at the hosting institution, attending classes or carrying out research activities/traineeship in presence (European Commission, 2021b; Quacquarelli Symonds, 2021). Therefore, the collected primary data, which are related to 514 replies, will take into consideration the type of mobility (physical, virtual or blended). Even though these data are just descriptive, they help understanding how the mobility modality impacts on the students' personal development, despite no completed data are available for both a national or international comparison with the exception of the researchs aimed to investigate the more general consequences of the Covid-19 pandemic on student mobility plans and expectations (Bista, Allen and Chan, 2021).

2.1. Sapienza students' choices: why study abroad

The first question addressed to Sapienza outgoing students' aimed to explore the underlying reasons for doing a mobility period abroad. Looking at Table 1, it is possible to note how the desire of learning/improving a foreign language (also by attending a study programme in a

different language) and the opportunity to live abroad and gain knowledge of another country are the keys of this choice (respectively, 24% and 19% of the total number of the responses and 70% and 55.4% of the total number of the cases); on the contrary, the possibility of builing a personal network does not seem to be attractive to students (4.1% of the total number of the responses). Nevertheless, deepening this aspect by taking into account the degree cycle, results show that PhD students are more likely to spend a mobility period abroad in order to experience different learning/teaching/research programmes and/or methods (87.5%) and to build up a personal and professional network (41.7%), so confirming the inclination toward the field of research expanding the own academic network also from the international point of view as well. Conversely, single-cycle degree students (80.5%) prefer to spend a mobility period in another University in order to learn/improve another language while bachelor students (62.3%) and master students (55.8%) choose to study abroad predominantly for living abroad and gaining knowledge of a different country.

Table 1. Main motivation for going abroad (including blended or only virtual mobility)

Variable	% of responses	% of cases
To learn/improve/follow a study programme in a foreign language	24.0	70.0
To live abroad, meet new people and gain knowledge of another country	19.0	55.4
To develop soft skills, such as adaptability, problem solving, curiosity, etc.	17.9	52.1
To experience different learning/teaching/research programmes and/or methods	18.6	53.7
To enhance my future employability (in my home country or abroad)	16.4	47.6
To build up a personal and professional network	4.1	12.1

Source: Authors own elaboration

2.2. Sapienza students' experience: the pros of studying abroad

As far as the benefits of the academic mobility is concerned, Figure 1 shows, according to the type of mobility experienced, that not all the students underline the same positive aspects of their time abroad. Results, obtained summarizing the responses of the Likert items "rather agree" and "strongly agree", put in evidence that doing a physical mobility at the hosting institution, attending classes or carrying out research activities/traineeship in presence records the highest values on most of the elements considered in the scale, specifically in

finding solutions in difficult and/or challenging contexts (95.1%) and in appreciating the value of different cultures (94.2%). The same pattern is also observed by considering the students that attended a physical mobility at the hosting institution but attended classes virtually, even though, differently from those who participated in more activities physically and much more in line with students who did a virtual mobility without moving to the country of the host institution, they state that the mobility period not trained them in expressing the own identity creatively (75.7%) and in working in team (63.6%). Moving to analyzing the impact of the blended mobility on student's personal development, it is possible to note that students who attended classes both virtually and in presence in the country of the host institution, are more similar, in certain respects, to students who did a psychical mobility attending classes in presence. However, these students, much more than the others, declare that this kind of mobility helped them in planning and organizing tasks and activities (91.8%) and in working in team (80.3%). Finally, virtual mobility, typical of those who never moved to the hosting institution, record the lowest values on most of the items, mainly with reference to the expressions of the own individuality creatively (66.7%) and to the thinking logically and drawing conclusions (66.6%). Nevertheless, if the absence of intense contact with both professors and colleagues has determinated these feelings, on the other side of the coin, it can be assumed that this could also incremented the predisposition to plan and organize independently tasks and activities (86.7%).

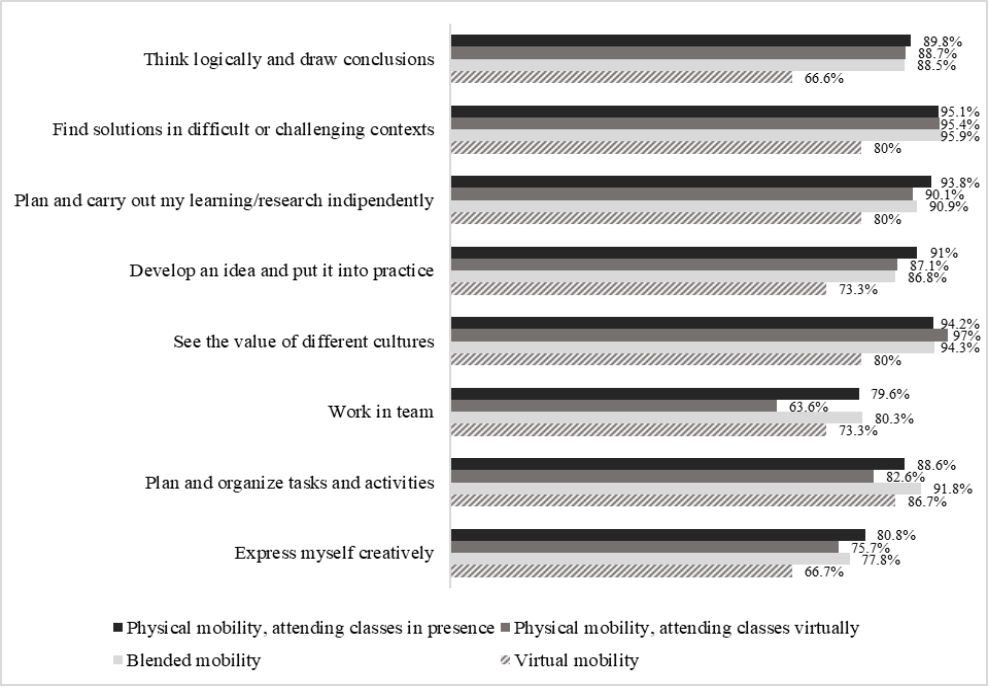

Figure 1. Impact of the academic mobility on students' personal development. Source: Authors own elaboration.

2.3. Sapienza students' ambitions: how the mobility improves the professional career

As regards the labour sphere, another specific question aimed to investigate how the Sapienza outgoing students think the mobility period abroad helped them in finding a job or in improving their employment condition. In this respect, results seem to confirm the general trend above showed since students who moved to the country of the hosting institution, attending classes in presence, are more confident than the others of their job opportunities. Observing the data presented in Table 2, even then obtained summarizing the responses of the Likert items "rather agree" and "strongly agree", it is possible to underline that 87% of them believe that their chances to get a new or better job have incresead after the mobility, 85.3% think that are more capable of taking over work tasks with high responsibility, 81.2% have a clear idea about the professional aspirations and goals and 67.7% presume to have better opportunity for jobs in the home country. Approximately, the same values could be observed with regards to the students who did a blended mobility; conversely, students who experienced a physical mobility participating virtually at classes are more in line with students who did a virtual mobility. In this sense, both record lowest value in the Likert items concerning the clarity of their professional aspirations (respectively, 75.7% and 66.7%) and the idea of having a better opportunities in the home country (64.4% and 60%).

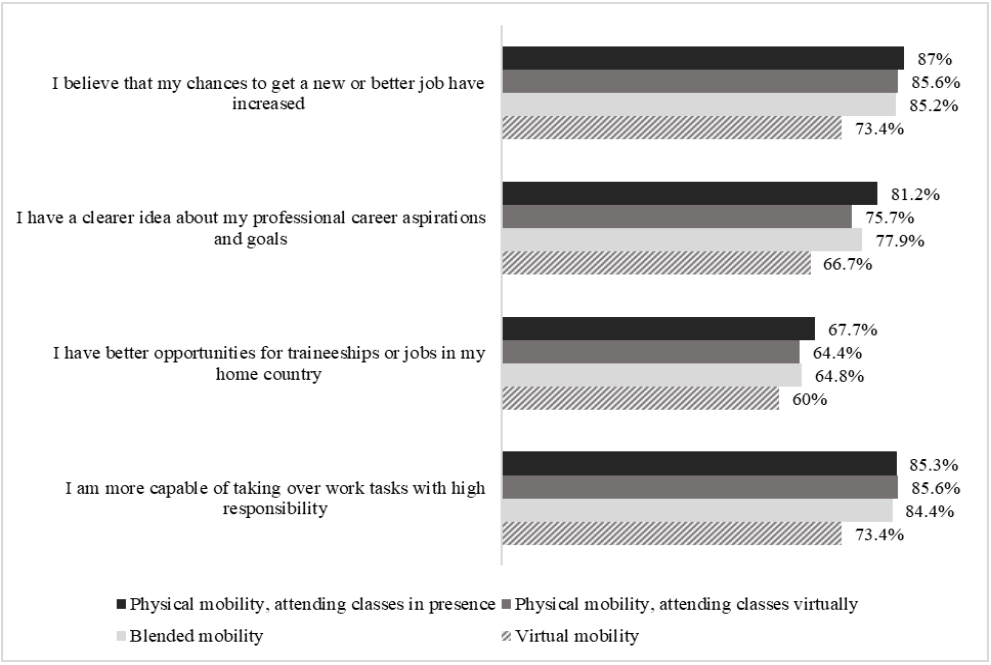

Figure 2. Impact of the academic mobility on students' job opportunities. Source: Authors own elaboration.

3. Conclusion

In the recent years, several studies have shown how academic mobility contribute to individual growth and in helping students acquiring skills in order to improve their professional development (Valle, 2011; Stavem, 2014). However, following the Covid-19 restrinction, not all the mobilities were held in presence and an ever increasing number of students experience a mobility period in other modality, such as the blended mobility or the virtual one. That is the basis on which this research has been carried out, with the aim of explore if all these types of mobility have the same impact on students' personal and occupational dimension.

The results that emerged from the survey conducted in 2021 on a sample of 514 students of Sapienza University of Rome have revealed that the greatest impact of the mobility occurs for those who did a physical mobility and attended classes in presence and for those who did a blended mobility, part of which took place in presence. On the contrary, virtual modality of the academic mobility seems to penalize the students in almost all of the aspects, starting with a reduced interaction with others that causes lack of dialogue and exchange of ideas up to a realist awareness of having, compared with those who did a physical mobility, less opportunities in working life.

Overall, taking into account all these issues, asking them "*How satisfied are you with your mobility experience in general?*", students who declare to be completely satisfied of the mobility period are almost 70% of those who did the exchange period attending classes in presence compared to 33.3% of students who experienced the virtual modality; in this vein, only 0.4% of students who move to the host institution attending classes in presence do not recommend this experience to another student, compared to the 13.3% of students who have done a virtual mobility.

References

Almeida, J. (2020). *Understanding Student Mobility in Europe. An Intedisciplinary Approach*. London: Routledge.

Bista, K., Allen R.M., Chan R.Y. (2021). *Impacts of COVID-19 on International Students and the Future of Student Mobility: International Perspectives and Experiences*. London: Routledge.

Devlin, M., Kristensen, S., Krzaklewska, E., & Nico M. (2017). *Learning mobility, social inclusion and non-formal education. Access, processes and outcomes*. Strasbourg: Council of Europe Publishing.

European Commission (2019). *Erasmus+ Higher Education Impact Study*. Luxembourg: Publications Office of the European Union.

European Commission (2020). *Erasmus+ 2019 in numbers*. Retrieved January 23, 2021, from https://ec.europa.eu/assets/eac/factsheets/factsheet-it-2019_en.html.

European Commission (2021a). *Erasmus+ 2020 in numbers*. Retrieved January 23, 2021, from https://ec.europa.eu/assets/eac/factsheets/factsheet-it-2020_en.html.

European Commission (2021b). *Mobility and Economic Impact of COVID-19 Restrictions in Italy using Mobile Network Operator Data*. Luxembourg: Publications Office of the European Union.

Hamilton, L., & Corbett-Whittier, C. (2013). *Using Case Study in Education Research*. London: SAGE Publications.

Pustulka, P., & Winogrodzka, D. (2021). Unpacking the Mobility Capacities and Imperatives of the 'Global Generation'. In D. Cairns (Ed.), *The Palgrave Handbook of Youth Mobility and Educational Migration* (pp. 47-62). Switzerland: Palgrave Macmillan.

Quacquarelli Symonds (2021). *How the coronavirus pandemic reshaped international higher education*. Retrieved January 23, 2021, from https://www.qs.com/portfolio-items/how-the-coronavirus-pandemic-reshaped-international-higher-education/

Stavem, J. (2014). *Student Mobility. Creating an Enveroinment for Social and Academic Success.* United Kingdom: Rowman & Littlefiedl.

Suárez-Ortega, M., & Risquez, A. (2014). The impact of mobility on the lives and careers of female and male academics in higher education. In N. Maadad & M. Tight (Eds.), *International Perspectives on Higher Education Research. Volume 11. Academic Mobility* (pp. 79-94). United Kingdom: Emerald Group Publishing.

Teichler, U. (2017). Internationalisation Trends in Higher Education and the Changing Role of International Student Mobility. *Journal of International Mobility*, 5, 177-216. doi: 10.3917/jim.005.0179

Valle, C. (2011). *The Impact of Student Mobility on Learning*. Washington DC: ERIC Clearinghouse.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14446

Assessment of Institutional Readiness for Online Learning

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Abstract

Covid19 has resulted in educational institutions moving in-person courses to remote instruction. Many faculty, students, and institutional support services were not prepared to handle this abrupt switch in instructional delivery method. Using the end-of-semester undergraduate student course evaluation toolkits, questions were added to assess online instruction in the Fall 2020 through Summer 2021 semesters. While undergraduate students initially seemed generally content with online instruction, we have seen some concerning trends as we assess the responses over time, with decreased satisfaction in courses and instruction and decreased engagement and motivation. The paper recommends some tools that may help institutions increase engagement of online learners.

Keywords: *Covid; Covid1;, Education; Online Readiness; Pandemic; Remote Learning.*

1. Introduction

When the Covid19 pandemic hit the United States in March 2020, educational institutions reacted to the need for continued learning by moving in-person courses to remote instruction. Many institutions were not prepared to handle this abrupt switch in instructional delivery method.

With the increased vaccine mandates, decreased enrollment, and the seemingly increased demand for online courses by both students and instructors, higher education institutions are assessing the effectiveness of online learning and the readiness of institutions, faculty, and students. It is believed that online learning can enhance rather than cannibalize traditional instruction by providing a more efficient (one-to-many) and convenient platform to attract students that have left the campus or do not intend to return to traditional instruction (Sharma et al., 2017; Tarhini et al., 2016; Zhang et al., 2012).

Despite the increasing desire for online instruction, institutions and students fail to fully utilize it and many institutions and faculty are not well-equipped to deliver quality instruction online. In addition, many students are not ready for the hands-off, self-directed approach to learning. While research has been conducted to assess the use of digital learning in educational institutions (Balakrishnan, 2017; Chiu et al., 2010; Lai et al., 2012; ; Lam et al., 2008; Teo and Beng Lee, 2010), researchers have not fully assessed faculty's and students' readiness for online learning.

2. Institutional and Student Readiness for Online Learning

2.1. Purpose of Study

Educational research has investigated the adoption of online learning among students (Ahmad and Khan, 2017; Tao et al., 2009), teachers (Birch and Irvine, 2009; Motaghian et al., 2013; Teo et al., 2009), and instructors (Nikou and Economides, 2017) by identifying their demographic, behavioral, and cultural biases. Technology readiness (TR), the penetration of different technology-related products and services, has been measured using the dimensions of enablers and inhibitors. TR was measured between genders and age (Jaafar, 2007), educational level (Lai, 2008), and the propensity to adopt based on self-efficacy and self-direction (Lin, et al., 2016).

This paper focuses our students' perceptions of readiness for online learning following the Covid19 pandemic, an area that has not been readily addressed in research.

2.2. Methodology

Using the end-of-semester undergraduate student course evaluation toolkits, questions were added to assess online instruction in Fall 2020 through Summer 2021 semesters. Students were asked closed-ended and open-ended questions about satisfaction with online courses. The closed-ended questions can be seen in the tables 2, 3, and 4. Response rates to the undergraduate survey can be found in table 1.

Table 1. Response Rates

Demographic	Semester	Response Rate
Undergraduate	Fall 2020	45.7%
	Spring 2021	51.44%
	Summer 2021	100%

Source: Buffalo State Instructional Design (2021).

Graduate students were sent a separate survey. It was expected that since many graduate students look for the convenience of online programs, their assessment of online readiness would differ from undergraduates, thus results were measured separately.

Results were analyzed on a descriptive basis, semester over semester, and are being used as input into the capus strategic plan. Results are also being used to further develop an online readiness assessment across all areas of the campus.

2.3. Results - Undergraduate

While undergraduate students initially seemed generally satisfied with online instruction, we have seen some concerning trends as we assess the responses over time. Questions and responses were grouped in three main areas: Technology (table 2), Education/Learning (table 3), and Top Concerns (table 4). Responses for Summer 2022 are not shown.

Technological concerns were not a major issue Fall 2020, with the exception of students' unfamiliarity with technology or applications and reliable internet service; however, we did see an increase in various technical issues in following semesters, which contradicts expectations. Students expressed concerns with planning and delivery of courses, technical requirements and integration of software, and lack of student support services.

Table 2. Fall 2020 and Spring 2021 Technological Challenges

Survey Question (Technological Challenges)	*F' 20 Freq*	*F' 20 %*	*S' 21 Freq*	*S' 21 %*	*% Change*
Instructors were uncomfortable with or lacked familiarity with required technologies or applications	733	6.87	575	14.62	+7.75
My own discomfort or lack of familiarity with required technologies or applications	1362	12.77	540	13.73	+0.96
Unclear expectations around which technologies and applications I am require to use	677	6.35	408	10.38	+4.03
My access to reliable communication software/tool (e.g. Skype, Zoom, Google)	640	6.00	293	7.45	+1.45
My access to reliable internet service	1450	13.59	631	16.05	+2.46
My access to reliable digital device (e.g. laptop, mobile device)	635	5.95	247	6.26	+0.31
My access to specialized software (e.g. Adobe products, statistical packages)	541	5.07	348	8.85	+3.78
My access to library resources	692	6.49	354	9.00	+2.51
Adequate digital replacements for face-to-face collaboration tools (e.g. whiteboards)	651	6.10	440	11.19	+5.09
Other	213	2.00	140	3.56	+1.56
No issues	6999	65.61	1803	45.85	-19.76

Source: Buffalo State Instructional Design (2021).

Learning and educational issues were significant in all semesters and increasingly so over time. Students found difficulty in balancing workloads, engagement and motivation, and felt expectations were either not communicated or too high.

Table 3. Fall 2020 and Spring 2021 Learning/Educational Challenges

Survey Question (Learning/Educational Challenges)	*F' 20 Freq*	*F' 20 %*	*S' 21 Freq*	*S' 21 %*	*% Change*
Finding time to participate in synchronous classes (e.g. live-streaming lectures or video conferencing at a set time)	1651	15.48	801	20.37	+4.89
Unclear expectations around course/assignment requirements	1414	13.25	869	22.10	+8.85
Competing class meetings and schedules	1204	11.29	538	13.68	+2.39
Personal preferences for face-to-face learning	3371	31.60	1367	34.77	+3.17
Course lessons or activities that have not translated well to a remote environment	1656	15.52	993	25.25	+9.73
Difficulty focusing or paying attention to remote instruction or activities	2913	27.31	1373	34.92	+7.61
Instructor availability/responsiveness	700	6.56	529	13.45	+6.89
Personal motivation/desire to complete coursework	3073	28.81	1355	34.46	+5.65
Once online I did not know how to find academic support services such as tutoring	534	5.01	248	6.31	+1.30
Other	182	1.71	92	2.34	+0.63
No issues	4768	44.69	1091	27.75	-16.94

Source: Buffalo State Instructional Design (2021).

The most expressed overall issues revolved around the feeling of isolation, technology, and perceptions of online coursework. Undergraduate students felt disconnected from campus, peers, and also felt overwhelmed by personal responsibilities. Technology, including the

Internet, software, and equipment, along with lack of support, hindered student performance. Finally, students' perception was that learning objectives were not realistic and achievable, and faculty made the self-directed courses more difficult and time-consuming.

Table 4. Fall 2020 and Spring 2021 Biggest Challenges

Survey Question (Biggest Challenges)	*F' 20 Freq*	*F' 20 %*	*S' 21 Freq*	*S' 21 %*	*% Change*
Grades/performing well in class	4557	43.75	1520	38.66	-5.09
Completing my internship or practicum requirements	1087	10.00	421	10.71	+0.71
Changes to grading structures (e.g. pass/fail, credit/no credit)	1306	12.24	489	12.44	+0.20
Not being able to see classmates	2200	20.62	959	24.39	+3.77
Not being able to communicate with instructors	2340	21.93	1035	26.32	+4.39
Possible delays in graduating/completing my program	1431	13.41	528	13.43	+0.02
Missing out on extracurricular-campus activities	1838	17.23	859	21.85	+4.62
Online privacy, protection of my personal data	571	5.35	297	7.55	+2.20
Security/privacy in taking online exams	320	3.00	178	4.53	+1.53
Housing security	311	2.92	89	2.26	-0.66
Food security	306	2.87	111	2.82	-0.05
Receiving the academic support services I need (e.g. tutoring)	727	6.81	301	7.66	+0.85
Desire for synchronous (live, online) classes as opposed to asynchronous (non-live, online) classes	1019	9.55	544	13.84	+4.29
Awareness of student support services available on campus and in the remote environment (e.g. tutoring, peer mentor)	438	4.11	193	4.91	+0.80
Supplemental instruction, EOP, etc.	200	1.87	93	2.37	+0.50
Other	147	1.38	85	2.16	+0.78
No issues	4290	40.21	1156	29.40	-10.81

Source: Buffalo State Instructional Design (2021).

2.4. Results – Graduate

As expected, graduate students were generally much more satisfied with online instruction, and the majority completed at least one course remotely prior to the pandemic. In converse to undergraduates, most were satisfied with the quality of instruction and felt they were performing well in the course. In addition, unlike undergraduate students, most graduate students were not seeking the on-campus and social connections.

2.5. Results – SOSSI (SUNY Online Student Success Inventory)

SOSSI is an independent study of student engagement of online learning. The 2020 report compared our institution's online learning to a sample of ten similar institutions and provided statistical comparisons on instructional design and delivery of online courses. Our institution scored at the mean across all questions for both first-year and last-year students. This indicates that design and delivery are at par, even though student satisfaction is decreasing.

3. Conclusion and Recommendations

Faculty are encountering many challenges in keeping the undergraduate online learners engaged. Challenges include an increased feeling of isolation, with little connection to campus and peers, technical issues and a lack of support, and student perception of online learning, in general. To remain engaged, students need to be motivated, have attention and interest in the topic, be actively involved in the course materials, and perceive the right level of academic challenge. Student engagement is best defined based on individual perception.

Online learners spend almost twice the amount of time working on assignments and course work as the traditional student. Faculty should consider this when designing the course, and not overload the student with "busy work." Faculty should also include engaging activities such as discussion boards, writing about topics, step-out-of-class projects, short audio lectures, virtual field trips, and group activities. They should provide motivators as ways to improve grades (e.g. in video quizzing, multiple attempts, etc.), diversity and choice of activities and assessments, and ways for students to achieve personal gratification (eg. choice of assignments). Faculty and institutions can reduce students' feeling of isolation by increasing interaction via discussions, emails, and video and written announcements, providing virtual technical and support services, and helping students manage time and responsibilities. In general, faculty and institutions need to increase their awareness of student engagement.

This research is a starting point on assessing how our online students are supported and what they want and need. While we understand that the past two years of online learning have been a semi-false reality, we also are aware that our institution needs to assess what our future online environment will be. Next steps include an improved survey instrument, assessment of services, assessment of student and faculty preparedness, and standard online faculty training, development, and certification across all courses.

References

Ahmad, A. and Khan, M.N. (2017). Students seeking health-related information over internet: an empirical study. *Journal of Health Management*. 19(2), 352-367.

Balakrishnan, V. (2017). Key determinants for intention to use social media for learning in higher education institutions. *Universal Access in the Information Society*. 16(2), 289-301.

Birch, A. and Irvine, V. (2009). Preservice teachers' acceptance of ICT integration in the classroom: applying the UTAUT model. *Educational Media International*. 46(4), 295-315.

Chiu, Y.-T., Fang, S.-C. and Tseng, C.-C. (2010). Early versus potential adopters. *International Journal of Retail and Distribution Management*. 38(6), 443-459.

Jaafar, M., Ramayah, T., Abdul-Aziz, A. and Saad, B. (2007). Technology readiness among managers of Malaysian construction firms. *Engineering, Construction and Architectural Management*. 14, 180-191.

Lai, C., Wang, Q. and Lei, J. (2012). What factors predict undergraduate students' use of technology for learning? A case from Hong Kong. *Computers and Education*. 59(2), 569-579.

Lai, M. (2008). Technology readiness, internet self-efficacy and computing experience of professional accounting students. *Campus-Wide Information Systems*, 25(1), 18-29.

Lam, S., Chiang, J. and Parasuraman, A. (2008). Effects of the dimensions of technology readiness on technology acceptance. *Journal of Interactive Marketing*. 22(4), 19-39.

Lin, H., Shijeng, L., Yeh, C.Y. and Wang, Y. (2016). Measuring mobile learning readiness: scale development and validation. *Internet Research*, 26(1), 265-287.

Motaghian, H., Hassanzadeh, A. and Moghadam, D.K. (2013. Factors affecting university instructors' adoption of web-based learning systems: case study of Iran. *Computers and Education*. 61, 158-167.

Nikou, S.A. and Economides, A.A. (2017). Mobile-based assessment: integrating acceptance and motivational factors into a combined model of self-determination theory and technology acceptance. *Computers in Human Behavior*. 68, 83-95.

Sharma, S.K., Sarrab, M. and Al-Shihi, H. (2017). Development and validation of mobile learning acceptance measure. *Interactive Learning Environments*, 25(7), 847-858.

Tao, Y.-H., Cheng, C.-J. and Sun, S.-Y. (2009). What influences college students to continue using business simulation games? The Taiwan experience. *Computers and Education*. 53, 929-939.

Tarhini, A., Hone, K., Liu, X. and Tarhini, T. (2016). Examining the moderating effect of individual level cultural values on users' acceptance of e-learning in developing countries: a structural equation modeling of an extended technology acceptance model. *Interactive Learning Environments*, 25(3), 306-332.

Teo, T. and Beng Lee, C. (2010). Explaining the intention to use technology among student teachers: an application of the theory of planned behavior (TPB). *Campus-Wide Information Systems*, 27(2), 60-67.

Teo, T., Beng Lee, C., Chai, C.S. and Wong, S.L. (2009). Assessing the intention to use technology among pre-service teachers in Singapore and Malaysia: a multigroup invariance analysis of the Technology Acceptance Model (TAM). *Computers and Education*. 53, 1000-1009.

Zhang, Y., Fang, Y., Wei, K.-K. and Wang, Z. (2012). Promoting the intention of students to continue their participation in e-learning systems: the role of the communication environment. *Information Technology and People*, 25(4), 356-375.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14417

Belonging in distance learning: The impact of interaction during the COVID-19 pandemic

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Abstract

The COVID-19 pandemic has created a unique situation in which higher education institutions, teachers, researchers, and students prove their ability to continue education online. In a longitudinal panel study at a German university, we investigated how freshmen and students in higher semesters (n = 72) cope with the online winter semester 2020/21. Commonly, a sense of belonging to a university is highly determined by academic and social engagement and positively impacts academic success and motivation. Due to the pandemic, the interaction between students, lecturers, and learning materials was limited to digital communication. The results reveal that interaction (student-to-content, student-to-staff, and student-to-student) hardly correlates with a sense of belonging, whereas correlations between interaction and academic success as well as motivation.

Keywords: *Distance learning; Sense of belonging; Social engagement; Academic engagement; COVID-19; Online.*

1. Introduction

During the worldwide COVID-19 pandemic most students have no other choice than distance learning. One of the reasons why students do not prefer distance learning is less social contact (Bashier and Elmossad 2020). In Germany, nearly all university students had to continue or start their new studies remotely in the winter semester of 2020. Students had to struggle with this situation all over the world, and some were more affected than others. In a study from a southeastern US university, students' most common stressors during the pandemic were identified as loss of routine, lack of social contact, as well as work, and finances (Halliburton et al. 2021). Taking into consideration the overall digital transition in life and industries, distance learning could increase in popularity in society after the pandemic. Before the pandemic, several studies revealed a relationship between a sense of belonging of students to their university or classroom and academic success, academic engagement, or emotional well-being (Freeman, Anderman, and Jensen 2007). Students who reported a higher level of satisfaction and motivation also stated a higher sense of university belonging (Pedler, Willis, and Nieuwoudt 2021). How students experience a sense of belonging in higher education distance learning is rarely analyzed. According to Rovai (2002), the meaning of belonging should be considered from the student's point of view. It should be also noted, that sense of belonging is a highly complex phenomenon. Ahn (2017), for example, identified four domains of university belonging after having examined 426 students from Bangor University in the UK in 2014 during onsite teaching: academic engagement, social engagement, surroundings, and personal space. The domain of *academic engagement* equates to curriculum, communication with lectures, and the whole educational process. Interaction and communication with fellow students in formal and informal groups as well as university activities at general and personal levels belong to the domain of *social engagement. Surroundings* include students' living space and their geographical and cultural location. Such meanings as life satisfaction, life attitudes, identity, and personal interests are allocated to the domain of *personal space*. Ahn's findings confirm the results of other studies, which identified, that students' sense of university belonging is, among other things, a result of social engagement and integrity (van Buer 2011; Petzold-Rudolph 2018).

Academic and social engagement becomes visible through interaction. According to Moore, there are three types of interaction at a university: student-to-content, student-to-staff, and student-to-student (Moore 1989). *Student-to-content* interaction refers to students' self-regulated learning with educational materials. *Student-to-staff* interaction implies communication with lectures and staff as well as the possibility to ask questions. *Student-to-student* interaction includes communication with fellow students and the possibility of knowledge exchange. An effective digital transformation process should entail the possibility to interact on these three levels. Hence, distance learning should not only replicate physical face-to-face sessions but make use of the virtual environment. The importance of social

contact should not be overlooked in the digital transformation of higher education, as personal contact with students and advisors has an impact on students' performance (Smith and Allen 2014). The pandemic is a unique situation to measure interaction since other aspects of academic and social engagement are not entirely available. In this investigation, we will concentrate on interaction and compare students that start a degree program during the COVID-19 pandemic with students that continue their studies. According to the following research questions, we will identify how freshmen and advanced students cope with the new reality of distance learning:

RQ1: How do students define a sense of belonging during the pandemic?
RQ2: Do the students have a sense of belonging to the University of Osnabrück and how important is this feeling for them during the pandemic?
RQ3: Does interaction as one manifestation of academic and social engagement impact the sense of belonging, academic success, or motivation during the pandemic?

2. Method

For this examination students in their first and advanced semester (third semester) at the University of Osnabrück, Germany, participated in a diary panel study during the online winter semester 2020/21. In a weekly survey, the participants reported on three courses. In addition, students filled out a monthly survey about interaction with the university lectures, fellow students as well as university staff, such as IT- or counseling services, and their sense of belonging. A total of two interviews, ten weekly questionnaires, and three monthly questionnaires took place with 72 students. The panel study was conducted in the German language and all aspects discussed here are translated for the presentation of the results. The survey was implemented using the online survey tool LimeSurvey. In total, 72 of the initial 90 students participated until the end of the semester (24 male, 46 female, 2 diverse; 34 first semester and 38 advanced students). For the study at hand, we will focus on the aspects of belonging, academic success, motivation, and interaction at three timepoints (t) combining the monthly, weekly, and interview evaluations. The study includes further questions that are not part of the investigation at hand. In total, for t1 69, and t2 and t3 each 71 participants could be included.

During the interviews, the students (n = 72) had to describe how they defined their sense of belonging to the University of Osnabrück. The statements were investigated by a content analysis following Mayring (2010). First, the main content of the transcribed interview was conducted. Second, a common level of abstraction was produced by a generalization of the identified content. In the next step, only content that answers the question was further integrated into the evaluation process to create items. In the final step of the content analysis,

identified items were transferred into the categories of sense of belonging according to Ahn (2017) with the help of a deductive approach.

The students were asked if they experienced a sense of belonging and if a sense of belonging is important for them. Both questions were asked in the monthly survey with a five-point Likert scale (totally disagree, disagree, partly, agree, totally agree). Timepoint 1 (t1) is at the beginning of the semester (early November 2020); t2 is before the winter holidays (end of December 2020) and t3 is at the end of the Semester (early February 2021). Academic success is measured according to the participants' self-evaluated learning outcomes according to Bloom's Taxonomy (Krathwohl 2002). *Motivation* is evaluated on a five-point Likert scale where the students indicate how much they are motivated to continue the lecture.

We refer to Moore`s (1989) categorization of visible interaction to measure the influence of interaction. *Student-to-content* is a rather complex variable, as there are many different ways in how students interact with learning materials. To represent the interaction with the content, the students should agree or disagree on a five-point Likert scale: (1) If they were confronted with new learning content and (2) if they learned something new in context with the lecture. The mean of both statements is calculated as a *content score*. *Student-to-student* interaction was very limited during the pandemic. Therefore, we asked the participants how often they met with fellow students online and offline during the winter semester. They were allowed to include any meeting independent of its purpose, like group activities, interactive learning, or private issues. A high frequency of meetings is interpreted as a high interaction with other students. We coded the frequency of meetings independent of offline and online as a *meeting score* (never (1), monthly (2), weekly (3), and daily (4)). We investigate *student-to-staff* interaction according to which lecture format the students participated regarding the three (free chosen) evaluated lectures with the following scores: canceled (1), online asynchronous (2), online synchronous (3), mixed online and face-to-face (4), and face-to-face lecture (5). The scores reflect the interactivity with zero for canceled lectures and a five for face-to-face onsite lectures.

The correlation of the data is calculated according to Spearman's ρ with r>.10 as low, r>.30 medium, and r>.50 high effect size (Cohen 2013). In addition, the p-value is calculated to indicate the statistical significance. The data conducted in this survey needs to be interpreted with caution due to several limitations: The investigated student group is highly motivated since the first 44 male, 44 female, and two diverse responding volunteers were selected for the survey. Eighteen respondents did not participate until the end. The constructs of a sense of belonging, academic success, and motivation are very complex and interaction is only one aspect that may determine it. Finally, the pandemic situation creates a unique test environment to investigate distance learning for diverse students who probably would never decide to undertake an online semester or study.

3. Results and Discussion

3.1. Sense of Belonging to a University

To define a sense of belonging to an institution is rather abstract. During the interviews, the students mainly described what they associate with the University of Osnabrück. For further investigation, we focus on the 72 volunteers that participated until the end of the survey. In total, 180 items are mentioned by the students which we assigned to 30 categories. In the mean 2.5 items are mentioned by the participants. 19 students mention one, 23 mention two, 16 mention three, and 14 mention four or more items in their statement. In the next step, the items are assigned to the four domains of belonging identified by Ahn (2017). No additional dimension was identified in the current study. Similar to her findings, our data reveal that social engagement is mentioned the most by students (Figure 1.).

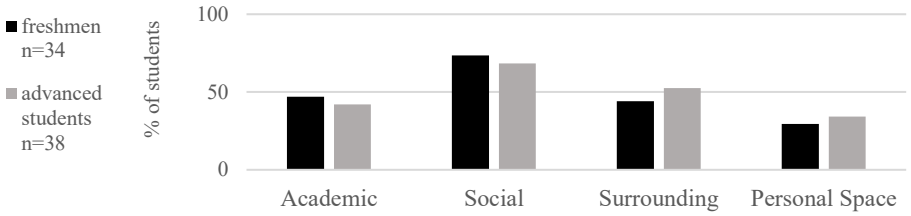

Figure 1: Four dimensions of sense of belonging to University of Osnabrück n=72 (see Ahn (2017) for further information of the categories and dimensions).

Comparing freshmen and advanced semester students, the dimensions of *academic engagement* and *social engagement* were mentioned most by first-semester students. Whereas the categories *surrounding* and *personal space* are mentioned most by advanced students. Within the domain *academic engagement*, the students refer to the university (n = 22), curricula (n = 15), tutor (n = 5), education purposes (n = 2), or service (n = 1). Only one student indicates the online environment of the university which is also an item in the category university. Within the dimension *social engagement*, the students mention contact to fellow students (n = 38), contact to lectures (n = 12), activities and events (n = 12), participation in university-related groups (n = 7), and mates (n=1). Physical places are mentioned within the domain *surrounding*, like Osnabrück as a city (n = 10) or being physically present (n = 28). Referring to the domain *personal space*, students mention items related to student (n = 11), life satisfaction (n = 8), pride (n = 4), or life attitudes (n = 2).

Contact to other persons as well as places at the university, like the library or dining hall, were mainly not available in person.

In addition, the students had to agree or disagree, if they felt that they belong to the University of Osnabrück and if this feeling was important to them. As shown in the boxplot visualization in figure two, freshmen are very constant in their responses. Most students disagree or partly agree to have a sense of belonging. The median drops from partly/disagree at time t1 to disagree at times t2 and t3. Responses according to the importance of a sense of belonging are constant at all three timepoints. On average, freshmen agree that this feeling is important. Advanced students respond slightly differently. On average, they partly agree to have a feeling of belonging whereas the interquartile range (50% of respondents represented by the box) shrinks from the range of agree to disagree at t1 to the range between partly to disagree at t2 and t3. For the second statement on the importance of a sense of belonging, the inter-quartile range is between agree and partly at t1 and grows to the range agree to disagree in t2 and t3. On average, the advanced students agree with this statement at time t1 and partly agree at t2 and t3.

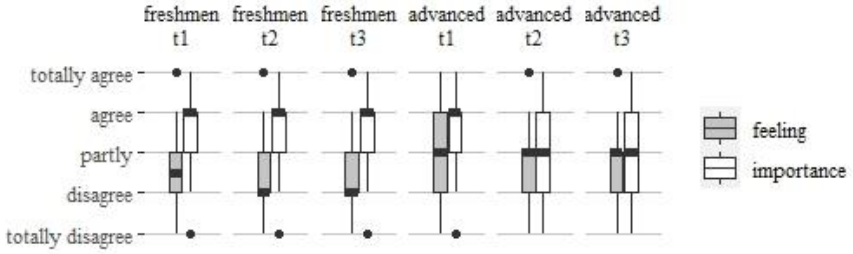

Figure 2: Sense of belonging to University of Osnabrück at three timepoints indicated by freshmen and advanced students. (Left plot: I feel that I belong to University of Osnabrück. Right plot: A sense of belonging to University of Osnabrück is important for me.)

3.2. Interaction concerning belonging, success, and motivation

As presented in table one, the scores for "content", "lectures", and "meeting" as defined in the method are set in correlation to "sense of belonging", "academic success", and "motivation". Taking all data into account, a statistical significance could only be calculated for correlations $r \geq 0.2$. The values below show no statistical significance. Sense of belonging shows no or low correlation with the other values except for two timepoints where the meeting score correlates negatively and significantly (freshmen at t3 with -0.53** and advanced at t2 with -0.24*). This indicates that the frequency of contact between students negatively impacts the students' sense of belonging for these two timepoints. One additional negative correlation of the meeting score is identified with academic success for freshmen at time t1 ($r = -0.22$*). The negative correlation could be explained by the pandemic situation where students had mostly online contact primarily with students they only just met. During the interviews, the students stated that getting to know each other is hard in the online

environment. Looking at academic success, a positive significant correlation becomes more likely with the calculated content scores and for lecture scores at time t3. For freshmen, an increase in the correlation from time t1 till t3 can be identified. This may indicate that over time the students interact more with the content and have a higher understanding of the learning materials. At the end of the semester, additional meetings and question hours were offered by the lecturers as mentioned by the students. This may explain the correlation of time t3 (academic success and lecture score). Content and lecture scores correlations with motivation increase as well overtime except for lecture score at t2 for the freshmen. The positive correlations may indicate that the student's interaction with the content and interaction during the lectures positively impact their motivation. Not shown in the table is that academic success and motivation have a constant statistical significance of $r \geq 0.5$ at all timepoints and in both student groups. Sense of belonging and motivation have a statistical significance with $r \geq 0.22$ except for advanced students at time t1 with $r = 0.14$. Academic success and sense of belonging show no statistical significance with $0 \leq r \leq 0.16$.

Table 1: Spearman ρ correlation for sense of belonging, academic success, motivation with content, lecture and meeting scores

		sense of belonging			academic success			motivation		
freshmen		t1	t2	t3	t1	t2	t3	t1	t2	t3
	lectures n =	93	95	87	93	95	87	93	95	87
	content score	- 0.04	0.10	0.04	0.15	0.40**	0.54**	0.21*	0.32**	0.57**
	lecture score	- 0.01	0.10	0.02	0.05	0.09	0.38**	0.21*	0.18	0.32**
	meeting score	- 0.04	0.16	-0.53**	-0.22*	- 0.04	- 0.06	- 0.01	- 0.10	- 0.19
advanced students		t1	t2	t3	t1	t2	t3	t1	t2	t3
	lectures n =	105	99	90	105	99	90	105	99	90
	content score	0.03	0.09	0.15	0.24*	0.40**	0.40**	0.11	0.24*	0.28**
	lecture score	- 0.04	0.03	0.16	0.13	0.09	0.46**	0.04	0.25*	0.35**
	meeting score	- 0.13	-0.24*	0.07	- 0.05	0.05	0.06	- 0.04	0.05	- 0.03

t1-t3 = time point of investigation, t1 n = 69 (freshmen n=33, advanced n = 36), t2&t3 n = 71 (freshmen n = 34, advanced = 37); lectures n = number of complete respones; $p < .01$ = **, $p < .05$ = *)

4. Conclusion

The findings of this investigation show that interaction has a minor correlation to a sense of belonging. This implies that interaction alone is not enough to explain it. This result is confirmed by the negative correlation between the meeting score and the sense of belonging for freshmen at the end of the semester. Interaction is more likely to correlate with academic success and motivation. Especially, the content interaction shows a positive impact on academic success and motivation. However, a sense of belonging to an institution might be an abstract phenomenon for students to understand, therefore the results show no correlation to other scores. In future work, we would like to discuss our findings in more detail in combination with the qualitative data from the interviews as well as in context of other

studies. Further, investigating of the sense of belonging to fellow students or to courses could achieve other results.

References

Ahn, Mi Young. 2017. "Sense of Belonging as an Indicator for Social Capital: A Mixed Methods Analysis of Students' Sense of Belonging to University." *PQDT - UK & Ireland*, no. April: 1–304. https://search.proquest.com/docview/1999212981?accountid=14169.

Bashier, Lienda, and Yousif Mohammed Elmossad. 2020. "Students' Perception on E. Learning and Remote Exams during COVID 19 Outbreak 2020." *International Journal of Pharmaceutical and Phytopharmacological Research* 10 (5): 142–48.

Buer, Jürgen van. 2011. "Zur Fokussierung Der Empirischen Hochschulforschung Auf Das Vorzeitige Ausscheiden Aus Dem Studium – Warum Wir so Auf Den Misserfolg Blicken." In *Stationen Empirischer Bildungsforschung*. Wiesbaden: VS Verlag für Sozialwissenschaften.

Cohen, Jacob. 2013. *Statistical Power Analysis for the Behavioral Sciences*. Academic press.

Freeman, Tierra M., Lynley H. Anderman, and Jane M. Jensen. 2007. "Sense of Belonging in College Freshmen at the Classroom and Campus Levels." *Journal of Experimental Education* 75 (3): 203–20.

Halliburton, Amanda E., Michele B. Hill, Bryan L. Dawson, Jennifer M. Hightower, and Hailey Rueden. 2021. "Increased Stress, Declining Mental Health: Emerging Adults' Experiences in College During COVID-19." *Emerging Adulthood*.

Krathwohl, David R. 2002. "A Revision of Bloom's Taxonomy: An Overview." *Theory Into Practice* 41 (4): 212–18.

Mayring, Philipp. 2010. *Qualitative Inhaltsanalyse*. Edited by Günter Mey and Katja Mruck. *Handbuch Qualitative Forschung in Der Psychologie*. Wiesbaden: VS Verlag für Sozialwissenschaften.

Moore, Michael G. 1989. "Editorial: Three Types of Interaction." *American Journal of Distance Education* 3 (2): 1–7.

Pedler, Megan Louise, Royce Willis, and Johanna Elizabeth Nieuwoudt. 2021. "A Sense of Belonging at University: Student Retention, Motivation and Enjoyment." *Journal of Further and Higher Education* 00 (00): 1–12.

Petzold-Rudolph, Kathrin. 2018. *Studienerfolg Und Hochschulbindung*. Wiesbaden: Springer Fachmedien Wiesbaden.

Rovai, Alfred P. 2002. "Building Sense of Community at a Distance." *The International Review of Research in Open and Distributed Learning* 3 (1).

Smith, Cathleen L., and Janine M. Allen. 2014. "Does Contact With Advisors Predict Judgments and Attitudes Consistent With Student Success? A Multi-Institutional Study." *NACADA Journal* 34 (1): 50–63.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14440

Hands-on learning at a world-class telescope

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Abstract

For the first time, an Italian University has the possibility to perform a multi-year observing campaign at a world-class telescope. This hands-on experience had a significant impact on the students' university path: from learning specific observing techniques on-site to teamwork and collaboration. In this paper we present the results of an observing campaign carried out at the Telescopio Nazionale Galileo (TNG) located in La Palma (Canary Islands, Spain) by undergraduate students of the Department of Physics and Astronomy, at the University of Firenze.

Keywords: *astrophysics; telescope observing; galaxies; hands-on learning; students' motivation; teamwork.*

1. Introduction

The hill of Arcetri in the outskirts of the city of Firenze, where Galileo spent his last years, has represented the pivotal site of research in physics and astronomy in Firenze, hosting both the Institute of Physics of the local University and the Arcetri Astrophysical Observatory, and being for this reason promoted to a historical site of the European Physical Society. During the 1980s, the Department of Astronomy and Space Science of the University was constituted, based in Arcetri alongside with the Physics Department, heir to the Institute of Physics (Mazzoni 2014). The two university departments eventually merged into the Department of Physics and Astronomy in 2010. The astrophysics researchers of the university departments have maintained a close collaboration with the Arcetri Observatory throughout the years. Within this collaboration, in 2017, a private donation to the Arcetri Observatory was partly devolved to the University. This private funding allowed university students, for the first time, to perform an observing campaign at a world-class telescope within a part of the teaching course *Complementi di Astronomia,* which is the subject of the present manuscript. Complementi di Astronomia is offered to bachelor and master students and gives a first introduction to experimental astronomy. Specifically, the course presents the relevant instruments, detectors, and telescope techniques, primarily for observations at optical wavelengths. A substantial part of the course is dedicated to hands-on observing sessions. The main scientific aim of the latter is to determine the angular diameter and the redshift of a sample of local spiral galaxies to provide an estimate of their distances and, possibly, of the Hubble parameter, H_0, which describes the current expansion rate of the Universe. Until 2017, observations had been performed at the 152 cm Cassini telescope located in Loiano (Bologna), Italy. In 2017, the students carried out the first international observing campaign at the *Telescopio Nazionale Galileo* (TNG) located at the Roche de los Muchachos in La Palma (Canary Islands, Spain). Such a campaign requires not only a significant budget (not affordable without external funding given the overall reduction in funding from the Italian State to the Universities), but also a considerable logistic effort between the teachers and the staff at the TNG. During the trip, we take the opportunity to visit most of the astronomical telescopes at the Roque.

In this manuscript, we critically discuss our *outside the classroom* experience from different perspectives (e.g., students teamwork on-site and in the lab) and how everything changed after the COVID-19 outbreak. We note that the discussion of the practical part of the lecture will be mostly qualitative. We did not carry out much literature research in first place for two main reasons. First and foremost, the experience we describe is virtually a *unicum* in Italy and, since it is subject to external funding, we did not have the perspective of a more structured teaching path related to on-site observations. This may change in the following years if we can secure funding that allows us to schedule several observing runs during the academic year. Second, we can only now begin to study the statistics of the students attending

the experimental part, as it started only 5 years ago and with a 3 year stop due to the pandemic. Further literature review and a follow-up study on how this kind of visit may contribute to the education of students will be carried out in the following academic years.

2. Scope of the observations

The TNG is the largest (with a 3.58 m diameter primary mirror) optical telescope of the Italian astronomical community and is managed by the Fundación Galileo Galilei (FGG, Fundación Canaria) on behalf of the Italian National Institute for Astrophysics (INAF)[1]. DOLoReS (Device Optimised for the Low RESolution) is an imager and a low-resolution spectrograph permanently installed at the TNG equipped with photometric filters and grisms. The DOLORES detector consists of one E2V back-illuminated and thinned 2048 × 2048 pixel CCD, with a scale of 0.275 arcsec pixel^{-1}, resulting in a field of view of 9.4 × 9.4 arcmin^2. The students used this instrument to perform both imaging and low-resolution spectroscopic observations of nearby spiral galaxies (z<0.2). Different dispersing elements (grisms) and slit widths ranging from 1″ to 1″.5 were used to perform spectroscopy, securing a spectral coverage in the 3500-8200 Å band with dispersions between 1 and 2.5 Å pixel^{-1}. The main scientific aim of the observations is to measure the apparent diameter (from imaging) and redshift (from spectroscopy) of local spiral galaxies to constrain the universe expansion, parameterized by the Hubble parameter, H_0. Ancillary science goals are the determination of the star formation rate and the estimate of the mass of the central supermassive black hole. The latter is possible whenever the galaxy observed has an *active galactic nucleus* (AGN hereafter). In an AGN, the supermassive black hole located in the galaxy center is accreting material from its immediate surroundings in a form of a disc, converting the gravitational potential of this matter into heat and, eventually, radiating this energy away. The nucleus of these galaxies shines bright at optical-UV wavelengths and, by computing the full-width at half maximum (FWHM) of specific broad emission lines and the continuum at a given optical wavelength, the students can obtain an estimate of the mass of the black hole. Below we first detail how the students prepare the observing run and the data analysis performed by the students once they are back in the laboratory at their home institution. During the course the students will select the observing targets, perform the observation campaign, reduce, and analyse the collected data.

2.1. Preparing the observations

The students are first preliminarily instructed on how they should use the online archives and what are the constraints to select the objects to create a suitable target list. Namely, the students are asked to select a set of galaxies (usually between 4 and 10 objects) that fulfil a

[1] http://www.tng.iac.es/

series of criteria ranging from the type of object (i.e., spirals) to its visibility at the telescope (e.g., coordinates, maximum air mass, relative distance from the Moon depending on the night conditions). The students also check whether there is an available spectrum in the literature to verify that bright emission lines (required for the redshift determination) are present. The students are divided in groups of maximum 3 people and each group explores a different interval of coordinates (i.e., the sky visible from the observing site) such that there are no overlaps in the possible targets the students can find. Each group then presents a list of galaxies with the finding charts (i.e., the image of the galaxy within the field-of-view of the telescope), the available magnitudes and surface brightness values at several wavelengths (e.g., *B*, *V* and *R*), the optical spectra from the literature and the integration times for both imaging and spectroscopy with the relative signal-to-noise ratio (*S/N*). Each group delivers a preliminary target list which is then verified by the teachers and merged to create the final one. This is the first step where the students put into practice what they have learnt during the lectures, thus dealing with several data archives of celestial objects, understanding the different nomenclatures, and working with astronomical software tools.

Figure 1. Top: Students in the control room at the TNG during the last observing run (April 2019) before the COVID-19 outbreak. Bottom: Set-up for the virtual observing. The third window in the first row shows the target observed, whilst the fourth window in the second row shows the monitor with the weather conditions of the night.

2.2. Observing at the telescope (before COVID-19)

Once the target list is prepared, it is sent to the support astronomer a few days before the observing night for final approval. In the control room, the students are guided by the support astronomer through the several steps to carry out both imaging and spectroscopy, meaning that the students themselves have the responsibility to input the command lines to acquire the target, check whether the source in the field-of-view is correct, select the right filter (or slit) for the imaging (and spectroscopic) observation. The students also need to interface with the

telescope operator, who is ultimately responsible for moving the telescope (Figure 1, top panel). Although the students always have the guidance of the support astronomer and the teachers are present during the entire run, they are required to do most of the steps themselves, to *learn and act fast*, exploiting every minute of the roughly three-hour observing time. In fact, a mistake in typing a command line on the terminal, for instance, means that precious observing time is lost, and this could undermine the entire observing schedule. All the steps done during the observations are, by all means, what is customarily done by professional astronomers for their science research. We asked the students, once finished, how the experience had been, and all the students agreed that this was the most stressful part of the entire process. Yet, they felt very rewarded once they knew they got their own data.

2.3. Data analysis

Back to the computer laboratory at home, the students must reduce and analyse the data on their own. During this part of the course the students gain sound knowledge and understanding of data handling. Students also become acquainted with several forms of data representation and explore different techniques of regression analysis to determine the 'best-fit' and data modelling. Astronomical data are stored in a FITS format; thus, the students further learn how to visualise them interactively with SAO Image DS9, which is one of the standard tools to examine astronomical images. Students are split again into groups of max 3 people and all the different groups choose one galaxy to analyse. They are provided with a data processing manual describing the main steps to follow for both the imaging and the spectroscopic reduction. They first need to tackle the estimate of the seeing, a parameter that represents the sharpness of a telescope image that depends upon the turbulence of the Earth's atmosphere. Roque de los Muchachos is a very good observing site, with an average seeing of 0.9 arcsec (measured from 2011 May to 2012 February, Gurtubai et al. 2013). The students then start to handle the calibration files, namely bias and flat field, for the data reduction of the images, and analyse their error statistics and readout noise. They create a master bias and flat field by computing the median of the different images (taking into account and removing the possible signature of cosmic rays), which are subsequently applied to the raw data to generate the final calibrated image. An example of raw and reduced images is shown in Figure 2 for the galaxy NGC 3294 observed on March 21st, 2021, remotely. The next step is the reduction of the spectroscopic data. The students calibrate the 2D spectral images for the bias, flat-field and correct for the cosmic rays. The 1D spectrum is then extracted together with the one of the background. Helium-Argon lamps are used for the wavelength calibration of both the source and the background spectra, which are interpolated across a common wavelength range. The 1D background spectrum is then subtracted from the source one. The spectrum of the galaxy is finally flux calibrated and corrected for atmospheric absorption by making use of the spectrum of a spectrophotometric standard star observed during the observation run with the same spectral set up. An example of raw and reduced 2D spectral

images by employing the reduction pipeline built by a group of students for the galaxy NGC 3294 is presented in Figure 3. The data reduction tasks described above are entirely carried out by the students using Matlab or Python under the supervision of the teachers and represent the most intensive part of the entire course, namely about 20 hours.

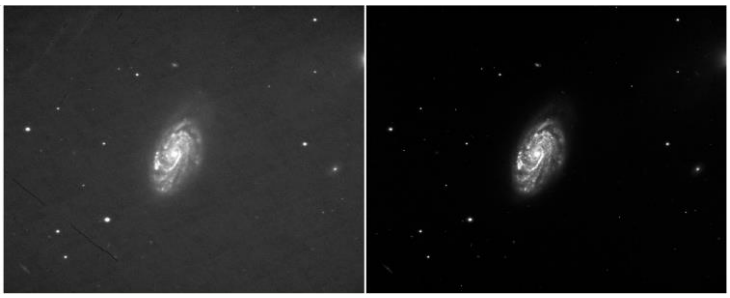

Figure 2. Raw (left) and calibrated (right) image of the local spiral galaxy NGC 3294 observed at the TNG.

3. Results and discussion

Over our 4-year campaign[2], our students created a database of 75 local spiral galaxies (including those observed at Loiano), 13 of them observed at the TNG. Forty students in total have visited La Palma and 87% of them are now involved in astrophysics studies across multi-levels in academia: 6 Bachelor students, 12 Master students, 15 PhD students (6 of them are based in Firenze) and 2 are currently post-doctoral researchers.

Before the COVID-19 outbreak, the activity in a face-to-face laboratory was characterized by significant interactions between the students and the teachers as well as amongst the groups. Most of the difficulties the students encountered during the laboratories concern coding and handling astronomical files but, to foster reasoning, we favoured a manual that provided only a basic guide to the students, who had to figure out and tailor the examples we provided to their case. This guide was insufficient to carry out the laboratory activities remotely. We had to expand the manual significantly, with a step-by-step reduction for the students to follow, which represented one of the most challenging parts of the course redesign for us as teachers as this choice had pros and cons. The students were faster in carrying out the different steps, but we observed that they were making more basic mistakes, mainly from copying the examples of the lines of code we provided without reasoning on how to tailor the specific line of code for their purposes (for example, modifying the pixel coordinates of the objects for the spectral extraction). Moreover, the students divided in groups were forced to meet in separate virtual rooms, thus the feedback amongst groups was lacking almost

[2] 2017, 2018, 2019 and 2021. COVID-19 forced all the observatories to shut down during 2020, whilst the 2021 observing run was done remotely.

completely. The final individual exam consists of an oral examination of the results of the data analysis and a couple of questions on the full course program.

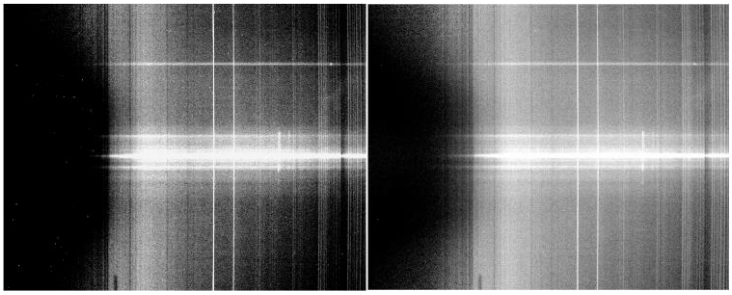

Figure 3. Raw (left) and calibrated (right) 2D spectral image of the local spiral galaxy NGC 3294 observed at the TNG.

During the online oral examination, we noticed that a significant fraction of the students who observed remotely did not fully understand the observing procedure done by the support astronomer during the observations, differently from those students that had the chance to be physically present at the telescope. We believe that the observed loss of insights into fundamental observational techniques was mostly driven by the remote observing and the absolute lack of student training on-site. This result is further supported by previous works on this topic, where significant concerns were raised over the limitations that remote observing may introduce (Lockman, 2005; Privon et al. 2009). Since Complementi di Astronomia went from a face-to-face course, with a significant fraction of the lectures done in the lab and observing on-site at the telescope, to 100% virtual format, the interactions among students were considerably reduced, and so was the feedback from the class during the online lectures. An option to ameliorate remote instruction in astronomy could be the use of robotic facilities as performed by The Open University (UK, Brodeur, Kolb, Minocha, Braithwaite, 2014; Kolb, Brodeur, Braithwaite, Minocha, 2018). The Copernico telescope located in the Cima Ekar, near Asiago (Italy) is moving towards this direction, but it is not fully operational in this way yet. Even though the study by Brodeur et al. (2014) shows that practical astronomy can be effectively taught through fully-remote methods, such an approach is still not comparable to on-site observation. As observational astrophysics is at the heart of our course, the COVID-19 pandemic not only affected the overall course logistic but also had an influence on the students' motivation. During the trip to La Palma that lasts around 5 days, the students have also the unique opportunity to visit several cutting-edge telescopes, such as the Gran Telescopio Canarias, the William Herschel Telescope, the Swedish Solar Tower, and the MAGIC (Major Atmospheric Gamma Imaging Cherenkov) telescope. Moreover, most of our students live in the city and thus have never had the chance to watch a real dark sky with the Milky Way, let alone star constellations and the zodiacal light. We believe that, regardless of what will be their path after their university studies, this

experience had a profound impact on their future career, forging a stronger scientific and critical mindset in our students.

4. Conclusions

With the current pandemic situation, observing on-site is still prohibited, thus we will continue with remote observing for the 2022 academic year. We highlight that this activity is only possible thanks to a private donation and the availability and direct collaboration with the TNG staff, which reserves us a few hours every year. The overall budget required in 2019, for instance, was roughly 15,000 euros for a total of 15 participants (12 students and 3 teachers), which represents a significant expense, unaffordable for a typical Italian university study program in Physics or Astronomy. Therefore, only an external fund can make the entire experience possible. TNG is a cutting-edge telescope, we are thus privileged to have the opportunity to observe at this, significantly oversubscribed, facility. To conclude, the authors wish to thank the Galileo Galilei Fundaciòn and INAF for the allotted observing time, the hospitality and the logistic and scientific support; Dr. Maria Grazia Magini, for the donation to support educational activity and young researchers in memory of the late Stefano Magini the Arcetri Astrophysical Observatory to have offered part of the donation to this activity; and finally the Department of Physics and Astronomy of the University of Firenze for the financial and logistic support to the initiative.

References

Brodeur, M. S.; Kolb, U.; Minocha, S.; Braithwaite, N. 2014. Teaching undergraduate astrophysics with PIRATE. III Workshop on Robotic Autonomous Observatories. Revista Mexicana de Astronomía y Astrofisica Vol. 45, p129-132.

Gurtubai, A. G. et al. (2013). TNG DIMM working on Roche de los Muchachos. *Monthly Notices of the Royal Astronomical Society*, 429, 506-515.

Kolb, U.; Brodeur, M.; Braithwaite, N.; Minocha, S. 2018. A robotic telescope for university-level distance teaching. proceeding of the Robotic Telescopes, Student Research, and Education Conference, June 2017 (RTSRE 2017).

Lockman, F. J. 2005. Can Remote Observing be Good Observing? Reflections on Procrustes and Antaeus. arXiv:astro-ph/0507140. Edited version of an article published in 1993 in 'Observing at a Distance' eds. D.T. Emerson & R.G. Clowes, World Scientific, p325.

Mazzoni, M. (2014). Breve storia dell'*anomalo* Dipartimento di Astronomia e Scienza dello Spazio. *Il Colle Di Galileo*, *3*(2), 7-20. doi: 10.13128/Colle_Galileo-15097.

Privon, G. C.; Beaton, R. L.; Whelan, D. G.; Yang, A.; Johnson, K.; Condon, J. 2009. The Importance of Hands-on Experience with Telescopes for Students. The Astronomy and Astrophysics Decadal Survey, Position Papers, no. 45.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14666

Social Innovation in Health

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Abstract

The first course on Social Innovation in Health (SIH) was conceived and implemented in order to provide students with the necessary tools to assume an active role in the current health and well-being issues of the population, through social undertaking and innovation. Each group created and developed a minimum viable product, covering various global health problems, such as visual impairment, existing contextual barriers for people with Down Syndrome or Autism Spectrum Disorder, among others. From the course, it is evident that SIH represents an incipient tool, with the potential to resolve health problems from a communitarian and interdisciplinary approach. Teaching undergraduate students is essential, as it allows tools and skills to be integrated in the development of future health professionals, as a complement to an ethical medical practice.

Keywords: *Social Innovation; health problems; interdisciplinary approach; institutional collaboration.*

1. Introduction and Problematic Contextualization

Social innovation in health (SIH) provides answers to health needs that have not been resolved through the traditional approach. It is still a developing concept, which has not been defined, but – as its name indicates – seeks to create value for society, involving the community directly, and is transversal, replicable, scalable and sustainable (Phills *et al.*, 2008). Thus, it arises as a response to problems and inequalities at the population level, providing tools for the community and the possibility of expanding towards improving health outcomes (Castro-Arroyave & Duque-Paz, 2020). It is developed in a multidisciplinary manner and involves actors from the public and private world (Battilana & Dorado, 2010; Mason *et al.*, 2015), aiming to identify social determinants and contextual factors in health, and aspiring to break down barriers that prevent the adequate promotion of health.

Multiple research has confirmed the urgency of adopting a renewed perspective, in which social innovation plays a vital role (Sibthorpe *et al., 2005*; Mason *et al.*, 2015). The evidence is clear in showing that disadvantaged social groups, whether due to socioeconomic or ethnic aspects, tend to experience more risk and worse health outcomes (Mitchell, 2016). Traditionally, these problems have been sought to be solved by strengthening healthcare facilities, which generally translates to greater economic investment by governments or private groups. However, even with highly complex health facilities and great care capacity, the results continue to be unfavorable because, to a large extent, the errors and shortcomings of healthcare systems at a local level are not recognized (Ruckert & Labonté, 2014). Therefore, it is possible that, by connecting the people of a community and using unperceived resources (be it geography, social structures or culture), problems that do not require a large financial expenditure, but rather a collaborative management, can be solved. For this, it is essential to generate social impact, community economic and socio-cultural value that allows continuous sustenance over time until a change in conditions is achieved, not only of health but of life and general wellbeing.

Consequently, it is necessary to promote the adoption of "upstream" strategies, meaning methods that seek to modify social determinants of health, which although they are outside of medical action as we traditionally understand it, are part of people's daily lives and affect the process of disease development (Roy *et al.,* 2013). As it deals with these issues, the approach of SIH places the well-being of people as the main objective, allowing the achievement of the Sustainable Development Goals proposed by the United Nations (Mulgan *et al.,* 2007).

In Latin America*,* the *Social Innovation in Health Initiative* (*Iniciativa de Innovación Social en Salud*, in Spanish) has managed to identify and map different cases of social innovation.

Cases such as the professionalization of a training program for health workers in indigenous communities from Brazil, the promotion of initiatives for the prevention of Chagas disease through education, the improvement of housing in Guatemala, and the creation of videos and mobile applications that improve access to health in Honduras, among others, stand out.

In Chile, despite the promotion of many innovative initiatives in the field of health, SIH has not yet been developed. Recently, a research led by Castro-Arroyave & Duque-Paz (2020) identified all the publications related to SIH in Latin America between 2013 and 2018. From the 80 publications found, only 1 came from Chile, and overall, there is major evidence in countries such as Colombia or Brazil.

At the third cycle educational level, there is also a deficit in curricular instances to allow its development, preventing its diffusion and growth.

2. Strategy Course on Social Innovation in Health

Based on the information from regional and national context, in 2020 a group of interested teachers who worked together at OcuLab, Chilean Laboratory for Social Innovation in Visual Impairment, together with Ashoka and 2811, decided to conceive and implement the first course of Social Innovation in Health, in this opportunity at the Pontificia Universidad Católica de Chile (PUC). Its aim was to promote the development of skills and knowledge of specific tools to the undergraduate students, in order to generate social innovations in the sector by co-creating solutions to certain challenges in the community. Multidisciplinary groups were organized, each one working together with different health centers and departments.

Due to the success of the course and the need to continue generating collaborative work, the course was repeated in 2021, this time in an international level and in alliance with “La Triada”, a cooperative university network composed by Universidad de Los Andes of Colombia (UA), Technological Institute of Monterrey of Mexico (ITM), and PUC.

Both versions were semi-annual, virtual, and included students aged 18 to 25, from different academic disciplines. The details about each course are detailed in table 1.

Throughout the semester, theoretical classes were held about the concept and importance of SIH. Afterwards, each team of students was encouraged to search for obstacles and/or challenges of the people from the center that they were assigned to work with and make contact with them in order to co-create a solution. These contacts were made under a strict information confidentiality protocol, and they could leave the activity at will, without prior justification.

Table 1. Specifications of each course

	2020	2021
Number of students	31 undergraduate students from PUC	25 undergraduate students (7 from UA, 6 from ITM and 12 from PUC)
Groups	5 groups of 4-5 students each	8 groups of 3-4 students each
Disciplines of students	Medicine, Engineering, Psychology, Nutrition, Design, Nursing, Speech Therapy, Kinesiology and Social Work.	Medicine, Engineering, Nutrition, Design, Nursing, Kinesiology and Social Work
Health centers and departments involved	. OcuLab PUC Laboratory for Social Innovation in Visual Impairment 2. PUC Cancer Center 3. PUC Down Syndrome Center 4. PUC Department of Geriatrics . PUC Department of Ophthalmology	OcuLab PUC Laboratory for Social Innovation in Visual Impairment *Mesón* group (Mexico) PUC Center for Autism Spectrum Disorder (Chile) *Suma Foundation* (Chile)

Abbreviations: PUC, Pontificia Universidad Católica de Chile; UA, Universidad de Los Andes of Colombia; ITM, Technological Institute of Monterrey of Mexico.

The work process was accompanied and followed-up by health-related mentors from the university and collaborating organizations, and conducted by a Social Lean Canvas, which allowed the students to identify factors involved in the process. Once the team detected the challenge and its origin, the potential solutions were developed; a Minimum Viable Product (MVP) was co-created, corresponding to the initial version of a product or service with the necessary characteristics to be offered to an initial group of clients (institutions), and to obtain feedback on it in order to modify or improve it before its full development (Lenarduzzi & Taibi, 2016).

The course concluded with a closing ceremony, where all the groups presented their progress and achievements in a 5-minute pitch presentation. They were evaluated by a jury

of professionals and specialists who determined the best project, to whom *Ashoka* Foundation granted financial support to continue their development.

3. Results and Findings

The groups of students worked with different institutions, detailed below:

OcuLab PUC: the 2020 group focused on encouraging laboral inclusion of people with visual impairment, creating a virtual platform designed to facilitate contact with companies and social groups, in order to find job opportunities. The 2021 group created an automated matchmaking service between people and programs, delivering personalized recommendations to each user with the objective of directing people with visual disabilities to specific aid programs.

Down Syndrome PUC Center: to promote the autonomy of people living with this syndrome, a simulated house project was designed with the aim to create a supervised space that would allow training and promote independent living.

PUC Cancer Center: to improve the educational content available to patients with cancer and their support networks at Sótero del Río Hospital, this group created a didactic audiovisual medium to disseminate information about their disease and treatment, through cell phones and social media.

PUC Department of Ophthalmology: this group worked at co-designing a low-cost support device for cell phones, in order to facilitate its use by users with reduced visual acuity and low vision, especially elderly people.

PUC Department of Geriatrics: once recognized the deficit in identification of medication in elderly people, a group that presents polypharmacy and is exposed to higher rates of illiteracy and visual problems, this group created a system of graphic symbols to be included in drug labels, facilitating their distinction (Figure 1).

Figure 1. Validated prototype of the instrument developed to facilitate the recognition of medication in elderly population with reading impairment.

Mesón group: in order to decrease the rate of HIV infections in the population, a communication channel to develop content related to mental health and destruction of

prejudice, in addition to generating finance for PREP medication, was developed by one group, while the other designed an online educational platform.

PUC Center for Autism Spectrum Disorder (ASD): in the current context of online education, the challenge of improving the educational repertoire for children with ASD was identified. Subsequently, a virtual platform equipped with visual tools and interactive material to be used in virtual meetings were developed.

Suma Foundation: due to the actual pandemic, the health routine care of patients with ASD was interrupted, leaving the care solely in the hands of their caregivers. In this context, one group designed a mobile application that included the profile of patients, caregivers and health professionals, in order to facilitate communication between them, and the other group created a social media profile where caregivers could connect and share experiences and tools between them.

4. Discussion

SIH represents a change in the rehabilitative biomedical model, which has historically focused on improving health through new therapies, medications, infrastructure, among others. Although the contribution of these measures is valued, many times they are far from what the population requires. This has led various authors to conceive and promote SIH as a response to the failure of the current social and institutional systems (Oosterlynck *et al.,* 2013).

In essence, SIH seeks to create networks between different groups in society, recognizing the need to generate a collaborative process with the aim of obtaining favorable health outcomes (Mulgan *et al.,* 2007). For this, it is crucial to interfere in the daily life of people whose quality of life we seek to improve, and that is precisely what SIH aims to promote.

The main objective of the university course was to teach undergraduate students about SIH and its impact, encouraging them to apply its philosophy to their future professional practice. Given its multidisciplinary nature, it was possible to generate valuable networks of contacts and information between young students and professionals around the world. The adoption of “thinking outside the traditional model” was encouraged, which also helped develop skills useful for student’s future professional practice, no matter their original area of knowledge, considering an ethical purpose when acquiring these new skills.

As a way to improve, new ideas could be implemented to maintain the students' motivation throughout the semester as most of them have a busy university life and their schedules are hard to match. It was difficult to maintain continuous contact between the students of each group and their mentors, considering meetings and classes were held online, and sometimes had to take into account different time zones. This on some occasions interfered and slowed

down the work process.

As future directions, we hope that the implemented courses will be repeated in the coming semesters, and continue to grow, both locally and internationally. Likewise, we continue to work so that the evidence on SIH increases, and its definition is improved, as well as the identification of factors that lead to its success or failure, allowing progress in its implementation. For this reason, we emphasize the importance of further comparative studies and/or systematic analyses, in order to assess the real benefits and costs of SIH, compared to traditional approaches.

5. Conclusions

SIH represents an original and incipient tool, which seeks to obtain community well-being through a non-traditional approach, providing multidisciplinary and co-created responses to problems not resolved by institutional or state health systems. Its knowledge and application in the medical area allows the adoption of a complementary perspective on health outcomes and new competences in a social ethical context, making its early teaching in university essential. Given its global nature, undoubtedly increased by the COVID-19 pandemic, and its potential future projection, collaborative efforts for its dissemination must be carried out regionally and internationally.

References

Battilana J & Dorado S. (2010). Building sustainable hybrid organizations: The case of commercial microfinance organizations. *Academy of Management Journal* 53(6), 1419-1440.

Castro-Arroyave DM & Duque-Paz LF (2020). Documentary research on social innovation in health in Latin America. *Infectious diseases of poverty* 9(1), 1-8

Lenarduzzi V & Taibi D. (2016). MVP explained: A systematic mapping study on the definitions of minimal viable product. At *42th Euromicro Conference on Software Engineering and Advanced Applications (SEAA)*. Institute of Electrical and Electronics Engineers

Mason C, Barraket J, Friel S, O'Rourke K, Stenta C. (2015). Social innovation for the promotion of health equity. *Health Promotion International* 30(2), 116-125

Mitchell F. (2016). Innovations in health equity and health philanthropy. *Stanford Social Innovation Review 14*, 3

Mulgan G, Tucker S, Ali R, Sanders B. (2007). Social Innovation: What It Is, Why It Matters and How It Can Be Accelerated. Skoll Center for Social Entrepreneurship. Said Business School. Oxford University.

Oosterlynck S, Kazepov Y, Novy A, Cools P, Barberis E, Wukovitsch F, Sarius T, Leubolt B. (2013). The butterfly and the elephant: local social innovation, the welfare state and new poverty dynamics. *ImPRovE Discussion Paper* 13(2)

Phills JA, Deiglmeier K, Miller D. T. (2008). Rediscovering social innovation. *Stanford Social Innovation Review 6* (4), 34-43.

Roy MJ, Donaldson C, Baker R, Kay A. (2013). Social enterprise: New pathways to health and well-being. *Journal of Public Health Policy* 34, 55–68.

Ruckert A & Labonté R. (2014). The global financial crisis and health equity: early experiences from Canada. *Globalization & Health* 10, 1–21.

Sibthorpe BM, Glasgow NJ, Wells RW (2005). Emerging themes in the sustainability of primary health care innovation. *Medical Journal of Australia* 183, 77–80

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14456

Teaching and learning anatomy online in South Africa during the COVID-19 pandemic

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Abstract

Due to the interactive nature of classic anatomy teaching and learning, great consideration and planning were necessary to deliver an effective online anatomy course. This paper describes the experiences of teaching and learning anatomy online in South Africa during the COVID-19 pandemic. An asynchronous approach was successful in delivering the course content; however, students expressed the desire to resume in-person, interactive cadaveric dissections. Anatomy course content was delivered using a variety of educational resources accounting for all learning styles and attempting to mimic a pre-pandemic setting. Although postgraduate student research timelines were disrupted, contact between research teams was maintained, allowing for projects to run through to completion. The challenges faced throughout the pandemic have shown that anatomical science is a constantly evolving discipline that requires a variety of resources.

Keywords: *Anatomy education; medical education; COVID-19; virtual; online learning; dissection.*

1. Introduction

The COVID-19 pandemic has disrupted higher education on a global scale, with universities forced to close and conduct teaching and learning via distance-based online learning, in an effort to curb the spread of the virus (Daniel et al., 2021; International Association of Universities, 2020). Social distancing and wearing of face masks became mandatory, with "lockdowns" enforced in some countries. In South Africa, a strict lockdown was implemented on the 26th March 2020, with only essential workers (such as emergency services, law enforcement, and health care providers) permitted to travel outside of their homes (Department of Higher Education and Training, 2020). In addition, national and provincial borders were closed. Although these restrictions were eased from the 1st May 2020, most higher education institutions had yet to resume in-person teaching for all or part of their teaching activities.

This article will describe the experiences of teaching anatomy online during the COVID-19 pandemic at a South African institution, situated in Cape Town. The authors comprise of two anatomy educators and two postgraduate (Master's) students, and therefore, can provide a range of perspectives. The authors' institution is classified as a "Historically Advantaged" institution, and as such, may be considered to be in a better position to deliver online education than some of the other institutions in the country. However, anatomy is a discipline that relies on cadaveric dissection as the gold standard for teaching and learning the three-dimensional (3D) structures and spatial relationships between structures within the human body (Ghosh, 2015).

2. Pre-pandemic teaching and learning

Prior to the COVID-19 pandemic, the delivery of anatomy to the Bachelor of Medicine and Bachelor of Surgery (MBChB), Allied Health Sciences, and Bachelor of Science (BSc) classes involved face-to-face didactic lectures and practical cadaveric dissection sessions. Cadaveric dissections took place in dissections halls in the Division of Clinical Anatomy (CA), with six to eight students dissecting one cadaver, for two to four-hour sessions. The Division of CA is also equipped with articulated skeletons, osteological material, and Lodox® (low-dose x-ray) scans accompany each cadaver. Assessment of practical anatomy knowledge was conducted face-to-face in dissection halls, using the "spot test" format. Postgraduate (PG) students from the Division of CA carried out all theoretical and practical coursework at the institution. The Honours programme involves coursework and research, while most of the Master's and Doctoral degrees are by research (dissertation) only. Furthermore, the PG CA courses aim to prepare students for the workplace, and thus the students were assigned a shared office space to work and assisted in near-peer tutoring of undergraduates.

2.1. Transition to online teaching and learning within a South African context

The shift to online teaching presented complications for institutions across South Africa. Few South African higher institutions had prior experience with fully online teaching and learning. After the commencement of lockdown on the 26th March 2020, all higher education institutions were mandated by the President of South Africa to close for early recess, with online teaching and learning resuming on the 20th April 2020 at the authors' institution (Department of Higher Education and Training, 2020). This period afforded educators the time to convert course content to a fully online delivery medium with the assistance of facilitated webinars held by the Centre for Health Professions Education.

South Africa experiences severe economic inequality, with parts of its population lacking electricity, internet access, and other resources essential for remote learning (Czerniewicz et al., 2020; Ojo & Onwuegbuzie, 2020). The authors' institution helped bridge this divide by providing staff and students with electronic devices and mobile network data, and zero-rated access to the university's online learning management platforms (du Plessis, 2020). Furthermore, the entire nation was affected by sporadic "load shedding" during which the electrical power supply is disconnected for extended periods, to meet the country's power supply demands, making it increasingly challenging for conducting online teaching and learning.

3. Clinical Anatomy in the pandemic setting

3.1. Undergraduate Courses in Anatomy

3.1.1. Course content resources and delivery

Due to the practical and interactive nature of classic anatomy teaching and learning, great consideration and planning were necessary to deliver an effective online anatomy course. All anatomy dissections were brought to an abrupt halt, and thus lecture slides needed to be adapted to provide an understanding of "real" anatomy. Lectures took the form of Microsoft PowerPoint presentations with voice recordings on each slide, mp3 recordings, or pdf documents. Asynchronous content delivery was recommended by the authors' institution to accommodate all students within the South African context. Thus, all lectures, supplementary resources, and assessments were made available on the university's learning management platform, SUNLearn. Where synchronous lectures were held on Microsoft Teams and Zoom, these were scheduled in consultation with the class, recorded, and subsequently posted on SUNLearn for those who were not able to attend. Email and discussion forums on SUNLearn were used for communication between the lecturers and students, although the engagement was generally poor. However, students mostly completed the compulsory quizzes by the deadline dates.

To mimic the frequency of pre-pandemic cadaveric interactions, students were encouraged to interact with the course content as frequently as possible using variable formats (Estai, 2016). Therefore, supplementary educational resources were made available, including question and answer sessions, quizzes, worksheets, and educational YouTube videos. In addition, some supplementary resources were compiled by lecturers in collaboration with the PG anatomy students, who provided insight into which aspects students may find challenging. Completion of and interaction with supplementary resources were made compulsory by some lecturers as it was believed that without deadlines, students would be reluctant to engage with the content. Other lecturers were concerned with increasing the cognitive load, known to be higher in online learning (Skulmowski & Xu, 2021), and thus rated resources according to their importance, with some being optional.

Primal Pictures (© Informa UK Ltd, 2022) and BlueLink – University of Michigan (Alsup & Fox, n.d.) were heavily incorporated into teaching anatomy. With an institutional subscription to Primal Pictures, students could access its full complement of features without incurring additional costs. These online resources enabled students to better visualise structures in 3D whilst conceptualising spatial and relational anatomy (Wilkinson, 2011). However, the absence of cadaveric dissections meant that students were limited in their exposure to anatomical variation as well as the haptic aspect of learning anatomy. Moreover, students were unable to fully experience the "hidden curriculum", which teaches the ethical considerations around sourcing of bodies, and facilitates the development of teamwork skills, respect, and empathy (Onigbinde et al. 2020). A virtual session was provided to account for this loss in the curriculum, within which the annual body donation thanksgiving ceremony was included.

3.1.2. Assessment

Assessments required redesigning for an online format, especially those assessing practical knowledge. Theoretical anatomy was assessed via multiple-choice questions for the larger classes, such as the MBChB cohort, and graded automatically on SUNLearn. In comparison, the smaller classes employed short- and long-answer assessment questions, graded manually by the lecturer. The practical component emulated the traditional anatomy "spot test" layout, displaying two-dimensional images of cadaveric material, histological tissues, and osteological structures for identification. However, this could not account for the assessment of spatial and relational anatomy, which can only be achieved when assessing using a cadaver or 3D model (Harmon et al., 2021). Concerns of online assessments being a gateway for dishonesty arose as assessments were not invigilated using webcams due to mobile network limitations. Although this risk could not be fully eliminated, assessment settings allowed for questions to be ordered randomly, time-limited, or only have one attempt.

3.1.3. Near-peer tutoring

Anatomical education frequently employs near-peer tutoring to assist lecturers with large class sizes (Thom, 2021), and therefore, gained popularity at the authors' institution. Near-peer tutors are senior students who have achieved a minimum score of 65% in the anatomy component of their respective degree. Near-peer tutoring affords the opportunity for students to seek assistance from a peer, which may be less intimidating than approaching a more experienced educator. In turn, near-peer tutors consolidate their own knowledge, gain teaching experience, and improve leadership and communication skills (Orsini et al., 2022). Neer-peer tutoring took two forms during the pandemic: asynchronous discussion forums for question and answer sessions, and synchronous one-on-one or small group sessions on Microsoft Teams.

3.1.4. Feedback from undergraduate students

Feedback for anatomy was informal, mainly in the form of unsolicited e-mails from students. However, a researcher from CA investigated the MBChB cohort's perspectives of learning anatomy online (Khan, 2021). It was reported that students appreciated the time and effort that educators invested into their resources to make them clear and understandable. Students enjoyed the ability to pause and re-watch the recorded lectures, and reported feeling less stressed when completing online examinations from their home environments when compared with invigilated assessments on campus. However, requests were received for more demonstrations with models or cadavers in the online content, or the resumption of in-person practical sessions (Khan, 2021).

3.2 Postgraduate Courses in Anatomy

3.2.1. Research and supervision

Postgraduate students were required to halt their research activities and work from home. Communication within research teams was conducted via Microsoft Teams and e-mail. As the lockdown extended, it became apparent that the practical components forming part of the Honours degree would not be able to take place at the institution. Thus, modules that required on-campus facilities were modified to a digital format where possible, such as using Primal Pictures to mimic cadaver dissections. Other modules were taught synchronously on Microsoft Teams or Zoom, such as journal club, which serves to equip students with scientific writing skills. Furthermore, all student timelines for research projects were affected due to the extended closure of the histological and dissection laboratories. Although PG students were understanding of the ongoing challenges, they expressed that working from home negatively affected their morale and motivation, placing emphasis on the value of in-person interactions when collaborating. Additionally, PG students were limited in their experience

of near-peer tutoring, negatively affecting their acquisition of associated skills, such as teaching and communication.

The pandemic however, afforded the opportunity to expand research interests within anatomy to include projects that could be conducted remotely, such as surveys and online interviews. One such study reported on the implementation of the synchronous virtual journal club (Keet et al., 2021). This study reported an overall positive experience with the rapid transition to a virtual environment while maintaining the benefits of teaching and learning (Keet et al., 2021).

4. Return to Campus: Anatomy Classes

A staggered approach was taken for the return of students to campus under strict institutional and governmental COVID-19 protocols. As the national lockdown continued throughout the latter half of 2020, PG CA students were first identified based on their need to complete their research projects and module assignments using the on-campus facilities. A strict roster was implemented, however further negatively affecting research timelines. The BSc students were the second cohort to return to campus for in-person practical dissection sessions, with the final-year students returning in the last quarter of 2020. The second-year BSc students returned for dissection sessions in the beginning of 2021, while their lectures were still conducted online. The BSc anatomy classes consisted of less than 30 students, and thus appropriate social distancing could be achieved in the dissection hall, which was not possible for the larger classes under the government mandated venue number restrictions. However, in-person invigilated assessments were resumed for many courses of the Faculty in 2021, with large classes divided into smaller groups that wrote the assessment in multiple venues at the same time.

As the new academic year of 2022 began in January, face-to-face teaching and learning resumed for all programmes offered at the Faculty as the venue number restrictions were eased by the government. Teaching was delivered in a hybrid format; however, students could choose to attend in-person or virtual lectures. The large MBChB cohort was divided into smaller groups for cadaver dissections. Three students were allocated to one cadaver, which is half of the number allocated in the pre-pandemic setting. Groups had one-hour interactive sessions with pre-dissected cadaveric material for each sub-topic within their system-based anatomy course, which is notably different from how practical sessions were structured before the pandemic, where students had several hours per session to dissect. This change resulted from the shortage of cadavers available for dissection as the body donation programme was closed for much of the pandemic.

5. Conclusion

Throughout the course of the COVID-19 pandemic, anatomical education shifted and adapted. Unique challenges to South Africa required innovative solutions to conduct online teaching and learning, involving an asynchronous approach and provision of resources to staff and students. Anatomy course content was delivered using a variety of educational resources accounting for all learning styles and attempting to mimic a pre-pandemic setting. However, the efficacy and impact of conducting a fully virtual anatomy course has still yet to be determined at the authors' institution. The authors are currently conducting a study involving undergraduate, postgraduate, and academic staff in anatomy of their perceptions of both fully online and blended learning approaches to teaching and learning anatomy and postgraduate research supervision. The resumption of the academic programmes in 2022 are being conducted in a hybrid format to account for the ever-changing circumstances surrounding the pandemic. From our experience, teaching anatomy by means of a hybrid approach with an emphasis on in-person practical sessions complemented by online asynchronous lecture material is feasible.

References

Alsup, B., & Fox, G. (n.d.) Michigan - BlueLink | AnatomyTOOL. Retrieved from https://anatomytool.org/content/michigan-bluelink

Czerniewicz, L., Agherdien, N., Badenhorst, J., Belluigi, D., Chambers, T., & Chili, M. et al. (2020). A Wake-Up Call: Equity, Inequality and Covid-19 Emergency Remote Teaching and Learning. Postdigital Science And Education, 2(3), 946-967. doi: 10.1007/s42438-020-00187-4

Daniel, W., Nivet, M., Warner, J., & Podolsky, D. (2021). An update on developments in medical education in response to the COVID-19 pandemic: A BEME scoping review: BEME Guide No. 64. Medical Teacher, 43(3):253-271. Doi: 10.1080/0142159X.2020.1864310

Department of Higher Education and Training. (2020). Measures to deal with the Coronavirus COVID-19 in the post-school education and training sector. South African Government. Retrieved from https://www.gov.za/speeches/minister-higher-education-science-and-innovation-statement-measures-deal-covid-19-threat

du Plessis. (2020). Important information for online learning in Term 2. Stellenbosch University: Institutional Committee for Business Continuity. Retrieved from https://www.sun.ac.za/english/Lists/news/DispForm.aspx?ID=7283

Estai, M., & Bunt, S. (2016). Best teaching practices in anatomy education: A critical review. Annals Of Anatomy - Anatomischer Anzeiger, 208, 151-157. doi: 10.1016/j.aanat.2016.02.010

Ghosh, SK. (2015). Human cadaveric dissection: a historical account from ancient Greece to the modern era. Anatomy & Cell Biology, 48:153–69. doi: 10.5115/acb.2015.48.3.153

Harmon, D., Attardi, S., Barremkala, M., Bentley, D., Brown, K., & Dennis, J. et al. (2021). An Analysis of Anatomy Education Before and During Covid-19: May–August 2020. Anatomical Sciences Education, 14(2), 132-147. doi: 10.1002/ase.2051

© Informa UK Ltd (trading as Primal Pictures). (2022). Primal Pictures, an informa business. Retrieved from www.primalpictures.com - www.anatomy.tv

International Association of Universities. (2020). The impact of Covid-19 on higher education around the world. IAU Global Survey Report. Retrieved from https://www.iau-aiu.net/IMG/pdf/iau_covid19_and_he_survey_report_final_may_2020.pdf

Keet, K. A., Baatjes, K. J., Venter, R. G., Wessels, Q., & Correia, J. C. (2021). Development of a Virtual Journal Club in Anatomy: a Responsive Pandemic Pedagogy. Medical science educator, 31(4), 1–8. doi:10.1007/s40670-021-01325-8

Khan, J. (2021). Opinions of anatomy students on online anatomy education during the COVID-19 pandemic [Honours Thesis, Stellenbosch University]. *Stellenbosch University.*

Onigbinde, O., Chia, T., Oyeniran, O., & Ajagbe, A. (2021). The place of cadaveric dissection in post-COVID-19 anatomy education. Morphologie, 105(351), 259-266. doi: 10.1016/j.morpho.2020.12.004

Ojo, E. O., Onwuegbuzie, A. J. (2020). University life in an era of disruption of COVID-19: A meta-methods and multi-mixed methods research study of perceptions and attitudes of South African students. International Journal of Multiple Research Approaches, 12(1), 20-55. doi: 10.29034/ijmra.v12n1editorial3

Orsini, E.; Quaranta, M.; Mariani, G.A.; Mongiorgi, S.; Cocco, L.; Billi, A.M.; Manzoli, L.; Ratti, S. (2022). Near-Peer Teaching in Human Anatomy from a Tutors' Perspective: An Eighteen-Year-Old Experience at the University of Bologna. International Journal of Environmental Research and Public Health, 19, 398. doi: 10.3390/ ijerph19010398

Skulmowski, A., & Xu, K. (2021). Understanding Cognitive Load in Digital and Online Learning: a New Perspective on Extraneous Cognitive Load. Educational Psychology Review. doi: 10.1007/s10648-021-09624-7

Thom, M., Kimble, B., Qua, K., & Wish-Baratz, S. (2021). Is remote near-peer anatomy teaching an effective teaching strategy? Lessons learned from the transition to online learning during the Covid-19 pandemic. Anatomical Sciences Education, 14(5), 552-561. doi: 10.1002/ase.2122

Wilkinson, T. (2012). Primal pictures anatomy teaching resources: 3D anatomy software and 3D real-time viewer. Journal of Anatomy, 220, 118-119. doi: 10.1111/j.1469-7580.2011.01446.x

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14405

Education models used across Europe to train Therapeutic Radiographers/Radiotherapists: a cross-case study

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Abstract

Interviews with radiotherapy (RT) stakeholders were completed across four European countries to identify the educational models used across Europe and how they affect competencies of Therapeutic Radiographers/Radiotherapists (TR/RTTs).

The stakeholders identified the following educational models:

- *Programmes below European Qualifications Framework (EQF) level 6 (EQF4 or EQF5)*
- *RT-only BSc programmes (EQF6)*
- *Multiple-specialism BSc programmes (EQF6)*
- *RT-only apprenticeships (EQF6)*
- *Multiple-specialism BSc followed by an MSc (EQF6→EQF7)*
- *Integrated masters (EQF7)*
- *RT-only pre-registration MSc (EQF7)*
- *'Common trunk' model (EQF6 or EQF7)*

Each educational model has its set of advantages and disadvantages, but most models can be used to achieve the same essential competencies of TR/RTTs. Some models showed weaknesses in their ability to develop adequate RT competencies (low EQF level, low RT-specific content). Regulating the standards of practice at national level ensures that essential competencies are developed across all course programmes, improving the care to RT patients.

Keywords: *Education models; Radiotherapy; Therapeutic Radiographers; Radiotherapists; Competencies; Healthcare.*

1. Introduction

Cancer is still one of the most significant causes of mortality and morbidity worldwide, with an expected 2.7 million new cases and 1.3 million deaths in 2021 alone across the European Union (EU) (Joint Research Centre, 2021). Given that around 50% of all cancer patients undergo Radiotherapy (RT) at some point in their treatment journey (Barton et al., 2014), adequate education for staff administering these treatments is crucial.

The focus of this study was Therapeutic Radiographers/Radiotherapists (TR/RTTs), who are responsible for delivering radiation during radiotherapy treatments, planning and preparation of treatments, and follow-up of patients during and after treatments, among other roles. These tasks are often performed as part of a multidisciplinary team that includes medics, nurses, medical physicists, among other healthcare professionals.

Even though most graduates will practice in the country where they graduate, mobility of healthcare staff is greatly facilitated through the mutual recognition of qualifications between EU member-states: Directive 2005/36/EC (European Parliament & European Council, 2005). Additionally, EU citizens can obtain treatment care in any other member state (European Parliament & European Council, 2011). Therefore, TR/RTTs' education of each EU country is important for all EU citizens.

However, the education of TR/RTTs varies considerably across Europe regarding academic level (from EQF4 to EQF7), course duration (from 0.5 to 5 years), branches of radiography included in the courses (RT-only or multiple specialisms), and different percentages of the courses dedicated to RT (from 10% to 100%) (Couto et al., 2018, 2021; England et al., 2017; HENRE, 2008; Janaszczyk & Bogusz-Czerniewicz, 2011; McNulty et al., 2016).

The course characteristics used to train TR/RTTs impact the competency level (Couto et al., 2021; Sá dos Reis et al., 2018). In turn, the competency level of TR/RTTs impacts the quality of care provided to RT patients (Baeza, 2012; ICRP, 2000). However, this literature did not explore the impact of education models on the competency level of graduates and patient care. Therefore, this study aimed to identify the education models used across Europe and assess their impact on the competencies of TRs/RTTs.

2. Methods

A *cross-case study* method was used. The cases were distributed geographically (Gerring, 2007), which allowed collection of European stakeholders' perception of the impact of TR/RTTs' education models on competency, through several interviews. This can be classified as an *instrumental case study*, since the aim was to replicate the case studies across four countries (*theoretical replication*) to understand a bigger picture: the European-wide education of TR/RTTs.

2.1. Population, sampling and recruitment

This study's target population was constituted by all EU countries. The UK was included in the study, since the research started before Brexit. Four countries with extreme differences in terms of characteristics of the courses (e.g. duration and specialims), identified in a previous study (Couto et al., 2021) were selected (*maximum variation sampling*). Table 1 shows the variation in course characteristics of the countries included in this study.

Table 1. EU countries sampling

Country selected	Course characteristics of the countries included in the study
Finland (FL)	RT+MI*, <20% of the programme dedicated to RT, 3-year programme
Portugal (PT)	RT+MI (recently transitioned from RT-only), 4-year programme
Poland (PL)	RT+MI+EP*, programmes from EQF5 (2 years) to EQF7 (5 years)
UK (UK)	RT-only, >80% of the programme is dedicated to RT, various pathways available (Bachelor's degrees, apprenticeships, pre-registration masters' programmes)

*EP = Electrophysiology specialism; MI = Medical Imaging specialism; RT = Radiotherapy specialism; EQF = European Qualifications Framework

Six to nine stakeholders were interviewed in each country. They were invited by national professional associations linked with SAFE EUROPE project, an European-funded project (www.safeeurope.eu) and through social media to minimise sampling bias. Participants were chosen to include a mix of stakeholders with different roles, providing different points of view (*critical case sampling*): local and migrant TR/RTTs, clinical managers, RT lecturers, students, and representatives of the national professional associations.

2.2. Semi-structured interviews

The semi-structured interview guide was designed based on results from previous research (Couto et al., 2018, 2021) and literature review. Open-ended questions allowed participants to discuss their educational background, the educational models used to train TR/RTTs, and its impact on graduates' competency and patient care.

The first interview, in Lisbon, November 2019, was performed face-to-face at a national conference. The following interviews were performed online due to COVID-19 restrictions.

2.3. Thematic Analysis and Rigour

The analysis started with a *line-by-line coding* to minimise researcher biases' influence on the data interpretation (Gibbs, 2020) and finished using an *elaborative coding*, which elaborates previous themes into the final thematic framework (Saldaña, 2013).

Several methods were used to improve rigour and trustworthiness: triangulation of sources, negative case analysis, member checking, peer debriefing, and researcher reflexivity were completed (FitzPatrick, 2019; Johnson, 1997; Robson, 2002). The results obtained were compared with previous results and published literature (*triangulation*) (Flick, 2020). The results were discussed with the SAFE EUROPE consortium and with three RT experts from a European professional organisation prior to publication as part of *peer debriefing*.

2.4. Ethical considerations

The Institute of Nursing and Health Research Ethics Filter Committee at Ulster University, UK, granted permission for this study. Participation was voluntary, confidentiality was guaranteed, an information letter was provided two weeks in advance and consent was collect on the day of the interview. Data was saved in password-protected computers.

3. Results and Discussion

Twenty-seven stakeholders were interviewed across four countries. Data saturation was achieved well before the completion of all interviews.

"Patient care and safety" was a main theme emerging from the analysis, mostly influenced by graduates' competencies. In turn, "competency level" was also identified as a main theme, which depends on the educational model used to train TR/RTTs. The subthemes related to the educational model were: EQF level, programme duration, specialisms, RT-specific training and regulation.

The main concerns identified by stakeholders were programmes at academic levels below EQF6 and courses with little RT-specific content that allow graduates to practice the TR/RTT profession. When courses do not include enough RT-specialisation, students graduate with competencies below the expected level for the roles taken. Without the RT-specific underpinning knowledge and practical training, graduates cannot take responsibility for RT tasks or perform them autonomously safely.

It is acknowledged that graduates can develop these competencies after graduation. However, the essential competencies must be acquired at the end of the degree that gives access to the profession. Otherwise, patient safety is compromised. According to the Bologna process, the EQF6 is the level that provides access to the profession (Cowling, 2008), but this varies widely across Europe.

The educational models and corresponding countries were discussed by the stakeholders are identified below. Note that some countries, such as the UK and Poland, have more than one educational model that gives access to the profession:

- Programmes below EQF6 (EQF4 or EQF5) – Germany, Poland and Spain
- RT-only BSc programmes (EQF6) – Portugal (before 2014) and the UK
- Multiple-specialism BSc programmes (EQF6) – Portugal (after 2014), Finland, and Malta
- RT-only apprenticeships (EQF6) – UK
- Multiple-specialism BSc followed by an MSc programme (EQF6 → EQF7) – Poland
- Integrated masters (EQF7) – no country identified by stakeholders
- RT-only pre-registration MSc (EQF7) – UK
- 'Common trunk' model (EQF6 or EQF7) – The Netherlands

The most common model is the traditional **Bachelor's (BSc) degrees at EQF6**. In very few countries these programmes are RT-only, while in most countries RT training is shared with other specialisms. In multi-specialism programmes, RT is mostly taught together with Medical Imaging (MI) and in rare instances with Electrophysiology (EP). Some multi-specialism programmes have very little RT content, a major concern for the stakeholders: "*you know a little bit of everything, but you don't know everything about one thing*" (FL2); "*There were like 20 [credits in radiotherapy] when whole school [programme] was 210 [credits]"* (FL5).

It was clear that '*there's always bias to the models that you know*' (UK1), referring to the traditional BSc programmes. This bias provides decision-makers with the safety of using well-established models but hinder the use of alternatives that could be more efficient and efficacious. The alternative models are discussed below.

The Alternative models at **EQF6** included **apprenticeships**. In this model, students join an educational programme led by the clinical department, who is responsible to develop their knowledge, skills and competencies. These models often include a partnership between a clinical department and an education institution. Given that clinical departments can employ graduates from other programmes without training costs, setting-up apprenticeships does not seem financially appealing. This model achieves the same standards as the traditional BSc programmes.

Another model includes **continuing the EQF6 programme into an EQF7**; either separate sequential programmes or as part of an integrated master's programme. In the former, students can start practising after the first cycle and enrol (or not) in the second cycle at a later stage. The latter is a continuous programme. These models were recommended in countries where the initial EQF6 programme was considered insufficient to practice RT (e.g. multi-specialism programmes lacking RT), requiring additional training to achieve essential RT competencies. In some countries, the EQF7 level is necessary since *'some activities […] we could do only when we have a Master's [EQF7]'* (PL5).

In **pre-registration Masters' (MSc) degrees**, BSc graduates of various backgrounds can join an RT-dedicated MSc programme that allows them to practice RT. These are shorter

than the traditional BSc programmes, often 2-year. However, since students developed many transversal skills in their initial programme, the MSc programme can focus on the RT-specific content, allowing graduates to achieve the '*the same standards of education and training*' (UK4) as traditional EQF6 BSc graduates. Some stakeholders highlighted that this pre-registration MSc do not equate to a specialisation MSc. The latter provides advanced skills, allowing TR/RTTs to perform advanced roles, while the former focuses on achieving the essential competencies to practice since *"they will only have, actually, two years [of RT training]"* (UK4).

Stakeholders also discussed a **"common trunk" model**. This term was previously used (Educator Preparation Committee, 2018) to describe programmes where students start in a "common trunk" but choose a specialisation branch at a certain point in their degree: *"for example, one last year, you can focus in radiotherapy"* (FL1). This model was extensively discussed in countries where RT-specific content was considered insufficient. The main advantage is that it efficiently uses resources during the "common trunk" but allocates enough time to develop essential competencies in the selected specialism. This model also allows TR/RTTs to develop more imaging competencies before specialising "*It would make sense to have a common trunk because we would increase the knowledge of MRI, CT... and then, yes, choose an option" (PT2).* This model seems appealing since it may be applied even if national regulations only allow for the traditional BSc programmes. However, regulation must be updated to clarify which specialisms/roles they can practice depending on the speciality they develop.

Even though stakeholders and European benchmarking documents (EFRS, 2018; ESTRO, 2014) recommend a minimum EQF6 to practice RT, some European countries still offer **EQF4 and EQF5 courses**. The EQF6 level ensures that graduates "manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts" (European Parliament & European Council, 2008, p. 13) which is essential for the roles undertaken by TR/RTTs. Stakeholders identified a safety risk in low EQF programmes: "They have no knowledge of dosimetry, […] physics, they have no knowledge at all" (PT5); "[it would be] unthinkable that a [TR with EQF6] would do this error" (PT7). Therefore, the EQF6 are not recommended.

3.1. The role of regulation

With regulation of learning outcomes, different models can be used in the same country and achieve the essential skills to practise safely. While a lack of regulation of learning outcomes may result in variation of competencies between graduates, compromising patient care.

In the UK, three different educational models (EQF6 BSc, EQF6 apprenticeship, and EQF7 pre-registration MSc) are used. All achieve the essential learning outcomes determined by

the regulator and professional body. Nevertheless, beyond the essential competencies, *'there are still very much large differences'* (UK5), especially regarding advanced RT techniques.

On the other hand, the lack of regulation in other countries creates variation in graduates' competencies across the country: *'some universities focus more […] on diagnostic aspects or radiotherapy aspects'* (PL1). This may compromise patient safety since *"when education is different, we can't do the same thing"* (FL1). Even though stakeholders emphasised the importance of standardisation at the European level, closing this lack of standardisation at national level must be prioritised.

4. Conclusion

Most education models seem suitable to achieve the necessary competencies to practice RT safely. However, most countries legislate the structure of the training programmes in a strict manner, limiting education institutions to very specific education models. This regulation hinders the use of more alternative models. Although all models have advantages and disadvantages, courses below EQF6 and courses with insufficient RT-specific may not offer adequate competencies to practise safely.

If countries regulate the learning outcomes instead of the programme structure, it would give education institutions the flexibility to use models that could be more efficacious at developing the competencies and more efficient, by using less resources to achieve the goals.

References

Baeza, M. (2012). Accident prevention in day-to-day clinical radiation therapy practice. *Proceedings of the First ICRP Symposium Onthe International System of Radiological Protection*, *41*(3), 179–187. https://doi.org/10.1016/j.icrp.2012.06.001

Barton, M. B., Jacob, S., Shafiq, J., Wong, K., Thompson, S. R., Hanna, T. P., & Delaney, G. P. (2014). Estimating the demand for radiotherapy from the evidence: A review of changes from 2003 to 2012. *Radiotherapy and Oncology*, *112*(1), 140–144. https://doi.org/10.1016/j.radonc.2014.03.024

Couto, J. G., McFadden, S., Bezzina, P., McClure, P., & Hughes, C. (2018). An evaluation of the educational requirements to practise radiography in the European Union. *Radiography*, *24*(1), 64–71. https://doi.org/10.1016/j.radi.2017.07.009

Couto, J. G., McFadden, S., McClure, P., Bezzina, P., Camilleri, L., & Hughes, C. (2021). Evaluation of radiotherapy education across the EU and the impact on graduates' competencies working on the linear accelerator. *Radiography*, *27*(2), 289–303. ccm. https://doi.org/10.1016/j.radi.2020.08.010

Cowling, C. (2008). A global overview of the changing roles of radiographers. *Radiography*, *14*, e28–e32. https://doi.org/10.1016/j.radi.2008.06.001

Educator Preparation Committee. (2018, February). *Proposed Credential Structure and Related Considerations for the Preliminary Education Specialist Teaching Credential*. https://www.ctc.ca.gov/docs/default-source/commission/agendas/2018-02/2018-02-4b.pdf?sfvrsn=66b456b1_2

EFRS. (2018, January). *European Qualifications Framework (EQF) Level 6 Benchmarking Document: Radiographers*. https://api.efrs.eu/api/assets/posts/205

England, A., Geers-van Gemeren, S., Henner, A., Kukkes, T., Pronk-Larive, D., Rainford, L., & McNulty, J. P. (2017). Clinical radiography education across Europe. *Radiography*, *23*, S7–S15. ccm. https://doi.org/10.1016/j.radi.2017.05.011

ESTRO. (2014). *European Higher Education Area Level 6. Benchmarking document for Radiation TherapisTs*. https://www.estro.org/ESTRO/media/ESTRO/Education/ESTRO-RTT-Benchmarking-document_rebranded.pdf

European Parliament & European Council. (2005). *Directive 2005/36/EC of the European Parliament and of the Council on the recognition of professional qualifications*. http://eur-lex.europa.eu/LEXUriServ/LexUriServ.do?uri=OJ:L:2005:255:0022:0142:EN:PDF

European Parliament & European Council. (2008). *Recommendation of the European Parliament and of the Council on the establishment of the European Qualifications Framework for lifelong learning*. doi.org/10.2766/14352

European Parliament & European Council. (2011). *Directive 2011/24/EU on the application of patients rights in cross-border healthcare.pdf*. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:088:0045:0065:en:PDF

FitzPatrick, B. (2019). Validity in qualitative health education research. *Currents in Pharmacy Teaching and Learning*, *11*(2), 211–217. https://doi.org/10.1016/j.cptl.2018.11.014

Flick, U. (2020). *Doing Triangulation and Mixed Methods* (By pages 1-10). SAGE Publications Ltd. https://doi.org/10.4135/9781529716634

Gerring, J. (2007). *Case study research: Principles and practices*. Cambridge University Press. doi.org/10.1017/9781316848593

Gibbs, G. R. (2020). *Analyzing Qualitative Data* (Second). SAGE Publications Ltd. https://doi.org/10.4135/9781526441867

HENRE. (2008). *Final report of HENRE II*. http://tuningacademy.org/wp-content/uploads/2014/02/HENRE-final-report-2005-2008.pdf

ICRP. (2000). *Prevention of Accidents to Patients Undergoing Radiation Therapy. ICRP Publication 86*. http://www.icrp.org/publication.asp?id=ICRP%20Publication%2086

Janaszczyk, A., & Bogusz-Czerniewicz, M. (2011). Comparison of curricula in radiation technology in the field of radiotherapy in selected European Union countries. *Reports of Practical Oncology and Radiotherapy*, *16*(5), 189–197. https://doi.org/10.1016/j.rpor.2011.04.006

Johnson, R. B. (1997). Examining the validity structure of qualitative research. *Education*, *118*(2), 282–292.

Joint Research Centre. (2021). *European Cancer Information System Data Explorer 2020*. https://ecis.jrc.ec.europa.eu/explorer.php?$0-0$1-AE27$2-All$4-1,2$3-All$6-0,85$5-2008,2008$7-7$CEstByCancer$X0_8-3$CEstRelativeCanc$X1_8-3$X1_9-AE27$CEstBySexByCancer$X2_8-3$X2_-1-1

McNulty, J. P., Rainford, L., Bezzina, P., Henner, A., Kukkes, T., Pronk-Larive, D., & Vandulek, C. (2016). A picture of radiography education across Europe. *Radiography*, *22*, 5–11. https://doi.org/10.1016/j.radi.2015.09.007

Robson, C. (2002). *Real world research: A resource for social scientists and practitioner-researchers* (2nd ed). Blackwell Publishers.

Sá dos Reis, C., Pires-Jorge, J. A., York, H., Flaction, L., Johansen, S., & Maehle, S. (2018). Curricula, attributes and clinical experiences of radiography programs in four European educational institutions. *Radiography*, *24*(3), e61–e68. https://doi.org/10.1016/j.radi.2018.03.002

Saldaña, J. (2013). *The coding manual for qualitative researchers* (2nd ed). SAGE.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14711

Public Health Film Presentation Experience in Medical School

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Abstract

The use of films as learning tool for Public Health topics has been rarely used in the literature despite their positive outcomes. The good results achieved in them have motivated us to implement this activity in the Public Health course of the Medicine degree. To get optimal results, it is necessary to find a list of movies that fit with the lessons on the agenda. The professors made a list of 25 films and groups of two or three students were organized. At the end of the course, each group made a presentation to the class about the movies and their Public Health issues, relating them to the agenda and the conflict raised. The activity was positive, especially valuing the learning experience and the contents treated.

Keywords: *Public; Health; Movies; Films; Activity; Medicine.*

1. Introduction

The use of commercial films as an educational tool has been used for decades in various branches of learning, especially after the popularization of the digital format on DVD. There are few cases in which these commercial films have been used for learning medicine, and even fewer for learning Public Health (Gallagher et al., 2011) (Silbart, 2006). By incorporating films into teaching, we can enhance the experience of medical students, increase their sensitivity, understanding, reflection and empathy, fostering realistic learning in a wide range of contexts and organizational environments that present complex or twisted challenges, allowing them to look at problems from other perspectives (Gritton et al., 2016).

The most effective way for a film to bring knowledge to the classroom is to show it with the tutor present and use it as a catalyst for debate and discussion with students in class. Previously there must be a job of choosing films, identification of the key points for learning and the topics on which a debate or discussion can be made. It is discouraged to use films as mere entertainment or to fill hours of the agenda (Gallagher et al., 2011). For material to be suitable, professors can use external quality criteria such as review aggregators to ensure the value of the film, review and update the movie list, ask students to suggest new titles, and introduce each movie before recommending it (Gallagher et al., 2014). There are several challenges that can condition the selection of films: Who decided the final script? What languages were chosen for the film and why? How can the effectiveness of a film as a Public Health tool be measured? (Fedunkiw, 2003).

The topics of movies should fulfill the learning criteria of the agenda. Klemenc et al asked 41 professors to prepare their own list of films, and finally they found 17 films that met the competencies of family doctors listed in the Educational Agenda produced by the European Academy of Teachers of General Medicine/Family Medicine (EURACT) (Klemenc Ketiš & Švab, 2017). Wilson et al described a method to systematically identify, classify, and select movies for Public Health students. Using keywords related to Public Health in the Internet Movie Database and the International Film Index, they classified the most suitable films for teaching. Using inclusion and exclusion criteria they ordered the films by relevance to Public Health, sophistication of analysis of Public Health content, potential for empowerment and use of advocacy, plausibility of movie and cinematic quality. (Wilson et al., 2010). This list had a heavy impact on the implantation of this activity in our Faculty.

2. Methodology

An exercise was implemented in the Public Health subject of the Medicine degree at the Cardenal Herrera-CEU University (Valencia, Spain), which has 53 students. The professors carried out a search in the scientific bibliography of other similar experiences, helped with search on cinema blogs, aimed at finding a catalog of films that would be interesting to the

students. The professors viewed many of these movies in advance to finally choose 25 with the following criteria: that they can bring knowledge, open the mind of students to new realities and generate debate. Some narrate historical events or biographies. Others show a particular aspect of health and disease. Some seek to impact the audience so that we reflect on a controversial issue. The 53 students were divided into 22 pairs and 3 triplets. The class list was randomly ordered, and from first to last they were called to choose a partner and a movie. After that, they had a month to watch the film, analyze it, and give a 10-minute presentation to the class. Because the limited time, we could not fulfill the Gallagher recommendation that the teacher attends the projection of the films, mentioned above.

3. Results

3.1. List of chosen movies

In Table 1 is shown the list of chosen movies, all of them previously watched by our professors to guarantee their quality and check their fitness with the Public Health agenda.

3.2. Recommendations for students

Some ideas were given to the students to prepare their presentations:

- Put the context: Is this movie based on true facts? Can you tell us the true story? If it is fictional, what is the historical period that is based? How was the status of medicine at that time? Some movies are made on the 90's or 00's have this health topic changed during the last decades? Is it the movie old fashioned or can it be valid today?
- About the characters of the movie: Do you want to highlight a quote or phrase that gives rise to thought or debate? Do you want to highlight attitude or beliefs of a specific character (or antagonist)? How did the characters act and how should they have acted? What was the role of the patient, the health personnel and the health management system? What ethical conflicts arise from the point of view of health?

The presentations were carried out during the course without difficulties. The students positively valued the experience and learned a lot both from their own presentations and from that of their classmates.

Table 1. List of chosen movies sorted by order of appearance in the Public Heath agenda:

Movie title	Year	Director	Topic	Commentary
Awakenings	1990	Penny Marshall	Neuro-degenerative disorders	Autobiography of Oliver Sacks, who investigated the use of levodopa in patients with lethargic encephalitis. One of the highlights is the intense doctor-patient relationship shown.
Arrugas	2011	Ignacio Ferreras	Ageing and Alzheimer	The film narrates the day to day in a nursing home that Emilio has just arrived, who has the onset of Alzheimer's disease. Miguel and other residents will help him in the process.
Bicicleta, cuchara, manzana	2010	Carles Bosch	Alzheimer's disease	Documentary on the evolution of Alzheimer's disease by Pasqual Maragall (president of Catalonia). The documentary tells the testimonies, and shadows of his personal struggle.
Still Alice	2014	Richard Glatzer	Alzheimer's disease	Alice is a Columbia University linguistics professor who is diagnosed with Alzheimer's The film focuses on how she copes with the process herself, along with her husband and children.
Amour	2012	Michael Haneke	Stroke	Anne and Georges are an elderly couple from Paris. Anne suffers a right hemiplegia, having to be cared for by George. The film tells of the harsh impact this event has on domestic life.
The fault in our stars	2014	Josh Boone	Cancer in youth	It tells the relationship with cancer of several characters. The film tells the daily life of the main couple and how cancer affects their daily relationships.
Super-size me	2004	Morgan Spurlock	Nutrition and health education	Documentary that narrates Morgan's experiment, consisting of eating exclusively McDonald's products for 30 days to evaluate their effects on his health (and winning 11 Kg).
Fed up	2014	Stephanie Soechtig	Nutrition and health education	Documentary about obesity in the US, specially focusing on the "lobby of sugar". It alerts on the increase of obesity and diabetes in children, with shorter expected lifespans.
Punto de equilibrio	1998	Ernesto Parysow	Diabetes	Fictional documentary on diabetes from an educational point of view. The protagonist receives the diagnosis, and he and his family will have to adapt to the new situation.
Contagion	2011	Steven Soder-bergh	Epidemio-logical outbreaks	Extensively documented fictional film based on 2009 Influenza A pandemic. It used many real concepts from epidemiology and Public Health to make it scientifically valid.

Movie title	Year	Director	Topic	Commentary
Casas de fuego	1995	Juan Bautista Stagnaro	Fight against Tripanosoma Cruzi	Biography of Salvador Mazza, who fought intensely against Chagas disease in impoverished areas of Argentina, confronting him with other doctors and the privileged classes.
Balto	1995	Simon Wells	Outbreak of Diphtheria	Children adaptation of the real story of serum run to Nome in 1925, when an outbreak of diphtheria in an isolated town in Alaska threatens high infant mortality.
22 Ángeles	2016	Miguel Bardem	Smallpox vaccination	Film based on the "Royal Philanthropic Expedition of the Vaccine", in which Francisco Javier Balmis and Isabel Zendal carried the smallpox vaccine to America and Philippines in 1803.
And the band played on	1993	Roger Spottis-woode	Origin of HIV	It tells the true story of Don Francis, one of the first scientists to suggest that AIDS was caused by an infectious agent after cases of neutropenia in the homosexual community.
Dallas buyers' club	2013	Jean Marc Vallée	Origin of Zidovudine for HIV	It tells the true story of Ron Woodroof, who illegally imported Zidovudine and T peptide to distribute them to HIV patients. He will even sue the FDA for banning their importation.
Trainspotting	1996	Danny Boyle	Drug abuse	Controversial film that narrates in all its harshness the experiences of some young Scotts addicted to heroin, with frequent relapses and dependency.
Requiem for a dream	2000	Darren Aronofsky	Drug abuse	The story tells the descent into the hell of drugs of its four protagonists: amphetamines to lose weight; problems with the justice for drug trafficking; with very explicit scenes.
Precious	2009	Lee Daniels	Health inequalities, sexual violence	Precious is an illiterate teenager, constantly abused and insulted by her mother and with two children resulting from sexual abuse, trying to detach herself from the violent environment.
The constant gardener	2005	Fernando Meirelles	Unethical clinical trials	Inspired by the real Kano trovafloxacin trial litigation (1996), the film focuses on the unethical practices carried out by a pharmacist company in Kenya poor villages.
The insider	1999	Michael Mann	Tobacco industry	It tells the true story of Jeffrey Wigand, a worker at the Brown Williamson tobacco company, who in 1993 revealed the unethical practices of the tobacco industry to recruit smokers.
Sicko	2007	Michael Moore	Health management	Michael Moore makes a critique of exclusively private healthcare, looking for stories of patients affected by this system and comparing it with Canada, Cuba or France.

Movie title	Year	Director	Topic	Commentary
John Q	2002	Nick Cassave-tes	Health management	Fictional story of a boy who needs a heart transplant. Despite having job insurance, it will not pay the expenses. A desperate father will take hostages in the hospital to get the intervention.
The death of Mr. Lazarescu	2005	Cristi Puiu	Health management	Fictional story of a citizen with a sudden extreme pain. Ambulance is slow to appear, and finally brings the patient to one hospital, but is rejected, and rejected again in another hospital. Meanwhile, the patient is dying, and no one seems to care.
I, Daniel Blake	2016	Ken Loach	Health management	A carpenter suffers a heart attack, and the cardiologist recommends not continue working. However, after a job evaluation, he is deemed fit for work and unemployment benefit is rejected. The film is a critique of the hard bureaucratic struggle that the carpenter suffers.
An inconvenient truth	2006	Davis Guggen-heim	Environment	Documentary in which Al Gore discusses widely about environmentalism, global warming, melting of the poles, CO_2 gases released into the atmosphere, the greenhouse effect, etc.

Source: self-made

4. Discussion

4.1. Similar experiences

There are few examples of an activity like this on Public Health. We can highlight:

- Silbart et al, who made a team role-playing game based on the film "A civil action". The students formed three teams representing affected families, an industry consortium, or state and federal regulatory authorities. Surprisingly, in class the students negotiated a more favorable long-term agreement than what was achieved in real life (Silbart, 2006).
- Gallagher et al conducted another study in New Zealand with 82 fourth-year medical students distributing DVDs of fifteen pre-selected films in the school library available to students free of charge. Students were encouraged to watch the films at home and present them to the class for five minutes, summarizing the plot, discussing Public Health issues and indicating whether they would recommend it to other students .(Gallagher et al., 2011).
- Wilson et al tried to carry out a similar experiment using novels instead of movies for the learning of Public Health. The experience was not so positive: of the 177 students, only 15 withdrew one of the recommended novels from the library. Most

of the students preferred a film to a novel, concluding that experiences with novels arouse less interest in students than films and that, therefore, activities with films should continue to be encouraged in Public Health subjects. (Wilson et al., 2012).

- The same team next year incorporated a film activity into a community health nursing course. They selected the films through teacher discussions, literature reviews, and internet searches. After the students watched the films, they were asked to identify family members and identify general family structure and processes, family interactions, and ecomaps. Students found that the benefits of using film to teach family assessment skills outweighed the limitations.(Wilson et al., 2013)
- Gallagher et al made again another study from Public Health subject to present a synopsis of the films they had seen, identifying Public Health problems. Surprisingly, although the student only had to choose one film, 54% of the students saw two or more. 88% of students agreed/strongly agreed that watching movies helped students learn about health and social issues. (Gallagher et al., 2014)
- Wade et al conducted a study in 2016 at the University of Washington Bothellen for 109 students enrolled in Health studies. They were asked conducted a survey of attitudes towards the use of films in Public Health education. Both students and professors perceived the films as useful to achieve learning objectives in health (Wade et al., 2018)
- Gonçalves et al carried out a study at the Abel Salazar Institute of Biomedical Sciences asking 494 Public Health students (Medicine degree) to present five films that they had previously seen. At the end of the unit, there was a final written exam with questions about the films and texts delivered directly related to them or to the Public Health problem addressed. Finally, in a questionnaire, more than 76% evaluated the usefulness of the activity with 4 or 5 points out of five, especially valuing the content and methods.(Gonçalves et al., 2021)

4.2. Difficulties and challenges

Main difficulties and drawbacks cited in the literature are: films are not perceived as a genuine Public Health intervention. Difficulty in viewing, adapting to the syllabus and evaluation (Botchway et al., 2017). Students did not want to watch the movies when the final exams approach or under other pressures such as getting a job for the summer mount. Students considered that only watching the film was a too informal strategy for learning and that the teacher should offer structured guidelines to maximize their learning. Film is an art form produced for commercial entertainment, sometimes focused on maximizing sales or critical acclaim, rather than learning, but this inconvenience can be diminished in genres such as documentaries (Gallagher et al., 2011). Some films are excessively long, and teachers must assess that the time wasted is worth it. Students may be multitasking while watching movies, reducing the benefit of the activity (Wade et al., 2018).

On the other hand, many advantages are cited: if properly analyzed, movies are an interesting way to learn and retain information more easily than a good lecture. .(Gallagher et al., 2011). They do not mean a significant burden on scheduled teaching in the classroom (Gallagher et al., 2014). Movies offer students a broader and more multidimensional range of opportunities to improve their development and learning (Gritton et al., 2016). For future years, students themselves can suggest other films "Thank you for Smoking" "The Last King of Scotland", and "Samson and Delilah" .(Gallagher et al., 2011). In our experience, students also recommended “Dark Waters (2019)”.

4.3. Other movies found in bibliography:

The top films scored by Wilson et al (N. Wilson et al., 2010), ordered by score, were: And the band played on (1993), An inconvenient truth (2006), Who killed the electric car? (2006), Sicko (2007), Super-size me (2004), The insider (1999), The corporation (2004), The yes men (2004), Erin Brockovich (2000), Bowling for Columbine (2002), A civil action (1998), The constant gardener (2005), Born into brothels (2004), Dark days (2000), Bright leaves (2004), The big one (1997), Life and debt (2001), Children underground (2001), City of God (2003), Down to the bone (2004), Raining stones (1993), Days of wine and roses (1962), Maria full of grace (2004), The lost weekend (1945), A time for drunken horses (2000), My own private Idaho (1991), Stephanie Daley (2007), Spider (2003), Umberto D (1952). The following films are also cited in the bibliography used for this work: Milk (2008), Motorcycle diaries (2004), 50/50 (2011), Stepmom (1998), Thank you for smoking, (2005), Fed up (2014), A beautiful mind (2001), Juno (2007), Lorenzo’s oil (1992), Million dollar baby (2004), My sister’s keeper (2009), Outbreak (1995), Philadelphia (1993), Rain Man (1988), Steel magnolias (1989), Precious (2009), Dreams of a life (2011), Contagion (2011), Desert flower (2009), Still Alice (2014), 4 Months, 3 Weeks and 2 Days (2007), Amour (2012), As good as it gets (1997), Doc Hollywood (1991), Dr. T & the women (2000), Once upon a time was I, Veronica (2012), Hannah and her sisters (1996), The untouchables (2011), Stopped on track (2011), The death of Mr. Lazarescu (2005), The doctor (1991), The king’s speech (2010), The last king of Scotland (2006), What’s eating Gilbert Grape? (1993), Wit (2001),

5. Conclusion

The use of films as learning tool for Public Health issues has been used on few occasions in the literature, but all of them have been successful experiences. A good selection of films made by professors and an adequate drawbacks management can result in a pleasant and recommendable educational experience for the students.

References

Botchway, S., Bettiol, S., M. van S.-P. in P., & 2017, undefined. (2017). Films for public health: developing the evidence base for films to support public health goals. *Researchgate.Net*, *137*(5), 260–261. https://doi.org/10.1177/1757913917720153

Fedunkiw, M. (2003). Malaria Films: Motion Pictures as a Public Health Tool. *American Journal of Public Health*, *93*(7), 1046–1056. https://doi.org/10.2105/ajph.93.7.1046

Gallagher, P., Wilson, N., Edwards, R., Cowie, R., & Baker, M. G. (2011). A pilot study of medical student attitudes to, and use of, commercial movies that address public health issues. *BMC Research Notes*, *4*(1), 1–7. https://doi.org/10.1186/1756-0500-4-111

Gallagher, P., Wilson, N., & Jaine, R. (2014). The efficient use of movies in a crowded curriculum. *Clinical Teacher*, *11*(2), 88–93. https://doi.org/10.1111/tct.12178

Gonçalves, G., Carvalho, C., Sacco, M., Gonçalves, G., Carvalho, C., & Sacco, M. (2021). Utilizar películas para enseñar Salud Pública a los estudiantes de medicina portugueses. *Revista de Medicina y Cine*, *17*(1), 25–32. https://doi.org/10.14201/RMC20201712532

Gritton, J., Stewart, J., Jeavons, C., Mehmet, N., & La Placa, V. (2016). Movies in the Classroom: Lessons for Curriculum Design. *Compass: Journal of Learning and Teaching*, *8*(12). https://doi.org/10.21100/compass.v8i12.272

Klemenc Ketiš, Z., & Švab, I. (2017). Using movies in family medicine teaching: A reference to EURACT Educational Agenda. *Zdravstveno Varstvo*, *56*(2), 99–106. https://doi.org/10.1515/sjph-2017-0013

Silbart, L. K. (2006). Incorporating problem-based learning exercises into an environmental health curriculum. *Journal of Environmental Health*, *68*(9), 43–47. http://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=00220892&AN=20713248&h=%2BminD6UsgpydjAz%2FdqNnsgQ526hk5HAS%2FKjf%2Fxe3%2BO5LBSuCfytEAHuL77NpsreKDf0ENakk2uMolfTDF7qX9w%3D%3D&crl=c&casa_token=WBBEnEyIz0cAAA

Wade, C. H., Barrientos, T., Macarulay, M., Alderson, W., Shibale, P. C., & Le, C. (2018). Student and Faculty Perspectives on the Use of Movies in Public Health Pedagogy. *Pedagogy in Health Promotion*, *4*(2), 131–139. https://doi.org/10.1177/2373379917715055

Wilson, A. H., Blake, B. J., Taylor, G. A., & Hannings, G. (2013). Cinemeducation: Teaching family assessment skills using full-length movies. *Public Health Nursing*, *30*(3), 239–245. https://doi.org/10.1111/phn.12025or

Wilson, N., Cowie, R., Baker, M. G., & Howden-Chapman, P. (2010). Movies for use in public health training: A pilot method for movie selection and initial results. *Medical Teacher*, *32*(3), 270–271. https://doi.org/10.3109/01421591003719525

Wilson, N., Tucker, A., Schutte, M., Gallagher, P., & Howden-Chapman, P. (2012). Learning about public health via novels: Low interest by medical students, especially relative to movies. *New Zealand Medical Journal*, *125*(1361), 112–113.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14422

Game-based learning to promote student engagement: an escape room on databases

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Abstract

The use of game dynamics in the academic environment has proven to be highly motivating for students. This paper focuses on an Escape Room game developed in a database subject to cover several objectives: to integrate contents in a single activity, to encourage group work, to increase student engagement and to promote a playful environment for proficiency testing.

The experience is evaluated by means of a survey in which students are asked about the degree of achievement of different objectives such as the improvement of learning, reflection on their own learning (metacognition) or their engagement and motivation. The analysis of the data collected reveals a high degree of acceptance of the activity among the students, so another objective of the work is to describe the implementation of the activity as well as to provide some tips that can be useful to adapt this type of game to other university subjects.

Keywords: *gamification; student motivation; database teaching; new teaching experiences.*

1. Introduction

Game-based learning is based on the incorporation of game techniques and dynamics in the classroom to improve aspects such as performance, engagement, motivation and, ultimately, the learning of specific content.

According to Kim (Kim, B. 2015) the term gamification was coined by Nick Pelling in 2002 and started to be frequently used in 2010. Gamification (Deterding et al. 2011) can be defined as the use of strategies, models, dynamics, mechanics and game elements in non-game contexts, with the purpose of transmitting a message or content or changing behaviour, through a playful experience that encourages motivation, engagement and fun. Therefore, gamification is not creating a game but transferring the positive characteristics of a game to something that is not. In general, gamification strategies promote intrinsic motivation, often including elements such as the setting of challenges, the use of a reward system and voluntary participation, which has a very positive effect on increasing the learner's personal effort, collaboration with peers, engagement with the group and with their own learning, and building self-confidence.

There are a multitude of games that can serve as inspiration to carry out a gamified activity. Cobos (Cobos et al. 2018) proposed and described a set of games used in different university subjects, some of them adapted from famous TV quiz shows.

One type of games that young people currently prefer are strategy games(Miranda, J. M. G. 2013). , among which Escape Rooms are classified. An Escape Room is a very popular game that consists of locking a group of players in a room with a time limit to solve an enigma that allows them to get out of the room (Boix et al. 2019). The use of Escape Room in a learning context is not new, several authors have reported their teaching experiences with this type of activity (Boix, 2019; López-Gómez et al. 2020): from activities where a live Escape Room is played where participants must find clues hidden in physical objects in the place where it takes place (classroom, library, campus, etc.) to others where the experience is virtual, which implies the creation of digital resources for this purpose.

In our case, the activity is proposed for a second subject on databases named Data Management, which is taught in the second year of the degree in Data Science .The format adopted for the game will be digital but it will take place in the physical classroom, face-to-face, which favours companionship, interaction between participants, close contact with the teaching staff and agility in the resolution of doubts by the team of teachers, among others.

Unlike other similar experiences such as those mentioned above, our objective is mainly playful and non-evaluative, trying to increase student and teacher satisfaction by implementing a striking game that transmits the attractiveness of the subject itself, without

requiring excessive effort on the part of the teachers. In addition, the implementation of such an activity within a database subject will allow us to fulfil other important goals:

- Integrating the different parts of the subject in a single activity. In a course where different technologies or topics not intrinsically linked are explained, this activity helps its integration within the subject. This subject deals with new models of databases generally known as NoSQL, and tools and techniques for data warehousing and multidimensional data models. It also presents an overview of data integration and migration processes.
- Presenting databases as a challenge from which to extract relevant information. The subject of databases deals with the organisation, management and manipulation of data of various kinds, so it is a good example of how to put into practice what has been learnt by using databases with a certain appeal.
- Encourage group work. The escape rooms are games with collaborative dynamics, so the participants must get involved in order to "all get out" or "none of them".
- Promoting a playful environment for proficiency testing. An informal atmosphere allows students to put into practice the skills acquired during the course, without the fear of not knowing.
- Encouraging innovative thinking ("think out of the box"), by incorporating informal elements and typical Escape Room puzzles into the game.

The paper is structured as follows: section 2 describes how the activity has been designed, detailing aspects such as the creation of the story, the graphical interface, the databases used, the incorporation of clues and other informal elements that help to capture the attention of the learner as well as other aspects related to its integration within a learning platform. Section 3 presents how the activity took place, section 4 shows the results by means of the analysis of the survey answers and finally, in section 5, conclusions are drawn.

2. Design of the activity

This section explains how the Escape Room "Aces of Databases" has been designed on the basis that motivating activities must have a sense of unity, be varied, be perceived as useful and include feedback (Hackman et al., 1976) .

2.1. Storyline and structure

A fundamental part of any Escape Room is the story into which the different puzzles/enigmas will be integrated. It is important that the storyline, which will be the common thread of the activity, is interesting for the audience. A simple way to achieve an attractive storyline is to take inspiration from a novel or a film. In our case, the delirious comedy *Top Secret*, filmed in 1984, has been used for this purpose.

In our linear Escape Room, the whole story is divided into episodes. Each of these episodes tells a part of the story and includes several puzzles to pass in order to advance in the game: the solutions to the individual riddles are combined in a certain way to form the key to move on to the next episode. Most of these riddles, in each episode, are related to each other and can be solved thanks to what has been learned in the databases subject.

(a) (b)

Figure 1 Example episode showing the narrative used (a) together with some clues (b).

Figure 1 shows two opening scenes of the game: figure 1.a displays the introduction to the story and the presentation of characters while figure 1.b shows some of the puzzles to be solved. When all the puzzles in an episode have been correctly solved, instructions are given to compose the key to access next episode by clicling the key icon (figure 1.b).

This graphical interface has been designed by means of the Genially tool, which allows the creation of visually attractive and original contents by inserting diverse elements such as images, videos, audios, animations and also allowing user interaction. In addition, this tool has the advantage that it is easy to use and that the created content is shared via a web URL, which facilitates its integration into learning platforms.

(a) (b)

Figure 2: Interactive contents included..

Figure 2 shows the interactive content introduced in another of the episodes: in the image (figure 2.a) there are several bright dots corresponding to areas to explore in order to find new clues to solve the following riddles; when these elements are clicked other hidden

elements become visible. The red arrows indicate the pressed items that activate the display of the highlighted elements. All episodes feature a key (figure 2.b) icon that displays the message of how to compose the code that will give access to the next episode. The contestants receive the appropriate feedback on their work when they enter the requested code, since it allows them to progress in the game or not.

2.2. Interesting Data, Open Data and Non-academic issues

One way to make the activity useful and meaningful is to make use of real data from which to draw interesting conclusions. For this purpose, geographical (e.g. country, city features), climatic or epidemiological databases can be used. There are public organizations that provide very interesting data collections that can be used to motivate students. In this activity different database systems (SQL and NoSQL) have been utilized, many of them come from the open data repository of the City Council of Valencia. Specifically, this repository has socioeconomic and demographic data by neighbourhoods (schools, kindergartens, medical centres, air quality, bicycle usage, age of residents, etc.).

On the other hand, the significance of any activity also depends on its relation to reality. Therefore, in the game it is not only recommended to use real data, but also to force them to connect with reality beyond the purely academic. For example, if a clue leads to a country, the required key may be the international telephone prefix of that country, data that you will be able to find through the usual web search engines. Likewise, something can be asked related to movies or TV series that are to the taste of the majority. In addition, it is highly recommended to include a physical activity, which involves getting away from the computer to observe something of the real world with the purpose to enhance the gaming experience. Figure 3 shows other kind of riddles, not directly linked with the academic subject.

Figure 3: Non-academic riddles

With all these ingredients, an activity is achieved that stands out for the variety of different types of puzzles used and that manages to link what has been learnt in the subject of databases with their usefulness in real life through collections of interest data.

3. Activity development

The activity was planned as a face-to-face activity (although it can be adapted to be carried out virtually) during a 2 hour session. For an Escape Room without physical objects, ICT support is necessary to create the content of the escape room, provide the instructions, control and monitor the progress and receive a final report. All these actions can be carried out from the learning platform, Moodle in our case, in conjunction with URL-accessible Genially contents, so the whole activity was integrated within this platform, which favours coherence with the rest of the subject.

The activity is presented to students on a voluntary basis, but for the activity to be successful, a high level of participation must be achieved. With this objective in mind, in addition to the material for the development of the activity, attention was paid to the development of additional material to encourage participation:

- a video (figure 3.a) has been created, in which the activity is shown as a challenge to demonstrate the skills acquired and their detective attitudes.
- an engaging presentation (figure 3.b) was designed, summarising all the reasons for taking part in the challenge: from academic incentives to prizes sponsored by the Chair of Gamification and Open Government of Valencia City Council.

(a) *(b)*

Figure 4: video and motivating presentation

The activity is carried out in groups, encouraging collaborative work and the sharing of roles. During the development of the activity, each team works autonomously, with minimal help from the lecturer. This requires that all the material and instructions provided are unambiguous and complete: all the resources that make up the activity should be thoroughly checked. It is also important that no group gets discouraged during the development, so additional hints were planned for the first episodes, provided periodically during the game, to help them to advance if they get stuck.

In this first edition, 75 students participated, grouped into 21 teams, of which only one team managed to beat the challenge. It is convenient that at least one group completes the game, so the difficulty must be well measured so that it is feasible to solve it in the established time.

The activity ends with the presentation of the teams' results, in which the good work done by the teams that have managed to overcome the challenge is acknowledged (figure 4). This element of positive feedback is very beneficial for these successful groups.

Figure 5: Escape room development

4. Results

The evaluation of the experience was carried out by means of a survey to find out the students' opinion. The survey is filled in voluntarily after the activity and includes 8 questions in which they have to mark the option that most closely matches their perception on a Likert scale from 1 to 5 (from Strongly Disagree to Strongly Agree), and other open questions (What did you like the most? What did you like the least? What improvements would you suggest?). Table 1 shows the average score of the 28 responses collected.

Table 1: Questions in the survey and average points

	Question text	**Average**
1	The activity has helped me to learn thecontents of the subject.	3,9
2	The activity has helped me to reflect on my own learning.	4,0
3	The activity has helped me to increase my involvement in the subject.	4,1
4	The activity has helped me to increase my motivation	4,0
5	I enjoyed the activity	4,1
6	The general difficulty of the activity seemed to me to be in line with what I have worked on in the course.	3,9
7	The organisation of the activity was correct	4,0
8	I would like a similar activity in other subjects	4,2

The student ratings for each of the questions show that 6 out of 8 questions score 4.0 or higher. The statement with which they agree the most is number 8 "They would like a similar activity in other subjects", and those with the lowest average score are number 1 and 6 . In all questions, at least 75% of the students give a score equal to or higher than 4 on the Likert scale (between 1 and 5), which implies very high student satisfaction. In the open questions, they mainly indicated novelty, fun and motivation as positive aspects. As for the negative aspects, they mentioned the pressure of limited time, the degree of difficulty and, in some cases, the complication of understanding the issues raised in non-academic terms.

5. Conclusions

An Escape Room game developed in a database course has been described in detail. The results of the survey show that the experience was satisfactory for the students. It was also rewarding for the teaching staff, both for the novelty of creating an activity in a different format and with a different purpose than usual, as well as for the good reception. However, the design and preparation was quite laborious, at least in its first edition, and the importance of a careful and complete organization for its success should be emphasized.

The experience has also helped teachers to appreciate the convenience of giving a greater sense of unity to the different activities taught in a subject. As future work, it is intended to improve this experience and help its expansion to other subjects.

Acknowledgments

This work has been possible thanks to the help granted by the Universitat de València (Servei de Formació Permanent i Innovació Educativa) in the context of the project UV-SFPIE_PID-1642016.

References

Boix, A, Pereles, J.M, Montoliu, R (2019). Learn2Escape: una experiencia interactiva de aprendizaje. In *Actas de las XXV Jornadas de Enseñanza Universitaria de Informàtica, Jenui 2019*, pp. 223 –230, Murcia, 2019.

Cobos, M.; Arevalillo-Herráez, M.; De Ves, E.; Roger, S.; García-Pineda, M.; Grimaldo, F.; Fuertes, A. (2018). Game-based learning supported by audience response tools: game proposals and preliminary assessment. *4th International Conference on Higher Education Advances (HEAd'18)*, 605-612. doi: 10.4995/HEAD18.2018.8044

Deterding, S., Dixon, D., Khaled, R. and Nacke, L. (2011). From game design elements togamefulness: defining gamification. In *Proceedings of the 15th International Academic MindTrek Conference*, 9–15.

Hackman, J.R. Oldham, G.R. (1976). Motivation through the design of work: Test of a theory. *Organizational Behavior & Human Performance*, 16(2), 250–279. 1976.

Kim, B. (2015). Understanding Gamification. (Library Technology Reports). *American Library Associtation*. Chicago, 2015. https://journals.ala.org/ltr/issue/download/502/252

López-Gómez, J.A, Rodrigo, R., Carrasco, A., Mata, F. (2020) La *Escape Room* como actividad de formación, evaluación y mejora de la motivación del estudiante: una experiencia en Ofimática Aplicada a la Ingeniería. In *Actas de las XXV Jornadas de Enseñanza Universitaria de Informàtica, Jenui 2020*, pp. 237 - 244, Valencia, 2020.

Miranda, J. M. G. (2013). Videojuegos de estrategia: algunos principios para la enseñanza Strategy Video Games: Some Principles for Teaching. *Revista electrónica de investigación educativa*, 15(1), 63J.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14642

Developing a Game Production Pipeline for University Educators

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Abstract

In this paper, we describe the initial process of developing what we call the Game Production Pipeline (GPP), an effort to assist and guide educators in making educational games within higher education. Noting the need to push the boundaries of engaging virtual learning principles in the wake of the pandemic, the GPP seeks to address the epistemic gap between game design, virtual education, and game production. We set out to investigate educator wants, needs, and challenges in this area. We also created a probing survey to collect juxtaposing feedback on the GPP from commercial game developers. We found that educators were more concerned with implementation than design, and that developers had notes on time and production management, and epistemic clashes in making educational games.

Keywords: *Online learning; virtual learning; educational games; serious games; game production; game design*

1. Introduction

The present paper reports on the work so far of a project called the Game Production Pipeline (GPP). The GPP is an initiative that seeks to create a point-of-access to support and expertise for making games for education and other utility purposes at Aalto University. The project is a response to an increase in inquiries about the use of games for educational purposes, especially in virtual educational contexts, alongside an increased interest in self-service game production. The aim is to offer a design and practice focused track to educational game-making, while also constituting a training-ground for research on how educational games are made.

Figure 1. Visualization of the Game Production Pipeline (GPP).

While a lot of scholarly attention is paid to the commercially successful game industry, a significant – and growing – amount of game work happens outside of it. This includes educational games, a segment that has been heavily researched in its efficacy as instructional learning tools, but less investigated from a design and production point of view. The benefits of better understanding how educational games are made are twofold. Firstly, informed practices can help focus and scale educational game-making into context-appropriate budgets and time frame constraints. Secondly, understanding practice is key to removing design expertise bottlenecks and improving the quality and purposefulness of educational game-making. We take both perspectives into consideration when developing our case.

2. Background and context

Recent global challenges and fast-paced technological development call for rethinking and transforming virtual education. Starting in early 2020, the pandemic has forced universities to do remote work and remote learning. Simultaneously, in 2022, universities are calling their students and faculty back to campus for face-to-face learning. We argue for the need to design engaging learning experiences in this complex, hybrid situation. We identified this as a strategic focus point for our educational development actions and launched Aalto Online Learning — Online Hybrid Lab in 2021. The launch was done after running a piloting phase from 2016 to 2020 that covered the whole university and resulted in around 250 production-

quality courses employing educational games, augmented and virtual reality environments, online textbooks, and videos. Our goal with this new lab is to design selected production pipelines (360° environments, MOOCs, and VR) to support creating those experiences and contents needed accordingly, and locally. Perspectives on educational games in this context are twofold; the issue of using and teaching with educational games, and the practical scaffolding of making games for and in education (Prensky 2008).

Using games in education is a growing point of interest across all academic disciplines and plenty of research has been conducted in this area, not least about games' educational efficacy during the covid-19 pandemic (Kriz 2020; Oe et al 2020; Nieto-Escamez & Roldán-Tapia 2021). In contrast, research focused on game-making practices and game production within the educational context (for teaching, and in higher education) is less explored.

In this gap, we see the need to explore game production which takes a scientifically informed, and game- and production-aware approach to this disconnect to further develop educational game-making in the university context. Additionally, we argue that local game production practices should be explored within higher education to safe-guard personalization and ownership of teaching by educators – in contrast to, for example, adopting or buying into wholesale existing course materials (Delaney-Klinger *et al* 2014).

3. Developing the game production pipeline

So far in the development of the GPP, we have taken three steps. The first was to perform a wants-and-needs review to better anticipate the optimal role for a GPP in our university setting. The second step was to outline an initial proposition for a production pipeline based on literature in conjunction with an assessment of the setting in terms of tools, educators' interest, and perceived challenges. In the third phase, the GPP outline was evaluated by game industry professionals to obtain practice-based expert feedback that would both inform the future of the GPP and provide insight about the comparison between the two settings.

3.1 Phase 1: Tools, skills, and implementation

The initial phase of developing the game production pipeline was focused on assessing challenges and possibilities connected to educational game production, asking: what are some potential issues that can and should be anticipated by the pipeline? What tools are available, what skills are needed, and how do educators make decisions that lead to game production? The purpose of this phase was to explore wants and needs among educators against these questions, and against existing research.

Previous research at the specific intersection of game production in higher education is limited. With notable exceptions (Ferreria da Rocha Neto *et al* 2018; Ahmed 2022) the literature is focused on artefact design, gameplay, and educational outcomes. The readings

were therefore focused on broad aspects of game production, as well as relevant production elements such as tools, processes, and expertise, to guide our work.

The GPP foundation was broadly developed based on insights from the fields of game production studies (Sotama & Švelch 2021; O'Donnell 2020) and game design praxiology (Kultima 2018; Garner 2014; Hagen 2010; van Roessel & van Mastrigt-Ide 2011). The practice and production perspective offered insight into the epistemic specifics of game-making, such as risk-assessment, talent acquisition, teamwork, the power of professional communities, and their histories (Tschang 2005; Kultima 2010; Kuittinen 2010; Burke & Kafai, 2014). Game design praxiology especially guided our decision to engage with the larger context of commercial game production for input on how to build the GPP (as described in phase 3). This is done based on the understanding that juxtaposing game-making settings offers an opportunity to highlight the interplay of context, production, and outputs.

Readings suggested that there is a significant epistemological gap between the understanding of games as educational tools, and games as developed for other contexts, such as entertainment, competition, or art (Berg Marklund 2015) For example, common game production processes are perceived as only partly beneficial to making games in educational contexts (Ferreria da Rocha Neto *et al* 2018, 474). Adding nuance to this point, it is unknown how specific design choices determine the level of success of games as instructional (Clark *et al* 2016, 108; Sailer & Homner 2019, 106). In other words, the consequences of making games in and for non-gaming contexts (especially educational contexts) are so far vague and potential benefits unclear. Here, the collaboration between game production expertise and topic expertise becomes particularly poignant to observe.

Studies also showed that the landscape for digital game-making tools is changing rapidly as a response to games becoming a mainstream conceptual and communicational tool (Kerr 2017; Consalvo 2021; Neil 2012; Young 2021). Game-making is now in a democratizing process wherein tools have become low-cost, low-code, and low-threshold, allowing a multiplicity of users, including educators, to gain access (Burke & Kafai, 2014; Toftedahl & Engström 2019). Based on this, and in conjunction with previous work by Aalto Online Learning (Kultima *et al* 2020), the self-service aspect of the pipeline was outlined around common, accessible tools, including *Construct 3*, *Unity*, *Ren'Py*, *Twine* and *Game Maker*.

To gauge the sentiments on educational game production of educators who are experienced in virtual learning tools and environments, the GPP was presented to educators within Unite! European University alliance in October of 2021. Based on the feedback from the session we were surprised to learn that the educators' main concerns were focused on implementation (see also Ahmad 2022); that is, production seemed to be less of an issue than embedding and contextualising games in teaching. As it stands, the pipeline expressly does not take an active part in the implementation of games for reasons that will be discussed below.

3.2 Phase 2: Sketching the pipeline

Informed by phase one, the next step in the GPP project was to outline the pipeline details in a document to clarify its underpinnings and purpose. The contents of the pipeline sketch were as follows: 1) Overview - *aims.* 2. Pipeline content - *what the GPP offers*. 3.Production examples - *what outputs might look like.* 4. Future development of the pipeline - *improving the GPP.*

The overview specified the aims of the pipeline; to assist in expectation management, to help in forming the idea and vision for the game, to connect with developers needed for the production, to put the production in motion with realistic scoping, and to end up with a polished product with appropriate visibility.

The proposed pipeline contents were **workshops** to increase awareness and knowledge about the GPP and educational games among educators, ideation, and wants-and-needs **assessment**, **selecting** a production path, **acquiring** tools and licenses, guidance in **working with a production team**, and guidance on **publishing and archiving**. The GPP was then further explained using existing game examples. The GPP outline also had a track for collecting feedback to improve the pipeline.

Importantly, the pipeline does not purport to help educators in *implementing* games into their teaching. This stance was taken based on previous research suggesting that the educational context is a make-or-break factor for the success of the game artifact as an educational tool (Berg Marklund 2015, 235; Ahmad 2022, 2), and not something the GPP can reasonably provide.

3.3 Phase 3: Drawing on commercial game production expertise

Nine (9) actors from the game industry were then invited to comment on the pipeline outline based on their experience as game-making professionals (roles: production, game design, quality assessment, art direction, and game direction). We presented them with the draft of the pipeline document and a set of prompting questions. The questions were posed and answered in the form of a survey presented alongside the pipeline document.

The queries were divided into four subsections, aligning with the GPP outline (see above), asking developers to give their *response* to the given outline and to *reflect* on it using their own relevant experiences. The pipeline draft was designed purposefully brief and somewhat naïve to prompt the developers' critical comments. The resulting data is a set of statements that, from the perspective of developers, highlight perceived strengths and weaknesses in the GPP and provide additional insights on challenges and best practices for game production.

Significant challenges identified by the developers were: Resource management - *the pipeline does not contain steps that adequately assess resource availability and use.* Client-developer interactions - *the pipeline does not account for pitching, scope adjustment,*

milestones, and testing in a balanced manner. Timeframes - *the pipeline overestimates the time needed to make educational games.* Production linearity - *the pipeline is unrealistic about project progression.* While we anticipated most of these comments, we were surprised how in line they were with each other.

Furthermore, some developers suggested and highlighted areas of improvement for the pipeline (not in the original outline): Prototyping - *step to visualize and concretize the game idea before production.* Detailed production trajectory - *more detailed breakdown of production.* Developer substance competence - *breakdown of developer and educator skill sets and interplays.* To this last point, the difficulty and time consumption of finding appropriate and available talent, was specifically mentioned.

4. Discussion

Developing the GPP has clarified what key production-points the pipeline should address. Juxtaposing the readings and educators' responses with the game industry professionals' we find that educators appear to find the prospect of implementing and using games in teaching more challenging than making them. Game industry professionals found that the pipeline document at large reflects a balanced and feasible plan in all parts except where developer expertise and educator expertise must interplay. In this area, both found significant challenges, which also aligns with previous research in this field. Game developers offered some practical advice for how to solve this, including tighter timeframes, and extensive prototyping. Measured against the aims of the GPP, the issue of talent is a possible future bottleneck that needs addressing as the competition for game design expertise is fierce, which speaks to the continued exploration of self-service game development.

5. Conclusions

This exploratory and charting preamble to the GPP venture tells us that with conscious GPP design the impact can be two-fold; 1) it places educator perspectives and the university setting at the forefront of educational game development, and 2) offers the possibility to continue studying how educational game-making happens as well as the subsequent implications for the product and its implementation. Furthermore, we note that a fruitful step towards implementing such pipelines is to engage the expertise and experience of commercial game-making. Crucially, this is not to fall in line with normative practices but to take advantage of the significant specificities in design challenges for education compared to other production contexts.

Going forward, the GPP will be tested in internal educational game development projects and iterated upon. It will also be supplemented by ideation and training workshops targeted at educators, as well as further benchmarking, and assessment.

Acknowledgements

Thank you to Solip Park for the Figure 1 illustration.

References

Ahmed, M. (2022) "Teachers' Roles and Game Designers' Perspectives in Educational Game Design Process" in *DiGRA Australia 2022 Conference Program*. Extended Abstract.

Berg Marklund, Björn. (2015) "Unpacking Digital Game-Based Learning The complexities of developing and using educational games." Doctoral dissertation. University of Skövde.

Burke, Quinn & Kafai, Yasmin. (2014). Decade of Game Making for Learning: From Tools to Communities. *Handbook of Digital Games.* 689-709. doi:10.1002/9781118796443.ch26.

Clark DB, Tanner-Smith EE, Killingsworth SS. (2016) "Digital Games, Design, and Learning: A Systematic Review and Meta-Analysis." *Review of Educational Research.* 2016;86(1):79-122. doi: 10.3102/0034654315582065

Delaney-Klinger, K., Vanevenhoven, J., Wagner, R., Chenoweth, J. (2014) "Faculty Transitions in Online Delivery: Make Or Buy? Tips For Developing A 'New To You' Online Course" in *Journal of College Teaching & Learning* 11(1). doi: 10.19030/tlc.v11i1.8396

Ferreria da Rocha Neto, T., *et al* (2018) "Educational Digital Game Production: A Survey on Practice in the Educational Context." *XIII Latin American Conference on Learning Technologies (LACLO)*. DOI 10.1109/LACLO.2018.00084

Hagen, U. (2010) "Designing for player experience: How professional game developers communicate design visions" in *Proceedings of the 2010 International DiGRA Nordic Conference: Experiencing Games: Games, Play, and Players*.

Kerr, A. (2017). *Global Games. Production, Circulation and Policy in the Networked Era.* Milton Park, UK: Routledge Taylor & Francis.

Kriz, W. (2020) "Gaming in the time of Covid-19" in *Simulation & Gaming*, 51(4) 403–410. doi: 10.1177/1046878120931602

Kuittinen, J. (2011). "The Anatomy of a Game Design Session." in A., Kultima, & K., Alha, (eds.) *Changing Faces of Game Innovation: GaIn and GIIP Research Project Report.* TRIM Research Reports 4. Tampere, Finland: University of Tampere.

Kultima, A. (2010). "The Organic Nature of Game Ideation: Game Ideas Arise from Solitude and Mature by Bouncing." *International Academic Conference on the Future of Game Design and Technology*, 33–39. doi: 10.1145/1920778.1920784

Kultima, A. (2018) *Game Design Praxiology*. Doctoral dissertation. University of Tampere.

Kultima, A., Park, S., Lassheikki, C. & Kauppinen, T. (2020) "Designing Games as Playable Concepts: Five Design Values for Tiny Embedded Educational Games" in *Proceedings of DiGRA 2020.*

Nieto-Escamez FA and Roldán-Tapia MD (2021) "Gamification as Online Teaching Strategy During COVID-19: A Mini-Review." *Frontiers in Psychology,* 12:648552. doi: 10.3389/fpsyg.2021.648552

O'Donnell, C. (2020). Game Production Studies: Studio Studies theory, method, and practice. In *Independent Videogames* Routledge. doi: 10.4324/9780367336219-12

Prensky, M. (2008). Students as designers and creators of educational computer games: Who else? *British Journal of Educational Technology*, *39*(6), 1004–1019. doi: 10.1111/j.1467-8535.2008.00823_2.x

Sailer, M., & Homner, L. (2020). "The Gamification of Learning: A Meta-analysis." *Educational Psychology Review*, *32*(1), 77–112. doi: 10.1007/s10648-019-09498-w

Sotamaa, O., & Svelch, J. (Eds.). (2021). *Game Production Studies* (1st ed.). Amsterdam University Press.

Tschang, F. T. (2005). "Videogames as Interactive Experiential Products and Their Manner of Development." *International Journal of Innovation Management* 9(1), 103-131. doi: 10.1142/S1363919605001198

Toftedahl, M, & Engström, H. (2019, August). "A Taxonomy of Game Engines and the Tools that Drive the Industry." *DiGRA'19 - Proceedings of the 2019 DiGRA International Conference: Game, Play and the Emerging Ludo-Mix*.

van Roessel & van Mastrigt-Ide (2011) "Collaboration and Team Composition in Applied Game Creation Processes" in *DiGRA '11 - Proceedings of the 2011 DiGRA International Conference: Think Design Play*.

Young, C.J. (2021) "Unity Production: Capturing the Everyday Game Maker Market" in *Game Production Studies*, Sotamaa, O., & Svelch, J. (eds.). Amsterdam University Press.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14522

Immersive Learning as a Pedagogical Method in Higher Education

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Abstract

Student engagement has long been a topic of discussion amongst scholars and practitioners alike. This paper aims to address this issue by introducing a novel method of imparting knowledge in a marketing course. An exercise using the reflective cycle by Gibbs (1988) as a guiding framework lead to the emergence of the creative thinking model of experiential learning. The proposed model entails the expansion of Kolb's (1984) experiential learning model. Prominence is given to the relevance of creative thinking during the experiential learning process.

Keywords: *Student engagement; creative thinking; experiential learning.*

1. Introduction

Higher education plays a critical role in the development of countries at both the economic and social levels (Brennan and Teichler, 2008). To this end, business leaders expect new entrants to the workforce to be able to practice a set of desirable skills such as critical and creative thinking, problem-solving and sound communication skills (Partnership for 21st Century Learning, 2015) in an effort to embrace emerging problems. This is supported by Miller and Dumford (2016), who claim that to have workforce ready students, we need to pay attention to creativity in educational settings. Meanwhile, pedagogical issues in higher education have been given considerable attention over time (Osman and Hornsby, 2018), leading to a variety of approaches. New methods of imparting knowledge have been implemented globally alongside more traditional methods. This paper aims to share how student learning was enhanced by adopting a new perspective on pedagogical techniques used. Key concepts outlined in transformative learning theories guided our endeavour to encourage students to challenge their personal worldview and to enable them to make sense and give adequate meaning to the experience on the programme, as detailed below. To achieve this, a "deep, structural shift in basic premises of thought, feelings, and actions" is required on the part of students (Transformative Learning Centre, 2004). The social interaction required in the programme would engage the students to critically evaluate and transform their notion of theoretical concepts learned on the programme into offerings that may be implemented in the real world is hoped to lead to the achievement of this shift. The success of the overhaul of this study unit is hoped to address the call by Osman and Hornsby (2018) asking for higher education that repositions the way we teach and provide education for social change. To operationalise these concepts, Kolb's experiential learning model (Kolb, 1984) was used as a guiding framework.

Due to its nature, this paper brings together a mélange of different themes addressed in the conference, namely (i) innovative materials and new tools for teaching, (ii) teaching and learning experiences, and (iii) experiences outside the classroom.

2. Background

Goodhart (2020) identifies learning as a time-consuming social activity involving the acquisition of knowledge from others, while Vygotsky (1962) stipulated that we learn through our exchanges with others, including peers, tutors and experts. Overall, this makes learning a social process that might not necessarily be smooth. Student engagement, defined as the "time and effort students devote to educationally purposeful activities" (Kahu 2013, p. 2), is a topic that has attracted considerable attention. In 2014, Khan wrote about increasing concerns related to student engagement. Student engagement is considered a precursor to student success (Kahu, 2013; Kuh, 2008; Tani, 2020). Through his work, Kuh stresses that

student engagement and student success can be made possible through high impact activities. According to the author, deep learning can take place through seminars and experiences, sharing of everyday intellectual experiences, learning communities, writing-intensive courses, collaborative assignments and projects, undergraduate research, diversity and global learning, service learning and community-based learning, internships and capstone courses and projects. To this end, another consideration that can be made is to consider students as partners in learning (Healy et al., 2015). Engaging the students to become active contributors can increase engagement, and it may offer opportunities to inform the curriculum through reflective practices. Creative cognition through creative thinking methods is thought to foster student engagement. It "can be understood as a set of cognitive processes that support the generation of novel and useful ideas" (Beaty et al., 2016, p. 87). Student engagement may also be fostered by applying creative thinking methods to promote deeper learning.

3. Theoretical Underpinnings

The inspiration for the overhaul of the study unit in question emerged from an evaluative process undertaken after taking over coordination of the programme. We took this opportunity to enfranchise our students by embarking on an academically grounded but simultaneously practical assessment method. This required a different type of preparation of the students.

Teaching in any form is aimed at improving abilities. Malcolm and Zukas (2009) claim that teaching connects teachers and students through practices that are multidimensional and temporal. In his work Pew (2007) makes a clear distinction between pedagogical and andragogical aspects of teaching methods in HE. Pedagogy is oriented towards more traditional methods where the teacher imparts knowledge to the student. On the other hand, andragogy involves processes that facilitate learning for adults. As identified by Knowles (1970), the concept of andragogy has attracted considerable criticism from various scholars (Grace, 2001). Aware of the critical elements of both approaches, we prefer to identify our method as a pedagogical approach since learning is still imparted to students although it is done in a highly participatory manner. In her work Cook-Sather (2011) identified the following five pedagogical processes that promote active learning: (a) reflecting on practice, (b) developing meta-cognitive awareness and finding a language for it, (c) modelling and explaining, (d) engaging in pedagogical transparency, (e) inviting students to engage in reflection and dialogue. Our primary aim is to engage students in a reflective practice using Kolb's experiential learning model (Kolb, 1984). This guided the different stages of how we expected the newly designed study unit to unfold with the aim of promoting student engagement throughout the semester. Apart from the formal lectures, the experience made by the students is considered the key learning resource. Essentially, this will complement the processes identified by Cook-Sather. Our approach is primarily influenced by the conclusions

in the work of Malcolm and Zukas (2009, p. 503), who state that; "mindful disciplinarity, or a critical awareness of the discipline as a site of intellectual and social practice, renders purpose and practice within the discipline an explicit and essential concern of its practitioners." As academic practitioners, we feel that developing methods that may enhance student engagement is critical for their learning.

4. The procedure

The aims for the redesign of the study unit were primarily to enhance student engagement through a learning by doing method using creative thinking methods learned by the students in a different study unit hoping for cross-fertilisation between other study units. Previously, the study unit was based on formal lectures highlighting aspects of the marketing process using traditional lecturing methods. The main elements of the new study unit involve the following touchpoints aimed at enhancing the students' learning experience; (a) the delivery of theoretical foundations, (b) sessions with practising marketing professionals, (c) a meeting with a Mystery Client who typically is the managing director or marketing director of the participating organisation, (d) presentation of a marketing plan to the Mystery Client[1]. While working in pairs to prepare their marketing plan, students in this study-unit are encouraged to make use of the Creative Problem-Solving process (CPS) (Isaksen et al. 2010) to manage the information they gather and to explicitly use creative thinking methods to generate ideas. Through this project, we have tried to create an environment that can enable students to interact and engage with the curriculum as much as possible. The social interaction generated during the pair-work, during class discussions and while engaging with the Mystery Client and marketing professionals is thought to benefit the immersive aspect. At the same time, the students acquire social and professional skills. The competencies to be developed in this study unit are categorised in two areas, knowledge and understanding, where the students are expected to be in a position to have understood the main principles in marketing strategy and planning and to be able to be in a position to justify the benefit of the alignment of creativity and innovation with marketing strategies to be used in real-world settings. Secondly, the students are expected to have developed the necessary skills to compile a marketing plan by applying creative thinking methods to foster an innovative approach. These competencies are assessed by way of submitting a marketing plan and a presentation of the same plan. This

[1] The Mystery Client is a real-world organisation that is invited to partner with the Univesity for the purposes of this study-unit. They typically are an established business who wish to address areas for improvement from a marketing perspective. The students act as marketing consultants to the Mystery Client who they meet and start engaging with on the sixth week of lectures following a formal learning component covering key principles in marketing. All students meet the Mysetery Client at the same time on the same day.

new design is hoped to enfranchise students by embarking on an academically grounded but simultaneously practical assessment method.

This novel approach was designed while being aware of the concerns raised above by Miller and Dumford (2016); a balance was sought between theoretical concepts and the opportunity to practice, thus applying experiential learning. On average, forty-two hours over fourteen weeks of student contact are assigned to the study unit. This design operationalised our belief that student engagement can contribute to the delivery of quality higher education where quality is seen as 'fit for purpose' (Akareem and Hossain, 2016).

5. Assessing the project

Evaluation of the success of the newly designed study unit was planned over two cohorts of students. Firstly, an observation phase with Cohort 1 during the academic year 2020/21. This led to an overall prima face satisfaction with the design involving the combination of theoretical knowledge and real-world exposure. Several indicators were observed, including; attendance to lectures, number and type of questions asked, number of interactions via email with the Mystery Client to elicit further information to facilitate the idea generation process and engagement with marketing professionals. During these sessions, we noticed that the students had an excellent level of engagement which was demonstrated by asking numerous detailed questions related to concepts that could support their work for the Mystery Client. In this case, an element of transference was observed. The student behaviour indicated that the embodiment of the role of a 'marketing consultant' was seen to improve engagement through the immersion method. A prima face the principles of 'constructive alignment' (Biggs and Tang, 2011), which involves a proactive pedagogical design where expectations of what the students should achieve by the end of the semester is outlined before the learning starts seem to have been well received. The immersive procedure appears to have stimulated the students to take ownership of the process. It was observed that the use of creative thinking methods like the CPS, which students were previously exposed to, acted as empowerment tools that facilitated how they structured their work and planned a course of action accordingly.

This observation process led to various annotations and meetings between the two authors to further develop the study unit and plan the data collection process. The second part of our project will involve collecting data from students in the form of feedback from Cohort 2, including students enrolled during the academic year 2021/22. Ethics clearance was sought from the relevant faculty within the university. Given that the study unit is typically accessed by approximately fifteen students on a niche Master's programme we decided to adopt a mixed-method approach to collect data for further analysis. To this end, students were presented with an information letter and a consent form at the beginning of the semester.

They were made aware that participation is voluntary and will not influence their final grade in the study unit.

Data will be collected through a focus group managed by the academics responsible for the study unit. From a conceptual point of view and to facilitate the discussion during the focus group, the reflective cycle by Gibbs (1988) will be used as indicated in Table 1.

Table 1. Prompts for use during the focus group.

Stage	**Cues**
Description	Where and when did the activities unfold? What happened? What was the outcome of the activities?
Feelings	How did I feel during the delivery of this study unit? What contributed to these feelings?
Evaluation	What went well during the project? What didn't work out well?
Analysis	Why did the process work out? What can be improved?
Conclusion	What did I learn from this experience? What could have been done differently?
Action Plan	How can the process be improved for next time?

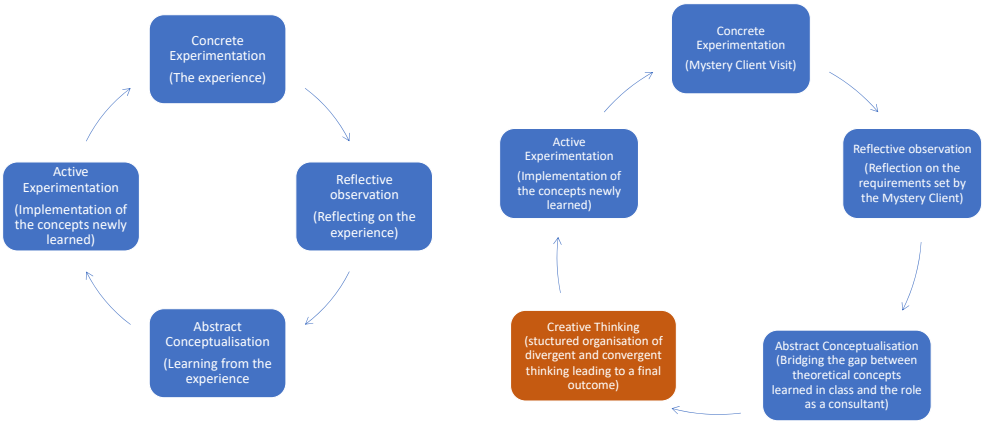

Figure 1: (left): Kolb's Experiential Learning Model (1984), (right): Creative Thinking Model of Experiential Learning. Adapted from Kolb (1984).

A second data collection method involves the use of questions measuring student engagement (I felt involved; I discuss the benefits with others), and their satisfaction with the course (This is one of the best courses I could have taken; Taking this course was a good experience) will be distributed for anonymous completion. The responses are adapted from the work of Oliver (1993) and will be measured on a five-point Likert scale.

6. Reflections and Conclusion

Kolb's experiential learning model was initially used to design this immersive approach. The model was regularly referred to as the activities unfolded with Cohort 1. It was noticed that within the model, a new component emerged. The encouragement to use creative thinking methods by the students led us to realise that the structured organisation of the thinking process facilitated the transition between abstract conceptualisation and active experimentation as used in Kolb's model. To this end, we propose including a new stage in the experiential learning cycle; Creative Thinking. The creative process involves shifting thinking modes. In his Structure of Intellect, Guilford (1967) identified five facets of creativity. Convergent and divergent are two of these modes of thinking employed to fine-tune information or new ideas leading to a final outcome. Students were observed using the information and observations gathered to define a problem and generate ideas in the search for a novel solution before embarking on active experimentation. An illustration of the proposed model may be found in Figure 2.

In conclusion, we feel that the new design enacted a transformative stance in the students by immersion through the allocation of concepts set in the experiential learning model, thus addressing issues raised by Osman and Hornsby (2018) and Miller and Dumford (2016). This was accomplished through engagement with a real-world scenario and the use of creative thinking methods. We ensured that a contextualised programme was assembled to enhance the level of sense-making, leading to a heightened experience. Further research could point in the direction of empirical studies measuring student engagement due to this approach. A limitation of this project emerged since data from previous cohorts before the overhaul of the study unit was not collected.

References

Akareem, H.S., & Hossain, S.S. (2016). Determinants of education quality: what makes students' perception different? *Open Review of Educational Research, 3*, 52 - 67.

Beaty, R.E., Benedek, M., Silvia, P.J., & Schacter, D.L. (2016). Creative Cognition and Brain Network Dynamics. *Trends in Cognitive Sciences, 20*, 87-95.

Biggs, J., & Tang, C. (2011). *Teaching for Quality Learning at University*. Maidenhead, UK: Open University Press.

Brennan, J., & Teichler, U. (2008). The future of higher education and of higher education research. *Higher Education*, 56(3), 259–264.

Cook-Sather, A. (2011). "Lessons in Higher Education: Five Pedagogical Practices That Promote Active Learning for Faculty and Students." *The journal of faculty development* 25, 33-39.

Gibbs, G. (1988). *Learning by doing: A guide to teaching and learning methods.* London: Further Education Unit.

Grace, A. P. (2001). Using queer cultural studies to transgress adult educational space. In V. Sheared & PA. Sissel (Eds.), *Making space: Merging theory and practice in adult education* (pp. 257-270). Westport, CN: Bergin & Garvey.

Guilford, J.P. (1967). *The nature of human intelligence.* McGraw-Hill.

Goodhart, C. (2020), "Learning is a social activity", *Review of Behavioral Finance*, Vol. 12 No. 1, pp. 21-25. https://doi.org/10.1108/RBF-10-2019-0149

Healey, M., Bovill, C., & Jenkins, A. (2015). Students as partners in learning. In Lea, J. (Ed.), *Enhancing learning and teaching in higher education: Engaging with the dimensions of practice* (pp.141-163). Maidenhead: Open University Press

Isaksen, S.G., Dorval, K.B., & Treffinger, D.J. (2010). *Creative Approaches to Problem Solving: A Framework for Innovation and Change*. SAGE.

Kahn, P.E. (2014), Theorising student engagement in higher education. *Br Educ Res J*, 40: 1005-1018. https://doi-org.ejournals.um.edu.mt/10.1002/berj.3121

Kahu, E.R. (2013). Framing student engagement in higher education. *Studies in Higher Education, 38*, 758 - 773.

Knowles, M. S. (1970). *The modern practice of adult education: Andragogy vs. pedagogy*. Chicago: Association Press/Follett.

Kolb, D. A. (1984). *Experiential Learning: Experience as the Source of Learning and Development*. Englewood Cliffs, NJ: Prentice Hall.

Kuh, George D. (2008). High-impact educational practices: What they are, who has access to them, and why they matter. AAC&U, Washington, D.C.

Malcolm, J. & Zukas, M. (2009) Making a mess of academic work: experience, purpose and identity - *Teaching in Higher Education*, 14(5), pp. 495-506

Miller, A.L. and Dumford, A.D. (2016), Creative Cognitive Processes in Higher Education. *J Creat Behav*, 50: 282-293. https://doi.org/10.1002/jocb.77

Oliver, Richard L. (1993), Cognitive, Affective, and Attribute Bases of the Satisfaction Response, *Journal of Consumer Research,* 20 (December), 418-30.

Osman, R. and Hornsby, D. J. (2018) Possibilities towards a socially just pedagogy: New tasks and challenges, *Journal of Human Behavior in the Social Environment*, 28:4, 397-405, DOI: 10.1080/10911359.2018.1441083

Partnership for 21st Century Learning (2015). *P21 Framework Definitions*. Retrieved from www.p21.org/our-work/p21-framework

Pew, S. (2007). Andragogy and pedagogy as foundational theory for student motivation in higher education. *InSight: a collection of faculty scholarship*, *2*, 14-25.

Tani, M., Gheith, M.H. & Papaluca, O. (2021). Drivers of student engagement in higher education: a behavioral reasoning theory perspective. *High Educ* 82**,** 499–518. https://doi-org.ejournals.um.edu.mt/10.1007/s10734-020-00647-7

Transformative Learning Centre. (2004). *The Transformative Learning Centre*. https://www.oise.utoronto.ca/tlcca/ Accessed January 28, 2022.

Vygotsky, L.S. (1962). Thought and Language. Cambridge, MA: MIT Press. (Original work published in 1934)

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14548

Cultivating gender inclusive leadership in higher education: Insights from a laboratory learning experience

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Abstract

Women continue to be underrepresented in managerial and upper echelon roles and the recent pandemic has intensified the barriers they face in their career path. Designing and delivering programs in higher education with the aim to cultivate a diversity and inclusion mindset in young individuals can contribute at narrowing the gender gap in leadership. The present study illustrates an educational program developed by a public University in Italy for master's degree students, with the purpose to stimulate the awareness of the gender equality debate and to provide tools to implement inclusive leadership behaviors and practices in the organizational contexts. The structure and the contents of the program, which has been delivered in a laboratory format, are discussed highlighting the learning approaches proposed, that combine lectures, group work, vicarious learning and conversation with experts. The case offers methodological insights and reflections on the issues that an inclusive leadership program should address.

Keywords: *inclusive leadership; women leadership; gender equality; experiential learning.*

1. Introduction

While organizations are progressively making progress on many aspects of gender equality, female representation in leadership continues to be a cause for concern (Catalysts, 2021; The Economist, 2021). The COVID-19 pandemic has intensified the disadvantages women face in terms of career advancements and, as indicated by the WEF (2021), closing the global gender gap has increased by a generation from 99.5 years to 135.6 years.

Designing and delivering programs in higher education aiming at cultivating a diversity and inclusion mindset represents an important strategy that can narrow the gender gap in leadership (Debebe et al., 2016; Sugiyama et al., 2016). Randel et al. (2018:190) defined inclusive leadership as "a set of positive leader behaviors that facilitate group members perceiving belongingness in the work group while maintaining their uniqueness within the group as they fully contribute to group processes and outcomes". In this article, we focus on inclusiveness related to gender issues, addressing the following question: how should inclusive leadership learning experience be designed in order to accelerate progress toward gender parity? A first issue to concerns sex composition of leadership programs. Even though women-only programs can provide the psychological safety that allow participants "to lower their defenses, share their experiences, and benefit from the support and experience of other women to work through their leadership challenges." (Debebe et al., 2016, p. 237), a mixed-sex program may represent an opportunity to compare different gender perspectives and nurture in men allyship for gender equality. Second, the design of the programs needs to be aligned with the current and emerging literature in the field of gender inclusiveness. In this regard, Ibarra, Elly and Kolb (2013) lamented, for instance, the scant attention devoted to unconscious gender bias in the leadership programs. Moreover, these programs require the implementation of experiential learning approaches which allow participants to become aware of how inclusive gender leadership can be practiced in the organizational settings.

This study illustrates an educational program delivered in a public Italian University in the format of a laboratory for male and female master's degree students. The laboratory aimed at: a) raising awareness of the meaning of leadership and inclusiveness, with particular regard to gender equality; b) identifying and deepening the skills that nurture inclusive leadership; c) developing the emotional awareness and self-confidence of the participants, which are essential skills for the exercise of an effective inclusive leadership; d) recognizing the organizational practices that can be implemented in the company to promote inclusive leadership; e) learning how to design gender inclusive leadership development interventions in organizational contexts.

In the next sections of the paper, the structure, the contents and the methodological approach adopted in the gender inclusive leadership lab will be illustrated. Implications on how higher education institutions can cultivate inclusive leadership will be discussed.

2. The methodological approach for designing the gender inclusive leadership lab

The laboratory has been designed within a project promoted by the University which aims to improve the employability of young women and strengthen the social and economic role of women in the labour market. It was delivered during autumn 2021 to a group of thirty master's degree students, both male and female, enrolled in different disciplinary areas (economics, humanities, science and languages). In order to be admitted to the laboratory, students were invited to fill an application form explaining their motivation to attend the program. The applications were assessed by a committee of instructors who evaluated the interest expressed by the students toward the issues of inclusiveness, gender and leadership. The laboratory has been structured in five seminars delivered in seven weeks. Figure 1 reports the main topic addressed by each seminar and the overall structure. Each seminar adopted different methodological approaches combining lessons, group discussions, vicarious learning through role models, and conversations with professionals. During the laboratory, students were also engaged in small groups in an experiential learning activity that consists of developing a project of gender inclusive leadership.

Figure 1. The structure of the gender inclusive leadership lab

The learning goals, the theoretical background and the contents of each seminar are described as follows.

2.1. Leadership and gender equality

The aim of the first seminar was to introduce participants to the debate of gender leadership through the discussion of recent figures that depict nowadays the gender gap phenomenon (e.g. Catalyst, 2021; European Institute for Gender Equality, 2021; McKinsey&Company, 2021; The Economist, 2021; World Economic Forum, 2021). After increasing students'

awareness on the gender gap issue and on the positive impact of gender equality on organization performance, the barriers women face to reach leadership positions were analysed. Relying on the contributions offered by the social role and role congruity theories (Eagly, 1987; Eagly, and Karau, 2002), a specific attention has been devoted to the unconscious bias (also referred to as implicit or second-generation gender bias), defined as "the powerful and often invisible barriers to women's advancement that arise from cultural beliefs about gender, as well as workplace structures, practices, and patterns of interaction that inadvertently favor men." (Ely et al., 2011, p. 475). Second-generation gender bias is more insidious and intangible than other forms of bias, making it difficult to identify, address, and dismantle, because people consciously reject the gender stereotypes but they still unconsciously make evaluations based on them. As discussed by a recent research (Gino and Coffman, 2021), unconscious bias training turned out to be ineffective because only a few of these programs give participants practical tools for reducing bias. Therefore, during the seminar participants discussed the different scenarios in which unconscious bias could occur (for instance during the recruitment, selection and performance assessment processes), and they examined the strategies that could be implemented to limit the influence of gender stereotypes (Ammerman and Groysberg, 2021).

2.2. Inclusive leadership in the organizational settings

In the second seminar, inclusive leadership has been defined according to the main characteristics described in the literature (Randel et al., 2018; Roberson e Perry, 2021), and virtuous business cases have been examined to identify the interventions implemented in the organizational environment to cultivate inclusive leaders. Moreover, metrics for assessing inclusive organizations have been critically examined (e.g. Bloomberg Gender Equality Index, Equileap Gender Diversity Criteria) as a means to develop an action plan for promoting an inclusive workplace and increase the visibility of the gender equality initiatives inside and outside the organization. This seminar also offered students the opportunity to have a debate with executives in charge of the Diversity&Inclusion departments who narrated their experience in implementing inclusive leadership strategies.

2.3. Self-awareness and social relationships at the basis of leadership development

The third seminar was aimed at transferring tools to nurture participants' self-awareness and self-efficacy, as primal competencies for becoming effective leaders. The gender confidence gap has been illustrated relying on the results of empirical research and talks from women leaders. Relying on Baldura's (1977) sources of self-efficacy, some concrete practices have been illustrated in terms of mastering experience, acquiring competencies necessary to pursue future goals, learning from positive performance outcomes, benefiting from social role models, asking for and reflecting on verbal feedback, and considering emotional and physiological states. Moreover, the seminar opened the discussion on the role of social

relationships in reducing gender differences in achieving leadership positions even in male-dominated sectors (Alonso et al., 2021). A specific focus has been devoted to mentoring and networking relationships. Specifically, the evolution of one-on-one mentoring toward group and peer mentoring have been emphasized (Chopra et al., 2020) as emerging opportunities for women to get access to knowledgeable mentors who can support them in their career path. Furthermore, considering the challenges women experience building and benefiting from networks to achieve career success (Greguletz et al., 2019; Woehler et al., 2021), participants were introduced to different communities which aim at fostering women's professional networking, especially in STEM (science, technology, engineering and mathematics) disciplines. Finally, exemplar practices on how networking can nurture an inclusive culture have been discussed (Cross, et al., 2021).

2.4. Work-life synergy

Competing role demands and family responsibilities have been indicated as one of the main barriers women face in their career progression. In their article, Kossek and Lee (2021) discussed the family-related career-limiting challenges women face in their career path and proposed the adoption of an organizational work-life inclusion where "work cultures and structures are generally perceived as supporting an individual's ability to thrive authentically in family and personal life roles on and off the job, while progressing in a career" (2021:4). Therefore, the aim of the fourth seminar was to accompany the participants toward a shift from the concept of work-life balance, which represents roles as competing based on the role stress theory and the conservation of resource theory (Hobfoll, 1989), toward the concept of work-life synergy/enrichment which leads individuals to find ways to generate positive spillover from one role to another (French et al., 2018). The debate was centered on how work and personal life can interact and cooperate, and how organizations can promote for male and female work-life enrichment producing higher levels of satisfaction, health and performance, but also career opportunities.

2.5. Inclusive leadership in practice

The concluding seminar of the laboratory was devoted to the presentation of group projects. Students divided in small groups were associated with a specific theme and invited to propose interventions aimed at implementing the different facets of inclusive gender leadership in the organizational context. The themes addressed by the groups covered the all issues addressed during the learning program, and specifically: a) how inclusive leadership can foster self-promotion in the organizational context and overcome gender unconscious bias; b) how mentoring programs can be designed for facilitating women in their leadership path; c) how to activate professional networks to reduce the gender gap and develop leadership skills; d) how to implement organizational practices for achieving work-life synergy; e) how to evaluate and communicate organization's inclusive leadership initiatives. Students received

a real-time feedback on their work from a committee which included some professional experts in the field of "diversity&inclusion" and the instructors of the lab.

Some quotes from the students' experience are reported as follows, which illustrate the contents and the learning methodologies they appreciated:

"The laboratory was an opportunity for me to confront myself on issues whose relevance I underestimated before, to listen to the experts and to test myself with the group project. It also helped me focus on my goals and the person I want to become. I really appreciated the atmosphere created during the seminars and the opportunity to interact and express oneself. It was also a space for sharing and discussion. It was a truly stimulating experience, as well as a personal and professional enrichment that I will certainly treasure."

"In addition to the intervention of some experts in the field of gender equality and inclusive leadership, the laboratory helped me acquire tools that allow me to have more confidence in myself, in my ideas and in my abilities. "

"Very interesting the different points of view of other students and experts. As a male, they enabled me to understand the different perspectives of each one and how certain situations are experienced, which perhaps before I did not fully grasp."

"The positivity that I could breathe gave me a lot of energy, the gender gap in leadership was treated not with resignation but concrete actions were always offered on what can be done."

3. Discussion and conclusion

Inclusive leadership is emerging as a critical set of behaviors required by today's organizations. Universities play a relevant role not only in advancing the knowledge in this field but also in cultivating a culture of equality in tomorrow's generation of leaders. The preliminary insights derived by the gender inclusive leadership program offer some reflections for instructors and practitioners. A first implication concerns the potential of a program based on mixed-sex composition. Participants' reflections on their learning experience showed that, if implemented in academic settings, a mixed gender approach does not generate those limitations identified in similar programs delivered in the organizational contexts (Debebe et al., 2016). Both male and female participants perceived the laboratory as a safe environment where they had the opportunity to share their opinions without fear of judgment. The gender-sensitive styles of instructors and experts favoured an open debate through which students had the opportunity to become aware of the other gender's perspectives in a way that they never experienced before, nurturing a process of personal growth. Moreover, this stimulated in both male and female a reflection on how to become actionable allies. Future studies can investigate further the contextual factors that enable

mixed-sex programs to be effective, overcoming the assumption that they inhibit safety for women and suppress their capacity to explore the gendered aspects of their leadership experiences. Secondly, the contents of each seminar have been designed coherently with the emerging literature in the field of inclusive and gender leadership, but also taking into account the major difficulties organizations are facing in promoting a culture of diversity and inclusion. The connection between the theoretical advancements and the emerging needs of the companies spurred the elaboration of a toolkit of practices which if implemented may contribute at narrowing the gender equality gap. Furthermore, the use of the experience-based learning activity of the group project facilitated the translation of the seminars' contents into the design of concrete inclusion initiatives. This collaborative learning approach not only represented a space of further debate on the gender leadership issue beyond the seminars, but also stimulated participants to creatively elaborate solutions in order to address the companies' challenges. Practitioners may benefit from the experience of such programs to redesign, in collaboration with universities, the companies' human resource management processes with the aim to encourage gender inclusive leadership behaviors (training, recruitment, performance management etc.) and to have access to a pool of newly graduates with a gender inclusive mindset that can be promoted inside the organization.

References

Alonso, M.T., Barba-Sánchez, V., López Bonal, M.T., & Macià, H. (2021). Two perspectives on the gender gap in computer engineering: From secondary school to higher education *Sustainability* 2021, 13, 10445, https://doi.org/10.3390/su131810445

Ammerman, C., & Groysberg, B. (2021). How to close the gender gap. *Harvard Business Review.* https://hbr.org/2021/05/how-to-close-the-gender-gap

Bandura, A (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*. 84 (2): 191–215. https://doi.org/10.1037/0033-295X.84.2.191

Catalyst (2021). *Women on corporate boards*. https://www.catalyst.org/research/women-on-corporate-boards/

Chopra, V., Dimick, J.B., & Saint, S. (2020). Making mentorship a team effort. *Harvard Business Review*. https://hbr.org/2020/03/making-mentorship-a-team-effort

Cross, R., Oakes, K., & Cross, C. (2021). Cultivating an inclusive culture through personal networks. *MIT Sloan Management Review*. https://sloanreview.mit.edu/article/cultivating-an-inclusive-culture-through-personal-networks/

Debebe, G., Anderson, D., Bilimoria, D., & Vinnicombe, S.M. (2016), Women's leadership development programs: Lessons learned and new frontiers. *Journal of Management Education*, Vol. 40(3), https://doi.org/231–252. 10.1177/1052562916639079

Eagly, A. H. (1987). *Sex differences in social behavior: A social-role interpretation*. Hillsdale, NJ: Erlbaum.

Eagly, A. H., & Karau, S. J. (2002). Role congruity theory of prejudice toward female leaders. *Psychological Review*, 109(3), 573–598. doi: 10.1037/0033-295X.109.3.573

Ely, R. J., Ibarra, H., & Kolb, D. (2011). Taking gender into account. Theory and design for women's leadership development programs. *Academy of Management Learning and Education*, 10(3), 474–493. https://doi.org/10.5465/amle.2010.0046

European Institute for Gender Equality (2021). *Gender equality index*. https://eige.europa.eu/gender-equality-index/about

French, K. A., Dumani, S., Allen, T. D., & Shockley, K. M. (2018). A meta-analysis of work–family conflict and social support. *Psychological Bulletin*, 144(3), 284-314. doi:10.1037/bul0000120

Gino, F., & Coffman, K. (2021). Unconscious bias training that works. *Harvard Business Review*. https://hbr.org/2021/09/unconscious-bias-training-that-works

Greguletz, E., Diehl, M.-R., & Kreutzer, K. (2019). Why women build less effective networks than men: The role of structural exclusion and personal hesitation. *Human Relations*, 72(7), 1234–1261. https://doi.org/10.1177/0018726718804303

Hobfoll, S. E. (1989). Conservation of resources: A new attempt at conceptualizing stress. *American Psychologist*, 44(3), 513–524. https://doi.org/10.1037/0003-066X.44.3.513.

Ibarra, H., Ely, R., & Kolb, D. (2013). Women rising: The unseen barriers. *Harvard Business Review*, September 61–66. https://hbr.org/2013/09/women-rising-the-unseen-barriers

Kossek, E.E. & Lee, K.H. (2021). Work-life inclusion for women's career equality: Why it matters and what to do about it. *Organizational Dynamics*, online first, https://doi.org/10.1016/j.orgdyn.2020.100818.

McKinsey&Company (2021). *Women in the workplace*. https://www.mckinsey.com/featured-insights/diversity-and-inclusion/women-in-the-workplace

Randel, A. E., Galvin, B. M., Shore, L. M., Ehrhart, K. H., Chung, B. G., Dean, M. A., & Kedharnath, U. (2018). Inclusive leadership: Realizing positive outcomes through belongingness and being valued for uniqueness. *Human Resource Management Review*, 28(2), 190–203. https://doi.org/10.1016/j.hrmr.2017.07.002

Roberson, Q. & Perry, J.L. (2021). Inclusive leadership in thought and action: A thematic analysis. *Group & Organization Management*, Vol. 0(0) 1–24. https://doi.org/10.1177/10596011211013161

Sugiyama, K., Cavanagh, K.V., van Esch, C., Bilimoria, D., & Brown, C. (2016). Inclusive leadership development: Drawing from pedagogies of women's and general leadership development programs. *Journal of Management Education*, Vol. 40(3) 253–292. https://doi.org/10.1177/1052562916632553

The Economist (2021). *The glass-ceiling index*. https://infographics.economist.com/2021/glass-ceiling/

Woehler, M:L:, Cullen-Lester, K.L., Porter, C.,M., & Frear, K.A. (2020). Whether, how, and why networks influence men's and women's career success: Review and research agenda. *Journal of Management* ,47(1), https://doi.org/10.1177/0149206320960529

World Economic Forum (2021). *Global gender gap report*. https://www.weforum.org/reports/global-gender-gap-report-2021

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14633

Marine Spatial Planning and Integrated Coastal Management as drivers for a more international, interdisciplinary and interactive approach to higher education

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Abstract

Environment and sustainability issues are becoming increasingly important world-wide. They also determine future career options of students. This change demands a modified portfolio of competences students should develop during their higher eduction studies. Within a multidimensional field between interdisciplinarity, internationalisation and interactivity various pathways can be taken to realise according adjustment of higher education settings. In this paper, we will present an example for successful innovation and adaptation to emerging needs. We refer to the case of an interdisciplinary module tailored to a international student group by creating interactivity in an online learning environment. The module has its topical drivers in Marine Spatial Planning and Integrated Coastal Zone Management. Both societal challenges provide multiple options to connect plus innovate existing (disciplinary) study programmes in an institutional framework.

Keywords: *Internationalisation, interdisciplinarity, interactive methods, higher education, sustainability.*

1. Introduction

Global environmental and sustainability concerns are becoming increasingly important and are also shaping future career options of students. This change demands a modified portfolio of competences students should develop during their higher eduction studies (i.e., futures-thinking competency, values-thinking competency, strategic-thinking competency, interpersonal competency, integrated problem-solving competency, (see Brundiers et al., 2021)). This set of competencies requires a broader and more holistic perspective in terms of disciplines, but also in the context of different geographical challenges as well as country-specific perspectives and approaches. It becomes crucuial to integrate interdisciplinary and international cooperation in higher education into study programmes at all level (courses, modules, programme, university profile, research of lecturers). This means an international and interdisciplinary learning environment needs to be actively created through cooperation between different disciplines and international partner universities. To gain the mentioned competencies, learning and teaching approaches have to be adopted accordingly, fostering interactivity and cooperation between the students in such a learning environment. Strengthening of cooperation and interactivity within a heterogeneous student group requires (and fosters) interdisciplinary knowledge, skills and approaches of both, lectureres and students (Fig. 1).

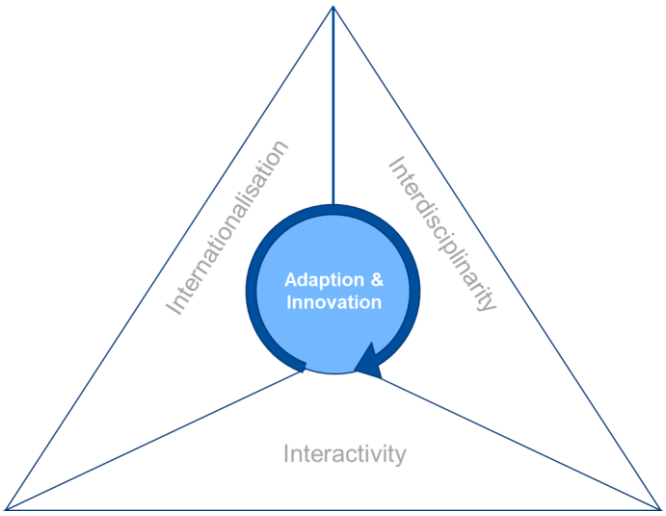

Figure 1. Adaption and innovation needs in higher education concerning content, competencies and structure to more interdisciplinary, internationalization and interactivity.

In addtion to the mentioned competences to be achieved in degree programmes, professional competences such as topical and disciplinary skills need to be developed by the students complementarily. The complexity and disciplinary diversity in degree programmes is high,

covering e.g. environmental sciences and management, as well as sustainable development. Futhermore, grand topics such as environmental and sustainability concerns have to be discussed with local and global perspectives and diverse solutions. International cooperation and exchange becomes crucial accordingly providing students international and intercultural experiences. Therefore, higher education in the context of social-ecological systems and sustainability has to include the didactical and methodological preparation of important and complex topics for a broad audience from various disciplines (Lozano et al., 2017).

Within this multidimensional field between interdisciplinarity, internationalisation and interactivity various pathways can be taken to realise long-term improvements. Any design of meaningful pathways needs to amalgamate two different levels at the same time: 1) The level of conceptualisation: creating an international and interdisciplinary learning environment by increasing cooperation between disciplines and international partner universities and permeability of different study programmes. 2) The level of implementation: applying innovative, interactive learning and teaching methods, e.g. digital teaching and learning settings to gain international and intercultural experiences in a digital and flexible environment without exclusion of specific disciplines.

This paper will present an example for successful innovation and adaptation to emerging needs. The authors will refer to the case of an interdisciplinary module tailored to a international student group by creating interactivity in an online learning environment. The module has its topical drivers in Marine Spatial Planning and Integrated Coastal Zone Management. Both societal challenges provide multiple options to connect and also innovate existing (disciplinary) study programmes in an institutional framework.

2. Conceptualisation and Implementation

2.1. Institutional framework

A structural framework for international and interdisciplinary higher education at the University of Oldenburg (Germany) has been proposed in the context of environmental and sustainability research. The framework refers the university´s strategic development plan which simultaneously aim at further internationalisation and activities under the priority theme environment and sustainability. It aims for an increased interdisciplinary cooperation and higher permeability of study programmes at the University of Oldenburg. With different activities, the opportunities for students to gain international and interdisciplinary knowledge and skills are increased. This is realised by cross-linking different studying programmes from different disciplines (incl. international study programmes) on different levels of higher education. Additionally, international and interdisciplinary courses (seminars, summer schools) and study programmes are cooperatively developed and offered with international

partner universities. The overall aim is to increase the visibility and attractiveness of the university for (international) students.

Within an environment of five degree programmes in the field of environment and sustainability science, different projects and activities are constituted to increase internationalisation, interdisciplinarity and interactivity and to create innovations in this three dimensions (Fig. 2).

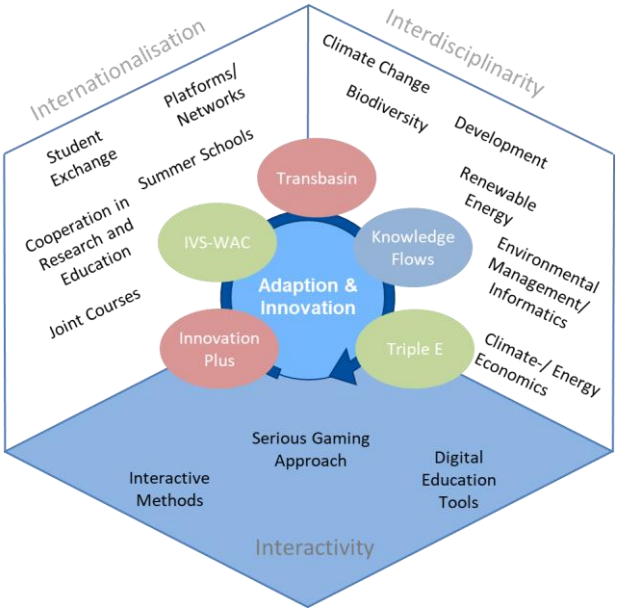

Figure 2. Projects within the multidimensional field between interdisciplinarity, internationalisation and interactivity: Various international activities and interactive tools are considered to implement adaptions and innovations concerning different interdisciplinary topics.

By enhancing international cooperation and building an exchange platform for researchers and lecturers international joint activities such as student exchanges and summer schools are fostered (EU ERASMUS + Strategic Partnerships " Marine Spatial Planning" and "Knowledge Flows in Maritime Spatial Planning"). With cooperated/joint course an international interdisciplinary environment for teaching and learning can be created (DAAD (German Academic Exchange Service) "IVS-WAC / International Virtual Seminar Water and Climate"). Additionally a structured interdisciplinary exchange programme for international students can improve the predictability and the recognition of an international exchange and therefore barriers can be reduced (university´s strategic project "Triple E").

With these projects it becomes possible to establish heterogeneous student groups concerning disciplines and culture in which the students can learn interactively and cooperatively. Such

mixed groups form the prerequisite to create the essential broad perspective and therefore develop nescessary competencies for environmental and sustainability issues students will face in their future carreer. Integration of appropriate teaching methods, such as Serious Game and WordPress Blog, foster the development of the specific set of competencies and will be presented and evaluated in the following.

2.2. Implementation Example

The setting of the project "Gamification of higher education on MSP and ICM" under the German Lower Saxonian State Ministry´s funding programme "Innovation plus" is a specific scheme in interactive teaching and learning in the context of Marine Spatial Planning and Integrated Coastal Zone Management: An established higher education module "Planning and Management of Coastal Zones and Sea Basins" was enhanced with a combinated approach of Serious Gaming, Lectures and a WordPress-Blog for a heterogeneous group in an interdisciplinary environment.

The module covers the complex interrelations between the natural marine and coastal space and human activities. Coastal and marine areas in Europe, especially the North Sea and Baltic Sea are of enormous social and economic importance and pressure. Its shared resources represent a crucial asset but also a mutual territorial challenge to European countries. Marine Spatial Planning (MSP) and Integrated Coastal Management (ICM) are much needed approaches to manage and organize the use of the sea and coastal areas to prevent uncoordinated planning and management and protect the unique environment with valuable habitats and high biodiversity. Both, MSP and ICM are complex and interdisciplinary fields of study and significantly important topics in marine and environmental sciences in higher education. This implies the dynamic interactions of the considered ecosystems with complex feedback mechanisms and low predictability on the one hand. On the other hand, it includes the social, legal and economic implications and interactions. The two lectures are generally separated lecture series (separated into ICM and MSP) with a significant overlap in the intended skills.

Within the module, a heterogeneous group of about 20 students - from all over the world with an interdisciplinary background - learns together. Additionally, to the variety of previous knowledge and experiences the current studies of the students vary as well: the module is electable within certain master programs focusing on natural science to economics or management. It is considered that the students can profit from the different backgrounds and learn interactively and collaboratively. The collaborative learning process is fostered by the innovative gaming approach and associated group work tasks. As an innovative approach of the module, overarching gaming days were included. After giving an overview on the topics in the first lectures and clarifying important terms the lecturers and students meet for playing

the serious game "MSP Challenge". Parallel to lectures and gaming events the students use the WordPress blog to present, reflect and discuss their findings.

„Serious Games" offers novel opportunities for problem-based interdisciplinary education for mutual understanding, exchange of ideas, development of new approaches and understanding the complexity of different activities. They are of particular value in teaching because the direct interaction of students and teachers with the subject matter is carried out through trial and error, practically and interactively. As such playing a Serious Game is a form of collaborative discovery learning. Since 2011, under the name ‚MSP Challenge' different Serious Games (Board Game and Simulation Platform) in support of MSP have been developed and applied, i.e., for education, social learning, stakeholder engagement and decision-support (Abspoel et al., 2019;). The MSP Challenge Simulation Platform is an interactive and collaborative tool for informed decision making to experience the complexity of possible actions of marine planning and coastal management based on real data (Mayer et al., 2014).. It combines role-play, game-technology, geodata and simulation models to create planning-oriented learning tools for MSP and a communicative environment that makes players think, talk and interact (Abspoel et al., 2019). The players shall develop the Exclusive Economic Zone of one country around the North Sea. The interaction and effects between human activities, geosystem and ecosystem are simulated (incl. feedback loops) and visualized in terms of pressures and indicators. Due to the COVID-19 pandemic situation the structure was adjusted to a completely online setting: Students work alone at home planning the marine space synchronously. Exchange between students, as well as time-out discussions and final reflection with the whole group were realized via video conference.

The students built the connection between the theoretical input, gaming experience and final assignment by creating blog pages along guiding questions (voluntary group work which prepares to the individual final report). At the beginning of the course groups were formed. Every group manages an own area in WordPress, work on tasks (i.e. using H5P tool) or where they create small information pages along guiding questions. Ideas, approaches and findings during the gaming experience are presented and discussed with their colleagues within a WordPress evaluation session.

The module was evaluated in three steps: pre-evaluation, mid-term evaluation and post-evaluation to (1) assess the characteristics of the group concerning nationality, background knowledge, interests and expectations, (2) the learning progress during studying depending on the different learning activity and (3) the overall satisfaction of the students with the module.

3. Experiences and conclusions

The presented setting illustrates one promising pathway to provide students with a modified portfolio of competences for their future career by aligning higher education with additional needs concerning environmental and sustainability issues. MSP and ICZM proved to be suitable cases due to their complex, interdisciplinary nature as well as their high relevance in science, education and policy.

Within the module international students from various study programmes within the university were successfully brought together. The combined approach of lectures, online Serious Gaming and WordPress Blog foster the interactive learning process of an international and interdisciplinary group of students. To assess the acquirement of certain competences the students were ask to rate their knowledge and skills concerning different categories within the pre- and mid-term evaluation. According to their statements, improvements can be observed for all evaluated competences, e.g. “Knowledge about MSP/ICZM”, “Design a strategy for a project you are participating in” and “Coordinate in teams”. Additionally, the students specified which of the applied methods helped them most to develop a specific competence. It is noticeable that no method is perceived to be helpful for all competences, but are relevant for certain sets of diverse competences. An approapriate mixture of methods is required to adress all the different skills, i.e., the MSP Challenge and the WordPress Blog helped the students with their professional development, also classical lectures were perceived as helpful. The MSP Challenge gaming approach supports the understanding of complex topics and the development of problem-solving skills while additionally fostering soft skills (i.e., team skills, digital skills) (Abspoel et al., 2019 and Behrendt et al., 2021). Within the blog the individual perspectives and knowledge can be shared and discussed among the student group (Torio et al., 2016)). The students receive group feedback from their colleagues on their individual exploration (Heidkamp & Kergel, 2014).

The identified main observations can be summarized as:

- An interdisciplinary and international group of students can successfully be formed through connecting contents and participants of various study programmes offered by an university.
- A combined teaching approach supports to enable students to learn interactively with a high motivation and satisfaction of the students and lecturers.
- The students proofed to receive a better understanding of complex topic, and developed various soft skills.
- The approach is flexible and adaptive to either face-to-face, hybrid or virtual/digital learning settings (can also be included in international, cooperative learning settings)

- Organisational (e.g. incl. sessions in different study schedules), technical (requirements for available devices) and didactical (balancing workload: between a (reduced) theoretical input and gaming events) challenges were observed

The experiences made have significant potential to be transferred to other major societal topics related to environmental science and sustainable development such as energy and climate. At the same time they stimulate to strengthen further international and interdisciplinary cooperation in higher education – also by integrating professional practice. Students and universities can profit from such broader topics and study options as well as further intercultural exchange.

References

Abspoel, L.; Mayer, I.S.; Keijser, X; Warmelink, H.;., Fairgrieve, R.:., Ripken, M.; Abramic, A.; Kannen, A.; Cormier, R.; Kidd, S. (2019). Communicating Maritime Spatial Planning: The MSP Challenge Approach. Marine Policy https://doi.org/10.1016/j.marpol.2019.02.057

Behrendt, T.; Ripken, M.; Warmelink, H.; Klenke, T. (2021). Maritime Spatial Planning and Integrated Coastal Zone Management in Higher Education: Utilizing the MSP Challenge Serious Game; INFORMATIK 2021. Gesellschaft für Informatik, Bonn. (pp. 67-77). DOI: 10.18420/informatik2021-004

Brundiers, K.; Barth, M., Cebrián, G.; Cohen, M.; Diaz, L.; Doucette-Remington, S., Dripps, W., Habron, G., Harré, N., Jarchow, M., Losch, K., Michel, J., Mochizuki, Y., Rieckmann, M., Parnell, R., Walker, P., Zint, M. (2021). Key competencies in sustainability in higher education—toward an agreed-upon reference framework. *Sustainability Science,* 16:13–29 https://doi.org/10.1007/s11625-020-00838-2.

Heidkamp, B.; Kergel, D. (2014). e-Portfolio und forschungsbasiertes Lernen *Greifswalder Beiträge*; 1/2014, pp. 70-74

Lozano, R.; Merrill, M.Y.; Sammalisto, K.; Ceulemans, K.; Lozano, F.J. (2017): Connecting Competences and Pedagogical Approaches for Sustainable Development in Higher Education: A Literature Review and Framework Proposal. *Sustainability* 9, 1889. https://doi.org/10.3390/su9101889

Mayer, I.S.; Zhou, Q.; Abspoel, L.; Keijser, X. (2014). Gaming the Future of the Ocean: The Marine Spatial PlanningChallenge 2050. *In SGDA 2014: Serious Games Development and Applications*; LNCS 8778; Springer: Cham, Switserland; pp. 150–162.

Torio, H.; Behrendt, T.; Heidkamp, B.; Kergel, D. (2016). Fostering Participation and Transparency in Laboratory Higher Education - Experiences with the "Seminar Blog ". *Proceedings of the International Conference – New Perspectives in Science Education* (pp. 337-341).

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14536

Distance technologies in the context of personalization of competence training of bachelors of art and pedagogical direction

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Abstract

The article discusses the features of personalization of the competence training for bachelors of art and pedagogical direction. Four characteristics of the essence of the personalization for the educational process are presented. Personalization of bachelor's degree training in the art and pedagogical direction is an unique way for a person to master and appropriate the richest potential of artistic culture. The potential of distance technologies has been identified, which contributes to the personalization of the competence training of bachelors of art and pedagogical direction. Firstly, distance technologies activate the subject position of the student. In the behavioral aspect, a bachelor of art and pedagogical direction, entering the position of the subject, must build his own educational trajectory, and in the sense-forming aspect, he must build his own relationship with the world of art. Secondly, they enhance the openness of the educational process. Thirdly, they actualize such personality qualities as initiative and creativity.

Keywords: *Personalization; distance technologies; e-learning; competence training.*

1. Introduction

In the XXI century, the priority vector of modernization of higher education is the implementation of a personality-oriented orientation, the activation of the processes of self-determination of students: self-determination, self-knowledge, self-realization. Many researchers argue that today this trend should receive a new impetus. It is not enough just to turn to the personality of the student, it is important to create conditions so that a person can turn to himself, make a conscious free choice, form a new reality in which he recreates himself (Bondarevskaya, 2000; Grachev, 2005; Grachev, 2006).

The following methodological guidelines contribute to the creation of an optimal personality-oriented education system: the principles of subjective, project, active, contextual types of learning, etc. (Bondarevskaya, 2000; Dede, 2008; Serikov, 2010). In our study, personalization serves as a methodological basis, which contributes to the activation of the personal-subjective position of students and teachers and thereby the formation of their professional competence, the implementation of the processes of selfhood and the development of their personality.

The term "personalization" is used ambiguously in modern literature. "Personalization", originating from the word "persona" ("persona" - "personality"), indicates belonging to a person or a focus on her. The term "personal" is interpreted as personal, inherent, concerning or belonging to an individual or an individual – "personal invitation", "personal computer", "personal profile", etc. (Petruneva, 2011). In this context, "personalization" is considered as the process of transformation of an object, its transformation in accordance with the characteristics and needs of a certain person. Today, there is a place for personalization of language and speech, technical devices, information space, environment, and so on, where a person "adjusts" elements of the surrounding reality, thereby ensuring comfortable and effective interaction with them (Grachev, 2005; Petruneva, 2011). Of course, personalization is realized in conditions of variability, which gives the individual the opportunity to choose.

2. Theoretical Framework

Based on the theoretical analysis of studies devoted to the essence of personalization in education, such scientists as (Grachev, 2005; Petrovsky, 1996) etc., we have identified the following characteristics: firstly, personalization is a process that has a mega-goal, which lies in the importance and necessity of the formation of the personality of each individual (participant in the educational process), the development of personal functions, satisfaction of the need to be a person and personal self-realization; secondly, it is the process of formation of a unique personality and individuality, the development of the author's position in relation to society and his own life through self-initiated and responsible transformation of the surrounding reality, in particular, elements of the educational system and the building

of individual development trajectories; thirdly, it is an interdependent process of exteriorization of the characteristics of a particular personality into the external reality, directly into the educational process, as a result of which there is an impact and transformation, either of its certain components, or of the personalities of other individuals, that is, there is an expedient transformation and diversification of the learning process, and the reverse process of interiorization, i.e. borrowing from the sphere of public relations and public experience of personally important elements of socialization; fourth, it is the process of manifestation, presentation, translation of one's individuality to other personalities; the implementation of adjustments to one's "self-image" in order to be in demand, competitive, contribute to culture and social processes and self-actualize (Bartolome et al., 2018; Mishina et al., 2019).

We have revealed and proved that it is the personalization of the competence training of bachelors of the artistic and pedagogical direction that increases the effectiveness of their education and personal development, in general. The competence-based artistic and pedagogical training of bachelors is a unique way for a person to master and appropriate the richest potential of artistic culture, to search for an individual way of self-expression in independent, artistic creativity; to acquire personally significant mechanisms by needs, goals, motives, values, vectors of self-development through the emotional and sensual sphere (Mishina et al., 2020).

In pedagogical science, it is proved that individual differences of students determine the process of cognition, development and competence formation (Bondarevskaya, 2000; Clarin, 2000). Today, we should not just take this circumstance into account, but we should help ensure that the bachelor becomes a co-author, the subject of his competent artistic and pedagogical training. A bachelor of art and pedagogical direction should clearly see the purpose of the formation of all components of competencies, be aware of the need for a particular stage of training for their competence and personal development.

Thus, based on the studied material, we will reveal the main provisions of the personalization of the competence training of bachelors of the artistic and pedagogical direction: firstly, personalization assumes that the development of competencies is an integral component of the professional and personal formation and self-realization of bachelors; secondly, personalization is carried out through the awareness by bachelors of the need to form a unique experience in the field of art pedagogy, which is possible through the proactive design of individual educational routes and routes of self-realization; thirdly, personalization is actualized in the process of manifestation by bachelors of their subjectivity through inclusion in mutually enriching interpersonal communication, dialogue, cooperation, co-creation, primarily with representatives of art pedagogy; fourth, personalization is an expedient transformation and diversification of the learning process, in which the potential for personal development is activated in accordance with its individual characteristics, which is especially

important and relevant, because the structure of artistic and creative activity does not fit into the format of one-time emotional and cognitive acts.

At the dawn of the discussion of the issues of personalization and individualization in education there was a belief that these ideas could be fully implemented if a certain level of e-learning and distance technologies were achieved.

In the Federal Law "On Education in the Russian Federation", distance learning technologies are understood as "educational technologies implemented mainly with the use of information and telecommunication technologies with indirect (at a distance) or not completely mediated interaction of a student and a teaching staff" (Federal Law, 2012) Distance technologies make it possible to realize the accessibility of education for different segments of the population, regardless of the place of residence of the student and his state of health.

3. Materials and Methods

Before proceeding to the empirical stage of our research, we identified the potential of distance learning technologies in the context of personalizing the competence-based artistic and pedagogical training of bachelors. Next, we will unlock the potential through the main three positions.

1.Distance technologies strengthen the subject position of the student. In the behavioral aspect, a bachelor of art and pedagogical direction, entering into the position of a subject, must build his own educational trajectory, and in the sense-forming aspect, he must build his own relationship with the world of art, "... and without losing his identity, see and comprehend the artistic world in its many differences, logics and cultural practices and "skip" its content through his inner world" (Kolbysheva, 2020). Remote technologies create a variable environment for designing their own learning trajectories.

The development of educational material using remote technologies presents the following opportunities: mastering the material at an individual pace; varying the amount of information being assimilated, the possibility of choosing additional material, control and evaluation tasks, obtaining objective information and using multimedia to perceive it in various formats (text, visual, auditory, etc.).

2.Distance technologies enhance the openness of the educational process. Today, this property correlates with the recognition of the fact that a person is also an open system. Realizing himself as an unchangeable given, he cannot fully realize his creative potential, turn to his uniqueness, identity (Skvortsov, 2009). This requires special conditions. And today such conditions can be remote resources: electronic educational courses, educational portals, electronic textbooks and books, on-line and virtual museums and exhibitions, professional chats and forums, etc. They, in turn, have the following properties: integrativity

presentation of various information formats: visual, auditory, verbal, animation, virtual, hypertext, etc., combining various types of activities: reproductive, productive, research, etc.; intersubject – provide opportunities for intersubject integration of information within a single resource; variability - contain the necessary volume to select various opportunities for personalization of educational and creative work: the level of complexity of the work, the mode and procedure for performing actions, reporting forms, etc.; efficiency - content updates occur in accordance with changes in objective reality.

3. Remote technologies actualize such personality qualities as initiative and creativity. It is these characteristics that form the basis of the future professional activity of bachelors of art and pedagogical direction: interpretation of phenomena, facts and works of art culture, search and implementation of extraordinary solutions to standard and non-standard professional artistic and pedagogical tasks, critical attitude to the circumstances and realities in the world of art and society.

The core of the personalization of the competence training of bachelors of the artistic and pedagogical direction is the initiative and creative design of individual routes of theoretical, practical, communicative, performing, evaluative development.

The empirical stage of our research was to test the effectiveness of the identified theoretical positions. The core of bachelor's training in the art and pedagogical direction is the art criticism competence. We monitored the level of development of this competence. In this regard, we have identified three criteria for the development of art criticism competence and four levels (low, acceptable, medium, high).

Diagnostics of the level of development of the art history competence of bachelors of the art and pedagogical direction was determined using the following methods: questionnaires, interviewing and observation (for the motivational and value criterion); testing to identify the coefficient of assimilation of art history knowledge and oral surveys (for the cognitive criterion); projective techniques, expert evaluation of the results of educational and educational-professional activities of students (for activity criteria).

An experimental study of the development of the art history competence of bachelors of the art and pedagogical direction based on the personalization of their education by means of distance technologies was conducted on the basis of the Institute of Philology and Intercultural Communication of Kazan Federal University. We formed two groups: an experimental group (EG) of 58 people and a control group (CG) of 57 people. Experimental work was carried out in three stages: ascertaining, forming and control.

In the designated groups, at the ascertaining stage, according to the results of diagnostics, students had low and acceptable levels of development of art criticism competence – 39.4% of the total number of students in EG and 41.8% in CG, 35.7% in EG and 34.3% in CG were

respectively at the acceptable level, 17.8% in EG and 15.6% on average% in CG, at high – 7.1% in EG and 8.3% in CG.

At the formative stage of the experiment, we included students in the process of designing individual educational routes for mastering artistic and theoretical disciplines. Students had access to electronic educational resources presented in the remote MOODLE format. For the best organization of students' work, we have developed an electronic catalog of information sources on types of visual and spatial arts.

4. Results

At the control stage, we conducted a re-diagnosis of the level of development of art criticism competence according to three criteria in the experimental and control groups. The comparative results of the initial and final stages of the experiment are shown in the table.

Table 1. Dynamics of the level of development of bachelor's art competence in experimental and control groups (in % of the total number of students).

	Levels							
	High		Average		Acceptable		Low	
	CG	EG	CG	EG	CG	EG	CG	EG
Ascertaining stage	8,3	7,1	15,6	17,8	34,3	35,7	41,8	39,4
Control stage	9,9	18,6	37,5	61,6	27,3	14,7	25,3	5,1

The indicators in the experimental group are objectively higher than in the control group, which gives us reason to consider the work carried out at the formative stage of the experiment effective.

5. Conclusion

Remote technologies not only open up the possibilities of solving cases that are relevant today, but also allow us to turn to the future, due to the mobility of the penetration of innovations into this system, the flexibility of using information, modern technologies. As a result, there is a situation of "some uncertainty", which is why the student has an impulse to initiative and creativity.

Thus, despite the ambiguity of the assessment of distance technologies in education, in particular, in art and pedagogical education, they become an integral part of the modern

educational system. Distance technologies contain a rich potential for the formation of a promising education system by attracting modern and innovative means. Remote technologies have an undoubted potential in personalizing the competence training of bachelors of the art and pedagogical direction. Firstly, distance technologies strengthen the student's subjective position; secondly, they enhance the openness of the educational process, and thirdly, they actualize such personality qualities as initiative and creativity.

References

Bartolome A., Castaneda L., & Adell J. (2018) Personalisation in educational technology: the absence of underlying pedagogies. *International Journal of Educational Technology in Higher Education,* 15, 14 https://doi.org/10.1186/s41239-018-0095-0

Bondarevskaya, E.V. (2000). Theory and practice of personality-oriented education. Rostov on Don: *Publishing house of RSPU*. https://www.rsl.ru

Clarin, M.V. (2000). Interactive learning is a tool for mastering new experience. *Pedagogika*, 7, 12-18. Retrieved from https://portalus.ru/modules/shkola/rus_readme.php?subaction=showfull&id=1191928437&archive=&start_from=&ucat=&

Dede, C. (2008). Theoretical perspectives influencing the use of information technology in teaching and learning. In Voogt J., & Knezek G. (Eds.), *International handbook of information technology in primary and secondary education,* 43-62. New York: Springer. https://doi.org/10.1007/978-0-387-73315-9_3

Federal Law No. 273-FZ of 29.12.2012 (as amended on 07.03.2018) "On Education in the Russian Federation" Retrieved from http://www.consultant.ru/document/cons_doc_LAW_140174/

Grachev, V.V. (2006). Personalization of learning: requirements for the content of education. *Alma mater. Bulletin of the higher school,* 8, 11-15. https://almavest.ru/ru/archive

Grachev, V.V. (2005) Sociocultural foundations of personalization of higher professional education. Moscow: *Publishing House of the Moscow State University.* https://www.rsl.ru

Kolbysheva, S.I. (2020). Aesthetic and artistic education as a socio-cultural phenomenon. *Art education and science*, 2 (23), 6-18. doi: 10.34684/hon.202002001

Mishina, A.V., Batyrshina, G.I., Yavgildina, Z.M., & Avramkova I.S. (2020). Personalization of art student training in the context of the transition to the digital economy. *International Journal of Criminology and Sociology*, 9, 931-935. doi: 10.6000/1929-4409.2020.09.97

Mishina, A.V., Yavgildina, Z.M., & Avramkova I.S. (2019). Methodological aspects of art criticism competence personalization of art field education bachelors. *Revista Turismo Estudos and Praticas*, 1, 184. Retrieved from https://geptal.com/rtep/index.php/tourism/article/view/217

Petrovsky V.A. (1996). Personality in Psychology: Paradigms of Subjectivity. Rostov on Don: *Publishing house of RSPU*. https://www.koob.ru/petrovsky/psychology_personality_pet

Petruneva, R.M. (2011). Individually-oriented organization of the educational process: illusion and reality. *Higher education in Russia,* 5, 65-70. Retrieved from https://findpatent.ru/magazine/084/845828.html

Serikov, V.V. (2010). The nature of pedagogical activity and features of professional education of a teacher. *Pedagogika,* 5, 29. Retrieved from http://izvestia.vspu.ru/files/publics/106/30-35.pdf

Skvortsov, L.V. (2009). Man in the paradigm of civilizational truth. *Russia and the modern world*, 2, 50-72. Retrieved from http://rossovmir.ru/files/_2_2009.pdf

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14246

Empowering effective language learners: An innovative course addressing language learning challenges in one Australian university

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Abstract

Language programs in Australian universities face the challenges of attracting and retaining students. Most Australian university students are unaware of the benefits of learning an additional language. When they do enrol, they lack adequate skills for effective language learning, resulting in high levels of attrition. This paper describes a course designed to address these challenges. Inspired by transformative learning, activities and materials were selected to increase awareness of processes involved in language learning, debunk preconceptions, and foster self-directed, independent learning. Preliminary findings based on students' reflections show the significant impact the course had on students' perceptions of language learning, their abilities to reflect on their own application of strategies and increased confidence in developing a plan to continue applying these new understandings and strategies in their language learning courses and beyond. Thus, the course facilitated students' transition from passive recipients of 'language injections', to self-directed, motivated, independent learners.

Keywords: *Transformative learning; foreign language learning; higher education; language learning strategies.*

1. Introduction

This short paper introduces an innovative course designed to address several challenges present in the teaching of languages in the Australian Higher Education context. This was a stand-alone, 12-week course open to students learning any language, and supplemented the language courses in which the students were enrolled. In this paper we describe the challenge of learning languages in Australia, outline the course and its rationale, and discuss initial findings from students' reflections on the course. We conclude with implications and concluding remarks.

2. Language learning in the Australian context

To understand the challenges faced by language learners in the Australian Higher Education system, we need to consider four paradoxes that characterise the state of affairs.

Paradox 1: A multilingual country, a monolingual bias

The 2016 Census of the Population showed that more than a fifth of Australians (21%) speak one of the 300 languages spoken across the country. Yet, despite this great linguistic diversity, the monolingual mindset is still deeply entrenched, and languages remain undervalued. Thus, there is little institutional support for so-called 'foreign languages' in the education system, with only 8% of Australian students learning one or more foreign languages in high school, compared to 50% of students across OECD countries (Richardson, 2021). As a result, most students enrolling in language courses at university are absolute beginners, expected to attained proficiency in a language in the three years of their degree, with the limitations mentioned in what follows.

Paradox 2: Covering more content in fewer hours

Following government funding cuts to universities, some institutions have reduced the number of languages offered, or stopped teaching languages altogether. Of the universities teaching foreign languages, contact hours have been reduced, leaving language instructors with less time to cover the curriculum and branch into other areas of instruction, such as strategies to equip students with effective learning tools. To enhance linguistic proficiency, motivated students previously chose to embark on study abroad and/or exchange programs, but Covid-19 put these initiatives on hold. Moreover, while online environments can offer a plethora of resources, this in itself can hinder the process, as students struggle to select the most effective programs/apps to use and lack the ability to self-direct their learning.

Paradox 3: Language learning is a social activity, which is hindered by Covid-19 restrictions

The current pandemic has compounded the difficulties students face. Universities moved classes online early in the beginning of the Australian academic year (February/March 2020),

before first year students had time to familiarise themselves with university culture and expectations, get to know their instructors, and establish friendships and/or study groups. These factors are conducive to learning and engagement and without them, beginner students often struggled to meet the demands of academic life. Indeed, anecdotal evidence indicates that online instruction had a demotivating effect on students.

Paradox 4: Even successful language learners are unaware of language learning processes

One of the findings of the study we describe is that students felt unprepared to fully engage with the opportunities and resources surrounding them and take responsibility for their own language learning journey. Most students reported having no or little contact with speakers of their target languages and felt intimidated and anxious about approaching them and other classmates. The drastic reduction of international students on campus further diminished opportunities for spontaneous interactions using their target language(s).

These feelings demonstrate the importance of socio-emotional factors associated with language learning. Students, however, conceptualise language learning as a predominantly cognitive activity which falls under the responsibility of their instructor. This is what we call, the 'language injection' metaphor, i.e., coming to class to be 'injected with language knowledge'. There is ample evidence that language learning involves not just cognition, but also sociability and emotions (Arnold, 2011). Furthermore, affect and cognition are now increasingly conceptualised as interdependent components of learning (Dörnyei et al., 2015). Being unaware of the impact of socio-emotional factors associated with language learning, students' feelings of dissatisfaction with their learning, anxiety about their performance, sense of isolation following Covid restrictions and the increase in mental health issues, further eroded their confidence and self-esteem, which impacted on their engagement.

The discussion above shows it is imperative to provide appropriate scaffolding to assist language learning, particularly in students' first year of study.These considerations motivated the development of the innovative course we discuss in the remainder of this paper.

3. Rationale of the course

The first-year course 1012LHS How to Learn Languages was designed to address the challenges mentioned above. While the course was created prior to Covid-19, the emergence of the pandemic further reinforced the rationale and urgency for its introduction. The course aimed to help students develop effective learning strategies to enhance competencies in all areas of language ability and to demystify commonly held beliefs about language acquisition. The course was taught in their second trimester of studies, so that students could draw on their limited language learning experience as a springboard for reflection. Overall, 122 students completed the course since its introduction in 2020.

The course was based on a series of highly interactive and experiential workshops, including short explanation segments followed by group discussions and implementation. Through small group practice activities conducted in the workshops, students were invited to reflect on their own language learning and apply the content introduced in the course to their own context and situation. They developed strategies, engaged in disciplinary knowledge, and learned how to self-evaluate their progress both in class and beyond. Thus, students developed the ability to scaffold and enhance their own learning journey, which fostered independent learning and self-reliance. We also included ample examples of our own language learning experience to reinforce that language acquisition beyond the critical age period is feasible, achievable, and worthwhile, but that it also presents challenges.

It is our firm belief that if students acquire basic strategies for successful language learning in the early stages of their degree, they will be capable of transferring these skills to second and third-year level and beyond – even beyond the context of language learning.

4. Pedagogical underpinnings

The course described here was inspired by principles of transformative learning, defined by Mezirow (1997, p.5) as "the process of effecting change in a frame of reference". He describes 'frames of references' as "the structures of assumptions through which we understand our experiences. They selectively shape and delimit expectations, perceptions, cognition, and feelings." (Mezirow, 1997, p.5). While the theory of transformative learning has been further refined by Mezirow and others, and different interpretations of this approach are found in the literature, there is consensus that transformative learning has 'perspective transformation' as a central goal.

Mezirow (2000) lists 10 non-sequential phases related to a shift of perspective, which can be used to track transformative practices in our student cohort.

1. A disorienting dilemma
2. Self-examination with feelings of fear, anger, guilt, or shame
3. A critical assessment of assumptions
4. Recognition that one's discontent and the process of transformation are shared
5. Exploration of options for new roles, relationships, and actions
6. Planning a course of action
7. Acquiring knowledge and skills for implementing one's plans
8. Provisional trying of new roles

9. Building competence and self-confidence in new roles and relationships

10. A reintegration into one's life on the basis of conditions dictated by one's new perspective

The list of phases shows that transformative learning involves processes of self-reflection and awareness, affective factors, critical thinking, and a commitment to action and change. Thus, transformative learning shares common principles with active learning, experiential learning, consciousness raising, critical thinking, meaning making, and other similar constructs, but also incorporates a strong commitment to effecting lifelong learning.

While the process of transformative learning is personal, we can use these phases as a framework to design and structure materials and activities that aim at enhancing students' likelihood of achieving particular phases. We will return to this point in the findings section.

5. Brief overview of the course and aims of each component

The content was designed around six central modules:

(1) Second language aquisition: the effects of age and context on language development.

This module included discussions of bi/multilingualism, tutored vs. untutored acquisition, child acquisition vs. adult foreign/second language learning. There were two main aims of this module. One was to introduce students to the key terms required to interpret and discuss their linguistic 'biographies'. The other aim was to help students create realistic expectations about their prospects as adult language learners, particularly in terms of ultimate attainment and time/effort required in language learning. Realistic expectations avoid frustration and shift the focus to what is achievable. Practice activities in this module included completing surveys and questionnaires reflecting on their language learning trajectories, formulating SMART goals to identify linguistic areas of personal priority. and, charting proficiency development using well-established frameworks (e.g., the CEFR, IELTS).

(2) Understanding individual variables that affect second/foreign language acquisition.

Here the aim was to introduce students to individual factors that play a role in second language acquisition and enhance reflection on how these factors affect students' own learning. This understanding heightened students' ability to organise their learning to suit their strengths. Activities in this module included self-reflections on the impact individual variables had on their learning, as well as TED talks by polyglots discussing effective language learning practices.

(3) Language learning strategies

A crucial aim of this module was to raise students' awareness of cognitive and socio-emotional processes involved in language learning. This increased awareness may normalise

feelings of anxiety and inhibition associated with using another language and assuage their fears and concerns about their learning abilities. An example of an effective activity was teaching and learning a new language to peers: Students organised themselves in small groups around a speaker of a language unknown to them and were given 45 minutes to learn something they wanted to say in that language (e.g., self-introductions). At the end of the lesson students produced basic messages in that language. This activity raised awareness about their role in guiding their own learning process.

(4) Enhancing the learning of the four macro-skills (speaking, listening, reading, writing).

The aim of this module was to expand knowledge and practice effective language learning techniques in all areas of language, both generally and for language-specific challenges (e.g., memorising ideograms, distinguishing tones, asking for help in appropriate ways). A typical activitiy involved learners in understanding the gist of readings in languages unknown to them while noticing the strategies they used. Emphasis was also placed on metacognitive activities, such as experimenting with a range of note-taking techniques that could be used beyond their language classes.

(5) Improving the fifth macro-skill: cultural awareness.

Due to the limited contact hours in university courses, most classes focus on developing linguistic competence. However, native speakers tend to be lenient when learners make grammatical mistakes but judge them negatively when they make pragmatic ‘mistakes’ (Eisenchlas, 2011). The aim of this module was to enhance learners' sensitivity to pragmatic conventions and expectations in the target language/culture, which in turn required the ability to reflect on their own cultural norms and understandings. A typical activity in this module involved conducting a ‘mini ethnographic study’ by selecting speech acts and investigating their pragmalinguistic and sociopragmatic features with the assistance of native/fluent speakers, readings on pragmatics, and similar resources.

(6) Language learning software and Apps to enhance various aspects of language learning

This module introduced students to additional sources of input in the target language. We focused on specific challenges raised by the online environment, such as the large choice of available resources, the need to cope with multitasking, or the sense of isolation reported by some learners. We also addressed the need to identify and develop new strategies to meet these challenges, such as collaborative strategies, and strategies to deal with human-computer interactions. We incorporated students’ existing knowledge of these tools to conduct a ‘show and tell’ session, where they demonstrated their favourite Apps (e.g., Duolingo, Memrise, Busu, HelloTalk,Tandem) to others learning the same language.

6. Assessment

Assessment in this course was conceptualised as an additional pedagogical opportunity, and therefore closely aligned with the activities and resources used in the course. Assessment included: (1) the completion of the MOOC (Massive Online Open Course) Learning how to Learn; (2) a portfolio of activities and short reflections (such as completing surveys and self-evaluation tests, completing worksheets based on videos or readings, etc); (3) a short initial reflection on their first semester language learning experience, identifying strengths and weaknesses, and (4) a final reflection on what they had learned during this course, identifying specific activities and resources that contributed to their learning and formulating a plan for action in their future studies.

Consistent with principles of transformative learning, the reflections were designed to help students challenge preconceived ideas, take charge of their learning, increase their repertoire of learning tools and identify what works for them. These assessment tasks also aligned with the phases of transformative learning. For example, Assessment item (3) required students to identify the challenges they experienced in their first trimester of language studies. Many of the students enrolling in university language courses enjoyed the experience of learning languages in high school and were then unprepared for the increasing demands of university study, compounded by online language learning. This unsettling experience presented a 'disoriented dilemma' that triggered transformation by raising students' awareness of the need for a change in perspective and behaviours. On the other hand, Assessment item (4) required students to reflect on the aspects of this course that led to shifts in perceptions and to reflect forward into applying their new understandings in a plan for action. The students' assignment reflections were used to ascertain some of these challenges mentioned above, as well as to present preliminary findings in the next section.

7. Preliminary findings

The effects of transformative learning may take time to manifest themselves, and thus their evaluation may require a long-term research approach. Moreover, as indicated, these effects were expected to vary widely among learners, depending on their degree of openness to new experiences, level of maturity, and individual variables. Despite these caveats, students' reflections yielded data on how they perceived the effectiveness of the course on their attitudes towards language learning, and on the areas in which they felt the course had an impact. Most students, regardless of their language learning expertise, reported satisfaction with the course and increased confidence in their abilities to self-direct their learning.

The students mentioned that the course as a whole impacted their language learning. For example, one student stated that "Discussions in this class with classmates during this trimester proved to be very important in pointing out new strategies or simply different ways

that I could put them into practice". Another student said "Overall, 1012LHS has revealed how restricting my approach was with language learning and delivered material that has truly impacted how I view study strategies and methods". In addition, there were numerous comments on specific strategies or tools that were beneficial, such as "start[ing] a language learning diary to help keep track of my emotional temperature. I also used it to plan for future language learning tasks, set goals and keep track of my learning. It has been good to organise my learning and have a study schedule". Another student mentioned starting a schedule for learning that included weekly goal setting which increased motivation, commitment, and helped them increase their confidence. Other students mentioned the lack of opportunity to travel abroad but had discovered new ways to immerse themselves in the language through digital technologies.

As mentioned, a key aim for this course was to reinforce the importance of affective strategies and the socio-emotional aspects of language learning. One student comment addressed this exact focus: "Affective strategies […] have particularly enhanced my language learning journey. I realised that the process of language learning is not just intellectual, but also social and emotional; affective strategies focus on taking one's emotional temperature through activities such as keeping a language learning diary or a checklist and have given me the ability to control any negative emotions that arise during my study when I feel unsatisfied with my progress". Moreover, another student mentioned the vital social aspect of language learning: "This trimester I have reached out to classmates for help, forcibly pushed myself out of my comfort zone to meet with people, created opportunities for group studying, and had conversations in my target languages in student chat groups. Recently we teamed up to create a language club at university and that is an idea I am glad we are taking ahead". This language club, initiated and lead by students for students, provides concrete evidence of the students' high level of engagement generated by participating in this course.

The transformative nature of this course was also evident in the students' abilities to employ metalanguage such as processes, strategies, emotional temperature, and comment on the specific categories of strategies (e.g., affective strategies) in their reflections, both to discuss their experiences and as a tool for planning their learning and future studies.

8. Implications

The transformative experience of this course and the perception of the benefits gained could lead students to reconsider the function of the language classroom and their own role within it. Language learning classes should be a space to scaffold learning and provide tools for students to continue learning outside the classroom. More importantly, the classes should foster a sense of agency in students with regards to their individual language learning journey. This functionality of the language classroom has long been recognised, however, funding

cuts to university programs, the move to online environments and Covid-19 restrictions have added urgency to the need for these changes and supplements to language learning classes. Targeted learning courses (like the one discussed in this paper) provide a means to transition from the 'language injection' perspective to one of independence and self-directed learning.

9. Concluding remarks

All true learning is in essence transformational. However, as has been widely documented in the literature and corroborated by students' reflections, learning a language per se does not result in the understanding of the cognitive, social and emotional factors that underpin the process, or in the mastery of effective strategies to cope with the task. These factors and strategies have to be explicitly introduced, discussed and applied. Once learners become aware of the factors that affect their learning and, through practice and self-reflection challenge their preconceptions, they will be better prepared to transfer this new understanding into contexts and situations beyond the classroom and into other areas of life. Thus, spending 12 weeks facilitating a change of perspective is a small investment of time, cost and effort which could yield long lasting benefits and promote life-long learning.

References

Arnold, J. (2011). Attention to Affect in Language Learning. *Anglistik. International Journal of English Studies*, *22*(1), 11-22. doi: http://dx.doi.org/10.14746/n.2019.52.1.2

Dörnyei, Z., MacIntyre, P. D., & Henry, A. (2015). Introduction: Applying complex dynamic systems principles to empirical research on L2 motivation. In Z. Dörnyei, A. Henry, & P. D. MacIntyre (Eds.), *Motivational dynamics in language learning* (pp. 1–7). Bristol, UK: Multilingual Matters.

Eisenchlas, S. A. (2011). On-line interactions as a resource to raise pragmatic awareness. *Journal of Pragmatics*, *43*(1), 51-61. doi: http://dx.doi.org/10.1016/j.pragma.2010.08.013

Mezirow, J. (1997). Transformative learning: Theory to practice. In P. Cranton (Ed.), *Transformative Learning in Action: Insights from Practice* (pp. 5-12). San Francisco: Jossey-Bass.

Mezirow, J. (2000). Learning to Think Like an Adult: Core Concepts of Transformation Theory. In J. Mezirow and Associates (Eds,), *Learning as Transformation:Critical Perspectives on a Theory in Progress* (pp. 3-33). San Francisco: Jossey-Bass.

Richardson, S. (2021). Australian students say they understand global issues, but few are learning another language compared to the OECD average. *The Conversation*, Retrieved from https://theconversation.com/australian-students-say-they-understand-global-issues-but-few-are-learning-another-language-compared-to-the-oecd-average-168073

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14184

Effective techniques to language training of foreign students in Russian universities

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Abstract

The strategic target of Kazan Federal University is enhancing its authority and gaining academic prestige in the area of research and development. For this reason, the objective of our research is to find out whether our techniques are effectively designed to meet the foreign students' professional language needs and how they impact their learning skills. Subsequently, these methods are being focused on developing their English communication skills in work-related situations. Firstly, we identified the strategy of formation the coherent speech at the level of topic-comment relationship. Secondly, we used the gambits as an essential instrument of speech culture. Comparative characteristics of the levels of English proficiency among foreign students of KFU and KNRTU-KAI illustrate the positive results of the experiment, which confirm the effectiveness and success of the proposed techniques. Thus,our methods of teaching English to foreign students make a certain contribution to the accelerated development of the necessary competencies.

Keywords: *Language personality; coherent speech; topic-comment relationship; gambits; language, education.*

1. Introduction

The creation of positive image of the Russian Federation and the Russian higher education as well as the enrollment of foreign citizens for gaining a Russian diploma are among the top priorities of Kazan Federal University (KFU). The integration of KFU into the global scientific and educational system and its self-presentation at the international level is provided by the implementation of the following mechanisms: the development of partnership and networking cooperation with leading universities, scientific centers and organizations of the world; the enrollment of foreign students and recruitment of foreign academic staff; the expansion of two-way academic mobility; the participation in international scientific projects; membership in international academic associations; organizing high-profile international events on the premises of KFU; targeted information campaign etc.

One of the top priorities of KFU is the development of educational services export which enables the university to consistently increase the number of foreign students, being among the leading Russian universities by the number of foreign learners. In 2019 there were 9 654 foreign students from 106 countries.

In the academic year of 2020-2021 the total enrollment of foreign students in KFU reached 13410 people. The majority of foreign first-year students are citizens of People's Republic of China. It is approximately 25% of the current total enrollment of foreign students. Apart from Chinese learners, there is a great deal of students from Turkmenistan, Uzbekistan, Kazakhstan, Egypt, and Latin-American countries. The university management set the goal to select the best applicants all over the world and to make their studies at KFU highly fascinating and comfortable. This intention is proved by the continual extension of a multi-cultural campus which is regarded to be one of the best in Russia. (Otchet. MD., 2019).

2. Material and Methods

2.1. Research questions

Our review of theoretical theses on this subject as well as our practical experience of intercultural communication at the lessons has enabled us to reveal the strategy of coherent speech development at the level of topic-comment relationship and determine how important it is to use gambits as an essential instrument in the context of oral communication culture.

2.2. Objective of the research

To identify how efficient methods of teaching a foreign language are within the framework of intercultural communication.

2.3. Research methods

The following methods were used in the research: analysis of literature review, methods of conversation and observation, questionnaire survey, methods of comparison and generalization.

Teaching the Russian and English languages for different specialties at our universities has changed the attitude of virtually all members of the institute staff towards a foreign language. For instance, many teachers of a foreign language found themselves to be unprepared to the new challenges. Thus, there emerged the necessity of review of their teaching methods which are to be based not only on their own cultural preferences but also on the culture of a language being taught. It has become obvious that it is impossible to teach a foreign language solely through providing authentic written and oral texts without their adequate interpretation. It is essential to keep in mind that only raising awareness of cross-cultural differences will enable teachers to identify their own and foreign perception of the learning material and determine why there is an occasional misinterpretation of language forms and language phenomena (Vereshchagin & Kostomarov, 1980; Gegel, 1990; Gerder, 1977; Gumboldt, 1985; Zakirova & Galeeva, 2018; Ter-Minasova, 2000; Furmanova, 1993).

In both universities KFU and KNRTU-KAI (Kazan National Research Technical University - KAI) the teaching of bachelor and master students is implemented in the Russian language. Whereas for studying for a Bachelor's degree it is sufficient to have B1 level of Russian, master's programs require B2 level. It is highly unlikely that all foreign students possess the above levels of a language competence and it is not uncommon that initial levels of their linguistic and speech competencies are inadequate to master the course of study. Moreover, foreign students need to be equipped with such a level of a foreign language knowledge which is sufficient for communication in an academic context. Implementation of these requirements regarding the language competence poses certain difficulties connected with the specifics of teaching in our universities: it is a limited number of in-class hours designated for studying a foreign language which results in the lack of adequate oral practice at the lessons. Then, there is a need to develop reading and listening skills up to a professionally sufficient level of a communicative competence. It is of importance to note that knowledge of a language and practical command of it require different psychological requisites and various neutral mechanisms. Detailed consideration of development of oral activity is well-observed in the works of Gabdulkhakov (2010) in which he emphasizes that development of coherent speech is to be based on the mechanism of speech production. Contemporary pedagogical technology as a teaching model, in V.F.Gabdulkhakov's opinion, is to include the following technological scheme: creation of situations by collective action of the whole learners' group which require to use various speech units; collective rules deduction of speech units usage; selection, classification and activation of speech material which consists of speech units; creation of situations which require independent construction of coherent

utterances. Unfortunately, the present technology is incompatible with the still common methodology which represents a system of instructions for teachers and regards students as the passive object for influence. (Davydov & Suprunova, 2003). Our research review on formation of the linguistic personality in the multicultural environment enabled us to determine the strategy of development of coherent speech in the framework of integrated study of different languages. In the current context of teaching practice, we assume it appropriates to teach students how to make sentences on the basis of topic-comment relationship technique which leads to accelerated formation of coherent speech in future. According to the concept of inter-sentence cohesion (ISC) developed in text linguistics, the main indicator of cohesion is semantic coherence which is based on general structural mechanisms – repetition and linking. ISC can be expressed as a connection among sentences, a complex group of sentences, passages, chunks, chapters and other parts of a text (Loseva, 1980; Sayakhova, 1995). Recognition of the importance of coherent speech formation at the level of topic-comment relationship has enabled to confirm our assumption about the necessity of special study of the word order in a whole text. To confirm our assumptions, we will illustrate them with the following examples (Table 1):

Table 1. The strategy of coherent speech development at the level of topic-comment relationship

Strategy	**Examples**
Linear saying sequence	In summer our students worked in Turkey. There are a lot of popular hotels in this country. Marti Mira is one of the best among them.
Saying with a regular (cross cutting) theme	My brother is a student of tourism faculty. He likes travelling very much. Recently he's been to Moscow.
Statement due to the parallel connection of derivative topics	In the morning I signed up for tour. Before lunch I had spa treatments. In the evening I went to the gym.

2.3.1 Topic-comment relationship

The results of the research suggested that mistakes in the structure of actual division of the sentence are mainly caused with lack of knowledge of the topic-comment relationship and inability to use the word order as a means of organizing a text. According to the results of the conducted research, errors in the structure of topic-comment relationship (the structure of actual division) tend to be caused by inability of students to make the three main types of it. According to the rules of making these types of sentences, the topic in a sentence is to be placed at the beginning of a sentence and it cannot be moved within a sentence. The comment part is placed at the end of a sentence and has the highest degree of actualization which cannot be moved within a sentence or text. The third type of sentences has the topic at the beginning

of a sentence and it cannot be moved to the end of a sentence. The comment cannot be moved to the beginning of a sentence. The topic and comment are to be placed properly in all sentences. According to our observations, each group of foreign students has a tendency to make a considerable number of mistakes connected with the topic-comment relationship. Moreover, in the course of study there is a continuous growth of the mistakes which is directly correlated with a growing length of an utterance. It all confirms the fact that it is necessary to specifically study the word order within a whole text but not within a single sentence.

2.3.2 Gambits.

The second issue to be examined in a more detail is the use of gambits at the lessons. To facilitate our communication in a foreign language and to give our speech a natural sound it is crucial to utilize as many spoken words and phrases as possible – the so-called gambits. A gambit is a word or phrase which helps us to express what we are trying to say. On the one hand, the gambit has a very little meaning – it does not express an opinion, it may only introduce the opinion. On the other hand, if we never use gambits in our conversation, other people will think we are very direct, abrupt, and even rude. If you want to express a deeply-held belief, people will understand you better if you start: I personally feel that… - and if you think your view is surprising, people will react better if you introduce it with: Not everyone will agree with me, but I think… Thus, gambits will make your English sound more natural, more confident and will make you easier to talk to. Above all, you will not be misunderstood (Keller & Warner, 2002).

We suggest some techniques of working with gambits: in each of the activities in pairs or small groups there is a list of gambits in front of students. Before they start their conversation, make sure they can say them. Try to use them in your conversations. If you find them difficult, have the conversation again and try to use them. It will help you if, after your conversation, you try to write it down and include the gambits. Then read aloud what you have written. Do not try to memorize the gambits. You will remember them better if you try to involve yourself in the activities in an active way. Above all, try to use them whenever you have an English conversation outside the classroom (Martinez, 2002; Hill, 1980). If someone asks you a question, you answer it if you can. But conversation does not consist of questions and answers. We hardly ever ask direct questions. We make observations and pass comments. We expect other people to respond to us. How they respond tells us how to develop what we say. This means that successful conversations depend partly on how we respond to what other people say. For example, if you disagree very strongly with what someone says, you could say: You must be joking! and the other person knows that you are surprised – this will make the person think more carefully before continuing. The adaptation process will go on quicker if gambits are used at any opportunity in extra-curricular activities (Keller & Warner, 2002).

Thus, it can be argued that conversation gambits efficiently encourage students to communicate freely in English and promote active cross-cultural exchange.

3. Study and Results

The results were obtained in the following way. We made up two tables 2 and 3. Each table is divided into four sections. We tested 70 foreign students from two universities: KNRTU-KAI and KFU. The examined category of students is placed in section 1. The other three sections were designed to distribute the levels of competence of students in oral English speech (high, intermediate and low). Table 2 shows the results in oral speech of KNRTU-KAI and KFU students before the experiment (in %). Table 3 shows the results in oral speech of KNRTU-KAI and KFU students after the experiment (in %), respectively. The diagnostics of foreign students' mastery in oral English speech has been performed with the aim of identifying the level of realization of coherent speech development at the level of topic-comment relationship with the use of gambits in 2019-2020. The sample constituted 30 KNRTU-KAI and 40 KFU foreign students. Three levels of students' mastery have been determined: the first level (High) – faultless construction of sentences in oral speech; the second level (Intermediate) – one mistake in the construction of sentences in oral speech; the third level (Low) – two or more mistakes in the construction of sentences in oral speech. For the purpose of diagnostics, utterances made by the students in the process of 5–7-minute spontaneous communication have been employed. The results are presented in Table 2.

Table 2. Diagnostic results in oral speech of KNRTU-KAI and KFU students before the experiment (in %).

Examined category	High level	Intermediate level	Low level
KNRTU-KAI students	12	47	41
KFU students	34	37	29

As we can see, neither KNRTU-KAI, nor KFU students show high indicators in the level of ownership of a good command of English. Both of them have an average level. This suggests that their speech is not always a role model. Then a two-month training workshop was held. The results of it we can notice in Table 3.

Table 3. Diagnostic results in oral speech of KNRTU-KAI and KFU students after the experiment (in %).

Examined category	High level	Intermediate level	Low level
KNRTU-KAI students	64	28	8
KFU students	75	23	2

They show that after the experiment, the average and high levels of mastery of oral English have changed significantly: high from 12% (KNRTU-KAI) and 34% (KFU) increased to 64% (KNRTU-KAI) and 75% (KFU). At the same time, the average level of mastery of oral speech, has significantly decreased: from 47% (KNRTU-KAI) and 37% (KFU) to 28% (KNRTU-KAI) and 23% (KFU). The results suggest that adding our techniques in a course of study where they are not currently used will have a positive impact on student perceptions of the instructor. We found that although most students (KNRTU-KAI) had low level (41%) before the experiment, they could achieve good results: intermediate level (28%) and high level (64%) respectively.

Statistical analysis of criteria for assessing the progress of foreign students defines the purpose of the presented tables: firstly, a comparative statistical assessment of the indicators of improving academic performance before and after the experiment. Secondly, identification of the factor of increasing productivity at the initial stage of training. Thus, the positive results of the experiment suggest that the proposed techniques of coherent speech formation at the level of topic-comment relationship as well as the active use of gambits have proved successful. And the results of Table 3 help to realize that the increasing productivity at the initial stage of training highly depends on foreign students' readiness to study at the university. However, we can notice a gap between KFU (29%) and almost 41% of KNRTU-KAI students at the low level. We could be wrong, but we think the quality of teaching and the prestige of the university will determine the level of education and preparation for passing the entrance exams of applicants.

4. Discussion and Conclusion

This manuscript is motivated by a series of experiments on the interaction between peers in a group. As a result of the experiment, we have come to the conclusion that for accelerated development of coherent speech both in English and Russian in the integrated study of different languages to be needed for successful study of the chosen specialties it is crucial to do the following: firstly, it is necessary to identify the strategy of coherent speech formation at the level of topic-comment relationship. Secondly, we should encourage students to use gambits as an essential instrument of speech culture. Although the proposed techniques for coherent speech formation at the topic-comment relationship and active use of gambits in speech cannot be regarded as single and universal, the positive results of the experiment indicate that opportunities for successful acquisition of the English language by foreign students are promising.

Thus, we conclude that the occurrence of the positive results is justified on the basis of existing experimental and theoretical results. Moreover, a survey examining students' attitude to the authors' solutions has shown a positive impact on student perception of the teachers

and their techniques. Therefore, these findings could play a beneficial role in the development of the foreign students' professional language skills. We argue that the above-mentioned techniques are quite relevant for teaching staff of universities in connection with a mass influx of foreign students wishing to receive a higher education in Russia.

References

Davydov, Yu. S. & Suprunova, L. L. (2003). *Concept of multicultural education in higher school of the Russian Federation* [Koncepciya polikul'turnogo obrazovaniya v vysshej shkole Rossijskoj Federacii]. Pyatigorsk: Pyatigorsk State Linguistic University Press.

Eric Keller & Sylvia, T. Warner (2002). *Conversational Gambits. Real English Conversation Practices.* Heinle.

Furmanova V.P. (1993) *Intercultural Communication and Linguistic and Cultural Studies in the Practice of Teaching Foreign Languages* [Mezhkul'turnaya kommunikatsiya i lingvokul'turovedeniye v teorii i praktike obucheniya inostrannym yazykam]. Saransk: Izd-vo Mordovskogo un-ta.

Gabdulkhakov, V. F. (2010). *Social communication and multicultural education* [Socialniye kommunikatsii i polikulturnoye obrazovaniye] Kazan': RIC Shkola.

Gegel, G.V. (1990) *Philosophy of Law* [Filosofiya prava] Moskva: Mysl.

Gerder, I.G. (1977) *Ideas for the Philosophy of the History of Mankind* [Idei k filosofii istorii chelovechestva]. Moskva: Nauka.

Hill, L.A. (1980) *Intermediate Steps to Understanding*, Oxford University Press. Tokyo.

Loseva, L.M. (1980) *How the Text Is Constructed* [Kak stroitsya tekst]. Moskva: Prosveschenie.

Otchet. MD. (2019) Report on International Activities of Kazan Federal University [Otchet o mezhdunarodnoj deyatel'nosti Kazanskogo Federal'nogo universiteta v 2019 godu]. Kazan: Department of International Relations, KFU. https://kpfu.ru/portal/docs/F_1112851555/Otchet.MD.2019.pdf.

Ron Martinez (2002). Conversation Lessons: The Natural Language of Conversations: An Intermediate Course, Heinle, Cengage Learning.

Sayakhova, L.G. (1995). *Language and Culture* [Yazyk i kul'tura]. Ufa: Bashkirskiy universitet.

Ter-Minasova, S.G. (2000) Language and Intercultural Communication [Yazyk i mezhkul'turnaya kommunikatsiya]. Moskva: Slovo.

V. fon Gumboldt (1985) *Language and Philosophy of Culture* [Yazyk i filosofiya kul'tury] Moskva: Progress.

Vereshchagin, Ye.M. & Kostomarov, V.G. (1980) Linguistic theory of the word [Lingvostranovedcheskaya teoriya slova]. Moskva: Rus. Yaz.

Zakirova, G. Sh & Galeeva, L.A. (2018) Linguistic Personality of a Student in a Multicultural Educational Environment [Yazykovaya lichnost studenta v polikulturnom obrazovatelnom prostranstve] *Kazanskiy pedagogicheskiy zhurnal*, No. 4, 105–108.

Zakirova, G. Sh & Galeeva, L.A. (2018, December 03-04) Organizational-pedagogical conditions for language training of foreign students of technical disciplines. 18th PCSF – Professional Culture of the Specialist of the Future. The European Proceedings of Social & Behavioural Sciences, 701-709. doi:10.15405/epsbs.2018.12.02.76

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14459

Negotiation of Form and Its Effects in NS-NNSs Conversational Interaction

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Abstract

This article presents a study of corrective feedback and learner uptake in native speaker and non-native speakers (NS-NNSs) conversational interaction in foreign language classroom setting. Transcripts totaling 10.5 hours of NS-NNSs conversation were analyzed, using Lyster and Ranta's error treatment model (1997), to investigate the feedback-uptake relationships in the context of NS-NNSs interaction. Results showed that the NS paid limited attention to the NNSs' linguistic errors. Among the existing types of corrective feedback, recast was significantly preferred by the NS, and peer translation was widely used by the NNSs. Negotiation of form was scarcely used by the NS. As for learner uptake and self-correction, peer feedback gained the best effect, while recast had the lowest rate. Negotiation of form got a higher rate of uptake, but a lower rate of learner-generated repair. Finally the results were discussed from the perspective of noticing theory in cognitive psychology.

Keywords: *NS-NNSs conversational interaction; corrective feedback; negotiation of form; uptake; self-correction.*

1. Introduction

Corrective feedback (CF) has been a significant issue in the study of second language acquisition. Scholars such as Gass (1988), Schmidt (1990) held that negative evidence could facilitate language learning and played an essential role in second language (L2) learning. Other scholars such as Lyster and Ranta (1997), and Oliver (2000) examined the nature and function of CF in L2 teaching and learning. Correct feedback plays a pivotal role in L2 learning, contributing to better overall L2 performance than similar instruction without CF (Lyster et al, 2013). Lyster and Ranta (1997) classified teachers' feedback to errors in communicative classrooms into six types: explicit correction, recast, repetition, clarification request, elicitation, and meta-linguistic feedback. It was found that recast and explicit correction were ineffective in eliciting student-generated repair, and four other feedback types --- elicitation, metalinguistic feedback, clarification requests, and repetition --- led to student-generated repair more sufficiently and were thus able to initiate what is characterized as negotiation of form. Similarly, Panova and Lyster (2002) observed corrective feedback and its uptake in adult L2 classrooms, and found that negotiation of form led to a high rate of uptake and student-generated self-correction. Research on corrective feedback in China, such as Zhao (2005), observed the means of corrective feedback and its relationship with student uptake in English classrooms. Some other studies touched upon corrective feedback occurring in international students' classrooms in which Chinese is the target language (such as Sun, 2010; Kai & Li, 2013). These studies confirmed that negotiation of form is an ideal type of corrective feedback.

The above studies were all based on traditional classroom interaction. Little research has observed how negotiation of form works in small groups in foreign language (FL) classrooms. The present study was designed to examine the role of negotiation of form in a small NS-NNSs group. Two questions would be answered: (1) What types of negotiation of form would be used in reaction to learners' errors in the NS-NNSs conversational interaction? (2) What is the effect of negotiation of form on learner uptake and self-correction in the NS-NNSs conversational interaction?

2. Research Procedure

2.1. Subjects

The subjects were four English learners and one native speaker. The four NNSs were from a senior school in East Guangdong province in China. The native speaker had sufficient teaching experience in China. In each class, the NS gave a topic to the students and asked one student to begin the discussion by giving his own opinion on the topic, followed by questions from other students and then by free talk and discussion. The NS participated in the discussion and provided feedback to the students' linguistic errors when necessary. The

whole class was arranged in a communicative context with a brief attention paid to linguistic forms. We made a totaling 10.5-hour-transcript of the NS-NNSs conversations on everyday topics such as tiger mother and cat mother, holiday, education in China, Leifeng Month, studying with a teacher, neighbor relationships and iPad and mobile phone.

2.2. Data Collection

We categorized errors into three types: phonological, lexical and grammatical. The NNSs frequently used a Chinese (L1) word or clause, so we regarded mother tongue as a special type of "error", as shown in Table 1. Then we calculated the NS's feedback, and categorized them into six types: recast, explicit correction, metalinguistic feedback, repetition, elicitation, and clarification request. Since L1 was frequently used and could gain peers' help and assistance, we treated "peer feedback" as a special type of corrective feedback, in an attempt to examine how the the NNSs responded to peer feedback. We then calculated each type of feedback, and arrived at its rate in all types of feedback. After that, we further calculated learner uptake and self-correction to find out the effect of negotiation of form, as opposed to that of non-negotiation of form and that of peer prompt.

Table 1: Different types of error (n=289)

Error type	number	Rate
Grammar	172	60
Mother tongue	59	29
Vocabulary	49	17
Pronunciation	9	3

3. Results and Analysis

Recast was used most frequently by the NS (43%), and explicit correction only accounted for 6%, as shown in Table 2. Recast is a kind of full or partial implicit reconstruction of the learners' error. It not only signifies where the error is, but also offers the correct forms directly and promptly without interfering with the communication, as in Example (1):

(1) NNS：My mother is a cat mother. She don't very strict.
NS: She isn't very strict.

Peer feedback is a special type in the present study. Such feedback might be a translated version from L1, as in example (2). And the NS may offer immediate help after the peer negotiation, as in example (3).

(2) NNS1：… and I went to see, er … see … 烟火 (fireworks) …
NNS 2: fireworks

NNS1: oh, fireworks

(3) NNS1: … yes, because we met many, many 亲戚，亲戚怎么说？(relatives, how to say it?)
NNS2：rele …

NNS3: releti …

NNS2: ye, relative.

NS: oh, relative, you visited many relatives.

In example 3, NNS 1's mother tongue elicits peer negotiation, finally leading to the NS's recast. The NNSs learned the word "relatives". During the conversation, the more NNSs were involved, the more likely the problem would be solved, especially when the NS participated the negotiation. Another factor that decided successful negotiation was that the peers provided a near-target-language feedback. Otherwise, the NS had no choice but to change the topic, as in Example 4.

(4) NNS 1：I think it (lucky money) only means, means, er,er 祝福 (wishes) …
NNS 2: 祝， kind, …

NNS 3: 祝福 (wishes)， 祝 …, happy …

NNS 2: good, …

NNS 3: congratulation …

NS: OK, okay, Max, what about you? Did you get any lucky money?

In contrast to recast and peer feedback, the number of negotiation of form was much smaller, with repetition accounting for 12%, metalinguistic feedback 4%, elicitation and clarification request only 3% respectively. Negotiation of form was scantly used. The rate is much lower than that of immersion classrooms (such as Lyster & Ranta, 1997) and other adult L2 classrooms (such as Panova & Lyster， 2002；Kai & Li, 2013).

We then sought to consider the response for different types of errors. As shown in Table 3, mother tongue gained the highest rate of feedback (38%), followed by lexical error (32%), grammatical error (25%), and error in pronunciation (5%). Most feedback from the NS was made for lexical errors, and a very small amount was made for grammatical errors (n=17, %=25). It must be pointed out that the NS gave very little feedback to pronunciation errors (only 5%). Like grammatical errors, pronunciation errors received little attention. Therefore, we did not take them into consideration.

Table2：Distribution of different types of corrective feedback（n = 98）

Feedback type	number	rate (%)
Recast	42	43
Peer feedback	28	29
Repetition	12	12
Explicit correction	6	6
Metalinguistic feedback	4	4
Elicitation	3	3
Clarification request	3	3

Table 3: Corrective feedback for different types of error (n=68)

Error type	**number**	**Rate**
Mother tongue	26	38
Vocabulary	22	32
Grammar	17	25
Pronunciation	3	5

The next question is whether negotiation of form led to learner uptake and self-correction. As shown in Table 4, results showed that recast gained the lowest rate of uptake (only 24%), while peer feedback got the highest rate (82%). Although the number of negotiation of form is small, it gained a higher rate of uptake than recast. This indicated that negotiation of form enabled learners to pay attention to linguistic forms in communication. Among the four types of negotiation of form, repetition and elicitation got the highest rate of uptake (67%). In terms of learners' self-correction, peer feedback got the highest rate (54%). Negotiation of form did not have a satisfactory effect as expected: elicitation got 33%, metalinguistic feedback 25% and repetition 17%.

Table 4: Uptake and self-correction of different types of feedback

Feedback type	Uptake		Self-correction	
	n	%	n	%
Recast (n=42)	10	24	4	10
Peer feedback (n=28)	23	82	15	54
Repetition (n=12)	8	67	2	17
Explicit correction (n=6)	4	63	1	17
Elicitation (n=3)	2	67	1	33
Clarification request(n=3)	1	33	0	-

4. Discussion

4.1 Distribution of Different Types of Correct Feedback

It was found that corrective feedback only accounted for 34% of all errors. If peer feedback was not considered, the NS' s feedback accounted for only 24%. Why is this so? First, this phenomenon is related to the nature of conversational communication, in which fluency is the first priority. If misunderstanding does not occur, no feedback is given to linguistic errors, especially grammatical errors. But in what situations did the 34% of the corrective feedback take place? Through further analysis, we found that corrective feedback occurred in the following four occasions. First, in a single move, if an utterance is grammatically wrong, the NS may give feedback though the error does not interfere with communication., as in Examples (5), (6):

(5) NNS: I fail exam.
NS: Oh, you fail an exam.

(6) NNS: … we have 2 year in junior school.
NS: Only 2 years in junior school. I understand.

Second, L1 has received peer feedback, as shown in Examples (2), (3), (4), but such feedback was mainly used to help peers to solve problems, most probably by offering an English translation. The NNS used an L1 word, phrase or clause to indicate that he had difficulty in expressing his idea in English. Such a signal for help often got immediate feedback from peers. And the NS displayed great interest in it, and may offer timely help:

(7) NNS 1: Yes … but … but … I worry about … en … worry about it, but the problem is … 就是恐怕有时候双方都不肯迈出那一步. (That is, sometimes, no one wants say hello first.)

NNS 2: He said … er …er … everyone, neither of them want to do the … want to do the … the first thing just … say "Hello".

NS: Nobody wants to be the first fool.

NNSs: Yes, yes.

Third, most NS feedback was intended for vocabulary. Unlike grammatical errors, lexical errors are more likely to create misunderstandings and cause a communication breakdown. In this study, the NS often gave on-the-spot comment or explanation for an incorrect use of a word, as in Example (8).

(8) NNS 1: I think an extra teacher is … is…unneeded.

NS: Unneeded? Unnecessary is a better word, and an even better one is superfluous.

NNSs: … super…fler …

NS: Superfluous. S-u-p-e-r-f-l-u-o-u-s. Usually it means above what is necessary, beyond what is necessary, not necessary.

NNS 2: too much.

NS: Yes, too much. Can you say the word for me, Martin? Superfluous.

NNS 3 (Martin): Superfluous

NS: Yes. Can everyone say that?

NNSs: Superfluous.

As could be seen, recast was widely used while negotiation of form was scantly used as feedback to the NNSs' linguistic errors. This phenomenon could be attributed to the NNSs' low proficiency level of English. What's more, they seldom use English in a real communicative context. In this case, the NS tends to recast learners' ill-formed utterances by directly providing the standard and grammatical expressions. Recast is the most efficient and natural means of responding to students' error and, at the same time, provides students with supportive, scaffolded help in using their L2 (Panova & Lyster, 2002). In addition, the NNS had great interest in using translation as a type of responding to their peers' problem.

4.2 An Explanation from the Perspective of Noticing

Communicating in L2 differs from communicating in L1 in that producing L2 utterances needs more mental effort. L2 Learners may pay attention to linguistic forms only after the meaning is clearly expressed and understood. At this point, the NS's feedback may lead to learners' uptake and self-correction. Corrective feedback enables L2 learners to notice the problems in their utterances, and thus 'push' them to analyze, adjust and repair ill-formed

utterances. Self-correction is a process of extracting the 'alternative form'. Learners are likely to benefit more from being pushed to retrieve target language forms than from merely hearing the forms in the input, because the retrieval and subsequent production stimulate the development of connections in the memory (de Bot, 1996). The fact that negotiation of form in the present study did not lead to ideal learner self-correction does not mean that negotiation of form has no such 'pushing' function for L2 learning. Instead, such a 'push' exists in an implicit state. Such phenomenon can be attributed to the following cognitive and psychological causes: (1) Learners' noticing resources have not yet completely transformed from meaning to linguistic forms. (2) Learners may have realized the importance of form, but have no time or attention to analyze the linguistic problems. (3) Learners have realized the linguistic problems, but cannot find a suitable alternative form. It must be pointed out that if there is no storage of needed linguistic forms in the learner's memory, any negotiation of form would be futile.

5. Conclusion

This study investigated the negotiation of form and its effect in NS-NNSs conversation in a foreign language setting. The results showed that: (1) The NS gave very little feedback to the NNSs' linguistic errors. (2) Among the types of feedback, recast was the most preferred means of feedback used by the NS, but it led to the smallest amount of learner uptake and self-correction. (3) Peer translation was a frequently-used feedback method among the NNS peers, and led to the largest amount of learner uptake and self-repair. (4) Negotiation of form was scantly used by the NS. It led to a high rate of learner uptake, but a low rate of learner's self-correction. Such a phenomenon has been explained from the perspective of noticing in cognitive psychology. Peer interaction and its effect on facilitating L2 learning needs to be investigated in the future research. In addition, while observing the effect of negotiation of form, researchers also need to consider the time, content, and means of negotiation (Zheng, 2007) in order to have a better understanding of the negotiation of form in NS-NNSs interaction and its effect of facilitating L2 learning.

References

de Bot, K. (1996). The psycholinguistics of the output hypothesis. *Language Learning*, (46):529-555.

Gass, S. (1988). Integrating research areas: A framework for second language studies. *Applied Linguistics* 9: 198-217.

Kai, T. & Li, B. L. (2013). Effects of different types of corrective feedback on Chinese acquisition from ZPD perspective. *Language Application Research*, (9):75-78.

Lyster. R, & L. Ranta. (1997). Corrective and learner uptake: negotiation of form in communicative classrooms. S*tudies in Second Language Acquisition,*(19): 37-66.

Lyster, R., Saito, K., & Sato, M. (2013). Oral corrective feedback in second language classrooms. *Language Teaching,* (46): 1-40.

Oliver, R. (2000). Age differences in negotiation and feedback in classroom and pair work. *Language learning,* (50): 119-151.

Panova, I. & R. Lyster. (2002). Patterns of corrective feedback and uptake in an adult ESL classroom. *TESOL Quarterly,* (36): 573-595.

Schmidt, R. (1990). The role of consciousness in second language learning. *Applied linguistics,* (11): 129-158.

Sun. N. N. (2010). Investigating international students' attitudes to teachers' feedback. *Journal of Yunnan Normal University*, (7):17-23.

Zhao, C. (2005). Teachers' corrective feedback at different level of English teaching -- A corpus-based study. *Journal of PLA University of Foreign Languages*, (3):35-40.

Zheng, P. Y. (2007). A multi-perspective study and consideration of negotiation of form. *Foreign Language World*, (5):76-82.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14408

Innovation linked with SDGs: Citizen Science projects to foster competencies for participation in the Digital Society

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Abstract

This paper describes the design of an innovative approach to teaching and learning academic communication and intercultural linguistics in the English Studies field to foster competencies for participation in the Digital Society. More specifically, we describe the learning outcomes, sequence of tasks and assessment of competencies for an itinerary of collaborative multimodal online tasks focused on the creation of a Citizen Science (CS) project linked with SDGs. These tasks drew on a genre-based pedagogy and task-based learning in connection with language and digital competencies. We conclude that the integration of CS and SDGs in the educational objectives of the course enables us to embrace the digital transition by promoting open and innovative education and training in transversal skills, digital and intercultural communication, language mediation and English.

Keywords: *English teaching; citizen science; sustainable development goals; digital communication; transversal competencies; genre pedagogy.*

1. Introduction

Society is in the midst of a paradigm shift driven by the green and digital transitions and accelerated by the socio-economic impact of the COVID-19 pandemic. As a result, bold skills agendas are proposed in Europe to drive the transition towards a climate-neutral economy and a digital society. For example, the new European Skills Agenda (European Commission, 2020) set objectives that highlight the key role of skills (e.g. entrepreneurship, learning-to-learn, digital competence, etc.) to boost the employability of citizens, and generate growth and participation in society. Similarly, the European Digital Competence Framework for Citizens (DigiComp, Carretero et al., 2017) is a tool for measuring 21 competencies grouped in 5 areas of digital skills (information and data literacy, communication and collaboration, digital content creation, safety, problem-solving). This tool has the potential to help with self-evaluation, setting learning goals, identifying training opportunities and job search and thus enable citizens to take advantage of the possibilities offered by a digital society. Both the new European Skills Agenda and the DigiComp put forth skills needed to achieve the UN 2030 Agenda for Sustainable Development Goals (SDGs, UNESCO 2019). All these agendas require innovative education and training through the full embracement of the green and digital transitions in higher education institutions. At this moment, there is a unique opportunity to critically rethink models of higher education to empower students by providing them with the skills, competencies and values needed to think and act green so that economic, social and technological progress does not destroy nature.

In this paper, we present the design of an innovative approach to teaching and learning academic communication and intercultural linguistics through Citizen Science in a university course in the field of English Studies. We describe the design of an itinerary of collaborative multimodal online tasks focused on Citizen Science (CS) projects linked with SDGs. To design these tasks, we drew on a genre-based pedagogy (Swales, 2004) and communicative language teaching approaches linked with language and digital competencies (Chong & Reinders, 2021). The integration of CS and SDGs in the course educational objectives was intended to promote open and innovative education and skills that should be prioritized in higher education. Thus, this study aimed to make learners aware of the societies they are engaged with and create interactive learning environments that connect context with learning through digital competence, intercultural communication, transversal skills, and English language competence.

2. Context of the study

Citizen Science (CS) projects linked to SDGs were incorporated into a university course offered in the field of English Studies. This optional course is open to undergraduate students in the 3rd and 4th year of the English Studies degree program and to graduate students

enrolled in the English curriculum strand of a master's program in secondary education and doctoral students working on digital and multimodal genres. The educational objectives of the course cover a range of topics related to the critical analysis of written and spoken genres in the field of humanities and social sciences. The analysis of these genres is approached from a discursive, multimodal, digital, and intercultural perspective, thus seeking to develop students' academic literacy skills by widening their genre repertoires and enabling them to create these genres in English. Collaborative pair and group work, the use of technology in connection with the development of research skills in linguistics, social science methods such as surveys and language communication and mediation competencies in English are some of the dimensions integrated into the teaching and learning process of this course.

However, this course requires innovation to prepare graduates to face a two-fold challenge: first, to improve their scientific literacy and achieve the SDGs of the 2030 Agenda for the democratization of science, accessibility and citizen participation; and second, to understand the affordances and limitations of digital communication in Web 2.0 and social media for the dissemination of disciplinary knowledge to non-specialized audiences. CS is an approach to science communication that seeks to involve citizens as active members of the research process (Fecher & Fieske, 2014) and therefore, it provides an excellent context for exploring ways of delivering digital communication, inclusive programs, and the syllabus transformations needed to meet the SDGs concerning the democratization of science and citizen participation. CS projects are multimodal online texts or digital genres that take advantage of Internet affordances to inform, educate, and persuade the general public to get involved in the identification and classification of research data. This digital genre is in line with open science practices, which are claimed to lead to increased trust and interest in science, a stronger science-society relationship, and improvement in public scientific literacy (Bonney et al., 2009). Hence, its inclusion is critical for the digital communication and communication in foreign language skills required for full online citizenship.

3. Genre pedagogy and methodological design

Genre pedagogy was adopted to teach CS projects as text types. Genre is defined as a rhetorical category of discourse with a communicative purpose (Swales, 2004) or "socially recognized ways of using language" (Hyland, 2007, p. 149). Genre pedagogy enables the teaching of writing scientific discourse and text types likely to be found in a particular target context. In particular, it facilitates the understanding of the text-specific rhetorical purposes and language expressions to achieve these purposes in the context of use, as opposed to a focus on form (i.e. syntactic structures, vocabulary) and composing in the teaching of writing. Therefore, a genre-based approach to teaching CS projects makes writing outcomes and expectations clear: it aids students to understand not only their main rhetorical structure, but also their main purpose (to obtain as much information as possible with the help of the

public), their discursive features (to inform the public as clearly as possible about what needs to be done) and multi-semiotic strategies (to persuade the public to attract their interest with textual and visual elements) (Bateman, 2008).

The genre-based tasks are planned around the range of online texts students will need to use in the target context of CS. The methodology employed for the design of genre-based learning tasks is a communicative approach to the teaching of foreign languages, namely technology-mediated task-based learning (Chong & Reinders, 2021; Tomlinson, 2012). Thanks to this approach, we can introduce authentic materials and real-world communicative situations that students can analyze and critically revise to, later on, involve them in the creation of similar tasks after familiarizing them with the genre conventions. Furthermore, to familiarize themselves with rhetorical demands or genre conventions, students will work with a small corpus of CS projects related to topics such as climate change, health, and wellbeing. CS projects are hosted in the digital environment; hence, ICTs and open access software are integrated to promote active and collaborative methodologies for both the completion of these mutimodal online tasks and the assessment of transversal (digital) skills.

4. Syllabus development

4.1. Learning objectives

The genre-based tasks are supported by a double premise. On the one hand, digital communication is an essential competence for working in online communities: the online communicator is a mediator. On the other hand, online communication is a tool capable of enabling large-scale participation in science and raising awareness about the main socio-economic problems that influence society from the perspective of global initiatives such as the UN 2030 Agenda for Sustainable Development Goals. More specifically, the following educational aims have been established:

- to introduce an emerging digital genre used for science dissemination.
- to foster skills such as critical thinking and autonomous learning of the linguistic resources, discourse, and register features of the genre of CS projects.
- to analyze how CS projects inform, teach, and persuade citizens to collaborate with research tasks (e.g. data collection and analysis).
- to emphasize the value of CS and SDGs for the democratization of science, accessibility and citizen participation that leads to scientific literacy.
- to understand the affordances and limitations of digital communication in Web 2.0 for disseminating disciplinary knowledge to non-specialized audiences.
- to build a framework for developing and measuring transversal skills (i.e. theoretical and applied linguistics knowledge; advanced linguistic competence in English;

searching, analyzing, and processing information; intercultural competence; the critical understanding of social and cultural reality and its representation).

4.2. Sequence of tasks

The following four collaborative multimodal online tasks that combine a variety of skills and texts which form "constellations" (Swales, 2004) in the target context were designed:

1. The first task is a WebQuest. In this online task students have to search, manage and evaluate information related to CS.
2. The second task builds on the information of the first one and relies on qualitative research methods to carry out a survey on Google Forms.
3. The third task is a corpus linguistics workshop or data-driven learning (DDL) task where students are required to use open software and techniques common in the digital humanities to analyze recurrent linguistic and register features in the CS corpus. The corpus is written in English and gathered from the EU-Citizen.Science platform (https://eu-citizen.science/projects).
4. The fourth and final task implies more complexity for the students since they must produce their own multimodal digital text (blog) using Google Sites. Students are expected to apply the theoretical frameworks learned in class and use different online resources. This task aims to assess effective digital communication, communication in English (C1 level), teamwork, and critical thinking.

This task sequence seeks to help students develop an understanding of the context of CS and the ways texts can be used to realize situated communicative purposes in this target context as well as to integrate writing and reading skills.

4.3. Assessment of competencies

Current theories of language assessment highlight the importance of moving away from vague descriptors often found in analytic scoring rubrics such as "adequate knowledge of syntax" and assessing student writing against clear performance criteria. To select the standards of performance for each task we relied on the language mediation descriptors of the Common European Framework of Reference for Languages (CEFR, Council of Europe, 2020), given that mediation is clearly involved in digital communication. The CEFR defines mediation as the "co-construction of meaning in interaction" and mediation strategies may include "linking to previous knowledge, amplifying the text, streamlining text, restructuring text in the appropriate discourse culture, breaking down complicated information, visually representing information and adjusting language" (North & Piccardo, 2016, p. 457). All of these strategies can be found in CS projects. Table 1 shows examples of "can-do" descriptors (or learning outcomes) linked to each of the four tasks and their corresponding digital competence area according to the DigiComp framework (Carretero et al., 2017).

Table 1. Descriptors for self-, peer- and teacher assessment

Task	"Can-do" mediation descriptors	DigiComp framework
Task 1 Webquest	Can rely on writing the relevant points included in propositionally complex but well-structured texts within their professional, academic, and personal interests (e.g. information from an article, website). Can select relevant detailed information and arguments on complex, abstract topics from multiple oral and written sources in researching an area for a project.	Information and data literacy Communication and collaboration
Task 2 Survey	Can interpret and describe clearly and reliably the salient points and details contained in complex diagrams and other visually organized information on complex academic or professional topics (e.g. diagrams/visual data collected as part of a research project). Can mediate during an interview, conveying complex information, and posing clarification and follow-up questions as necessary. Can establish a supportive environment for sharing ideas and practice by providing clear explanations and encouraging people to explore and discuss the issue they are encountering, relating it to their experience. Can exploit software to create a survey.	Information and data literacy Communication and collaboration Digital content creation Safety Problem-solving
Task 3 DDL corpus Workshop	Can interpret and present various forms of empirical data from texts within their professional, academic, and personal interests (e.g. information from an article, website). Can exploit open software to analyze language (e.g. high frequency words, language patterns, semantic prosody).	Information and data literacy Communication and collaboration Digital content creation Safety Problem-solving
Task 4 Blog	Can compare, contrast, synthesize and report in writing information and viewpoints contained in different sources (e.g. surveys, blogs, documentaries, web talks, papers in academic journals), reconstructing arguments and accounts in a coherent presentation. Can exploit information and arguments from several sources to discuss a specialized topic glossing with evaluative comments and adding their opinion. Can recognize the intended audience of a text, style, and register. Can make abstract concepts accessible by visually representing them (e.g. infographics, tables) facilitating understanding by highlighting the relationship between ideas (e.g. problem-solution, compare-contrast). Can make information in a complex written text (e.g. a scientific article) more accessible by presenting the content in a different genre and register.	Information and data literacy Communication and collaboration Digital content creation Safety Problem-solving

The descriptors and competence areas were used to design rubrics for self- and peer-assessment of the transversal skills involved in each task. Self- and peer-assessment enable reflection, which is one of the main strengths of the teaching-learning process in genre pedagogy since students are encouraged to consider the tasks and the criteria used for judging their performance. The same performance standards will be applied by the teacher to judge each task performance and provide feedback.

5. Conclusion

We have reported on the design of an itinerary of collaborative multimodal online tasks focused on Citizen Science projects linked with SDGs. This approach to teaching and learning through genre analysis, corpus linguistics, and technology-mediated tasks sought to foster critical thinking and skills development for participation in the Digital Society in a university course in the field of English Studies. The aim was to introduce students to a new way of communicating science to promote citizen engagement in science-making practices supported by digital resources. The proposed topics in this project bring to the foreground the social reality that we live by promoting open access policies, science democratization, and collaborative practices between scientists and the lay public. We consider this modest study as an example of good practice that can be reduplicated in other teaching contexts since it works with transversal and interdisciplinary knowledge from the scientific and humanities disciplines. The competencies promoted through the multimodal online tasks are regarded by students as necessary in their future careers and will empower them to participate as responsible citizens in the sustainable development of our society.

Acknowledgements

This study is supported by the Spanish Ministry of Science and Innovation (project code PID2019-105655RB-I00/ AEI/10.13039/501100011033), the Government of Aragon (group code H16_20), and the University of Zaragoza (project code PIIDUZ_178).

References

Bateman, J. A. (2008). *Multimodality and genre: A foundation for the systematic analysis of multimodal documents*. London: Palgrave Macmillan.

Bonney, R., Cooper, C. B., Dickinson, J., Kelling S., Phillips, T., Rosenberg, K. V., & Shirk, J. (2009). Citizen Science: A developing tool for expanding science knowledge and scientific literacy. *BioScience*, 59(11), 977–984, doi:10.1525/bio.2009.59.11.9

Carretero Gomez, S., Vuorikari, R. & Punie, Y. (2017). *DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use*. doi:10.2760/38842.

Chong, S. W., & Reinders, H. (2021). A methodological review of qualitative research syntheses in CALL: The state-of-the-art. *System*, 103, 102646. doi:10.1016/j.system.2021.102646

Council of Europe (2020). *Common European Framework of Reference for Languages: Learning, teaching, assessment – Companion volume*. Available at www.coe.int/lang-cefr

European Commission. (2020). *European skills agenda for sustainable competitiveness, social fairness and resilience*. Available at https://ec.europa.eu/social/main.jsp?catId=1223&langId=en

Fecher, B., & Friesike, S. (2014). Open Science: One term, five schools of thought. In: Bartling S., Friesike S. (eds) *Opening science: The evolving guide on how the internet is changing research, collaboration and scholarly publishing* (pp. 17-47). Cham: Springer. doi:10.1007/978-3-319-00026-8_2

Hyland, K. (2007). Genre pedagogy: Language, literacy and L2 writing instruction. *Journal of Second Language Writing*, 16, 148–164. doi:10.1016/j.jslw.2007.07.005

North, B., & Piccardo, E. (2016). Developing illustrative descriptors of aspects of mediation for the Common European Framework of Reference (CEFR): A Council of Europe project. *Language Teaching,* 49(3), 455-459. doi:10.1017/S0261444816000100

UNESCO (2019). *Framework for the implementation of education for sustainable development (ESD) beyond 2019*. Available at https://unesdoc.unesco.org/ark:/48223/pf0000370215.locale=en

Swales, J. M. (2004). *Research genres: Explorations and applications*. New York: Cambridge University Press.

Tomlinson, B. (2012). Materials development for language learning and teaching. *Language Teaching*, 45(2), 143–179. doi:10.1017/S0261444811000528

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14613

The Climate Crisis in Foreign Language/Environmental Literacy Education: A Binational Virtual Exchange

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Abstract

This contribution provides a best-practice example or case study of a transatlantic online course focused on the integrative acquisition of environmental literacy, intercultural skills, and foreign language proficiency. Through binational and transdisciplinary group and class interactions, students from universities in Germany and the United States learned to identify and negotiate culturally and discipline-mediated perspectives on the more-than-human world. Discussing novels, films, media and cultural artifacts that centrally engage ecological themes, students learned to think of the relationship between nature and culture as deeply imbricated. If human culture is acknowledged as part of nature, and culture as a concept extends beyond the human sphere, intercultural competence as a skill or outcome acquires a new, added meaning. Intercultural competence then includes both the ability to negotiate differences between divergent human cultural viewpoints and practices (Byram 1997), as well as the ability to establish an egalitarian relationship with the nonhuman world that goes beyond anthropocentric extractivism.

Keywords: *Online education; virtual exchange; transdisciplinarity; intercultural learning; environmental literacy; natureculture.*

1. Introduction

In an age increasingly marked by devastating wildfires, rising sea levels, warming ocean waters and violent storms, the climate crisis has become one of the most central and urgent "global issues" under discussion in the humanities, and specifically in pedagogy and teacher training. In Germany, for example, the Shell youth study of 2019 explored what young Germans view as the most impactful issues of the moment, determining that "[e]nvironmental protection and climate change, in particular, have gained considerably in importance as issues of relevance to the future" (Shell, 2019, p. 13). As is becoming increasingly clear, climate change is creating a planetary emergency that in the coming decades will require combined transnational efforts by individuals and societies.

Jointly offered online by our two universities, in the United States and Germany, the course "Climate Crisis" was co-taught by faculty from Georgia College and State University (Dr. Hedwig Fraunhofer) and the Friedrich-Schiller Universität Jena (Prof. Dr. Laurenz Volkmann), using synchronous online meetings (via Zoom) as well as asynchronous elements in combination with a Moodle-based platform hosted by Jena University. The transdisciplinary course, which was open to students from all disciplines, attracted 28 students from both universities – while German students enrolled as majors in English (plus another subject), all studying to become teachers in the future, US-American students had diverse academic majors in the humanities, health sciences, and the natural sciences. The course took seriously the widely agreed upon assumption that the sciences must provide the factual, data-based knowledge basis for any possible intervention in the climate crisis. And yet, the humanities can and must facilitate and enrich the discussion, interpretation, and dissemination of these data and their possible consequences for human action. While climate change is indeed a hyperobject in the philosopher Timothy Morton's sense (Morton, 2013) – too large an entity for humans to envision – cultural artifacts, film and literature enable us to go beyond the limits of our imagination, helping us visualize and conceptualize imminent threats to our planet's ecology, including mass extinction.

2. An integrative approach

Arguing from an interdisciplinary perspective, Skutnabb-Kangas et al. (2003, p. 9) explain: "The links between language, culture and the environment suggest that biological, cultural and linguistic diversity should be studied together, as distinct but closely and necessarily related manifestations of the diversity of life on Earth." Establishing this close link between, or imbrication of, cultural and ecological diversity was the main task of our course.

Such an integrative approach needed to be thoroughly informed by ecocritical theories and concepts. Ecocriticism is defined as a meta-discipline, striving to bring to light the cultural and societal bases for anthropocentric concepts and practices (Marland, 2013). As a field of

research within the humanities, ecocriticism focuses on the relationship of humans to their more-than-human environments from a cultural, literary, and historical perspective. Ecocriticism is primarily interested in literary and cultural representations and concepts of the more-than-human (what we used to call the "nonhuman" in a more problematic, binary terminology), and in the way in which such representations contribute to conceptualizations of "nature." Recent developments in ecocriticism have focused on shifting the perspective "beyond anthropocentrism" (Lindgren & Öhman, 2018), questioning anthropocentrism as a world view that considers human interests to have priority over those of nonhuman entities. These insights have exposed how human concerns thus end up overriding ecological matters, and how nature is often seen as a mere resource at humans' free disposal. Unfortunately, the results of this extractivist view of the nonhuman are becoming only too clear.

According to ecocritical perspectives, a critique of anthropocentrism has to be combined with calls for sustainable development, defined as a "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 41). The UNESCO has defined a number of learning objectives in line with seventeen sustainable development goals (UNESCO, 2017). The overarching goal is to develop sustainability competencies that are, in all areas, useful and necessary. The learning objectives are subdivided into goals in different domains: cognitive, socio-emotional, and behavioral. First, *cognitive objectives* for each goal aim at the acquisition of knowledge that lets individuals understand the complexity of the respective goal and how it can be achieved. Second, the *socio-emotional* domain presents learning goals for the development of learners´ collaboration, communication, and self-reflection skills, as well as values, attitudes, and motivations regarding any element of sustainable development. Third, the *behavioral learning* objectives are geared towards the acquisition of action competences. The UNESCO provides a detailed overview of these learning objectives, accompanied by a number of topics and exemplary activities and methods (cf. UNESCO, 2017, pp. 12-45). Since the learning objectives are designed to be suitable and relevant for learners of all ages and from all parts of the world, it is the responsibility of educators to adapt the chosen objectives to meet national and local needs (such as different national/regional or institutional requirements regarding modules, assignments, examinations, and degrees).

3. Environmental literacy and intercultural learning beyond the human

Recent definitions in the field of pedagogy have shifted the focus from "ecological pedagogy" or "learning for sustainable development" to aspects of "environmental literacy" (Küchler, 2016, p. 156). Environmental literacy can easily be integrated and combined with critical skills, and specifically with critical media literacy. To define the latter, we propose the informed analysis and discussion of mass media's and popular texts' relationships to cultural, social, political, ideological and economic concepts, structures, and practices,

including conceptualizations of race, class, and gender. What needs to be added to this list (while acknowledging important questions of intersectionality or enmeshment), however, is the conceptualization of species (a biological term) and of the more-than-human in general (biotics as well as abiotics). In this context, it is essential for students to become aware that critical thinking describes the ability to call into question societal and cultural norms, opinions, and practices. Students learn to reflect on how their own values, actions, and perceptions have been influenced by their media environments, and how this cultural preconditioning has shaped and formed their positions on matters of ecology and sustainability (see also UNESCO, 2017, p. 10), as well as their understanding of themselves, as humans, in relation to "nature."

Drawing a parallel with the more-than-human realm, Eppelsheimer et al. point to the concept of the ecotone, the transition zone between two biological communities or habitats, as a paradigm for foreign language learning in general and for the relationship between second language pedagogy and the environmental humanities in particular: "Th[e] notion of the ecotone […] offers a paradigm for the fruitful collaboration between foreign languages and the environmental humanities. […] In other words, foreign-language learners reflect on the world and themselves through the lens of another language and culture, striving to understand differences in meaning, mentality, and worldviews as expressed in their own and the foreign language(s). We are all learners in this regard." (Eppelsheimer et al., 2014, pp. 5, 8). In our binational project, we aimed at not only the honing of foreign language skills, but also at the development of intercultural competences. Byram prominently defines intercultural competence as comprising "attitudes of curiosity and openness, skills of interpreting and relating, knowledge of social groups and their products and practices and skills of discovery and interaction" (Byram, 1997, p. 49). When approaching an issue such as the environment, diverse learners bring with them different cultural schemata that shape their notions of the world around them and also influence their attitudes and behaviors towards naturalcultural phenomena. Binational courses, or courses with students from different cultural backgrounds in general, provide ideal learning scenarios for both instructors and students to become aware of their own cultural preconditioning – understanding others' culturally conditioned perspectives and negotiating divergent views, linguistic codes and cultural narratives. Here the aim can also be to understand culturally varied concepts of "nature," "life," "human" or diverse, more-than-human entities or phenomena.

We, as instructors, thus aimed at integrating multiple learning goals, particularly in the fields of intercultural and ecological learning – a strategy in line with most environmental literacy models (Deetjen & Ludwig, 2021). Students were encouraged to observe and discuss different cultural practices and perspectives related to the natural environment, while also learning to see nature and culture as ultimately co-extensive and co-productive. Through examinations of culture-specific media presentations, narratives, metaphors, and imagery,

pedagogical approaches to the environment and specifically the climate crisis can foster an understanding of both differences and commonalities between students' own culture and other global human cultures, as well as a greater understanding of cultures beyond the human.

4. A transnational agenda

Discussing various genres such as commercials engaging in "greenwashing," young adult fiction with an ecocritical agenda, novels thematizing the lack of human attention to ecological threats, a graphic novel, eco-documentaries, feature films and multimodal explanation books, the students in the course learned to see nature and culture as intimately entangled. In their instructions, the instructors urged student presenters to avoid what guest speaker Küchler (2016) critiqued as "disaster pedagogy" or "doom-gulp-gloom" pedagogy. Feedback from students was gleaned through both universities' course assessment systems, featuring quantitative online evaluation; through interviews with course participants conducted by University Communications at one university; as well as through informal student comments. Several students were also asked to provide qualitative data in interviews conducted by members of a third-party project sponsored by the German Academic Exchange Service (DAAD) (see https://www.zlb.uni-jena.de/internationales/lehramt-international-ideas; for a more detailed report see Volkmann, 2021, Braselmann et al., forthcoming). Regarding the aspect of ecological education or ecological literacy (Küchler, 2016), the students expressed a strong sense of having gained important insights and competences. It became clear that the course had refrained from both an alarmist, moralistic approach and an anthropocentric belief in "technological fixes." Students explained that the course had encouraged them to venture beyond anthropocentric frameworks (Hartley, 2015). They also understood that intercultural encounters, such as the one experienced in the course's online context, are and need to be shaped by more than just a "tool-box" of interculturally relevant knowledge and skills, but always involves a complex "negotiation of meaning" between culturally different agents (see Byram, 1997). The climate emergency is a key global issue that calls for action-oriented transdisciplinary and transnational cooperation. In their projects – from in-class interactions and binational group presentations to co-authored written or audiovisual projects – students in our course demonstrated their ability to cooperate in multicultural teams.

In the summer term of 2022 the two course instructors will be conducting a second iteration of this course, entitled "*The Climate Crisis through Philosophy, Film and Fiction: The Sequel."* Providing new content, this course takes up where the course taught in Summer 2021 left off. Most importantly, however, the new course will put even greater emphasis on binational student cooperation and discussion and also include a new experiential emphasis on interaction with the natural world.

References

Braselmann, S., Ewers, E., & Kramer, P. (forthcoming). Kompetenzvermittlung durch digitale Auslandserfahrungen im Studium. Eine Erhebung zu Potentialen für eine interkulturelle und reflexive Lehramtsausbildung.

Byram, M. (1997). *Teaching and assessing intercultural communicative competence.* Clevedon: Multilingual Matters.

Deetjen, C., & Ludwig, C. (2021). Introduction – developing students' critical environmental literacies in the ELT classroom. *anglistik & englischunterricht*, *94*, 9–24.

Eppelsheimer, N., Küchler, U., & Melin, C. (2014). Claiming the language ecotone: Translinguality, resilience, and the environmental humanities. *Resilience: A Journal of the Environmental Humanities, 1* (3), 54–68.

Hartley, D. (2015). Against the anthropocene. *Salvage*, *1*(1), 107–118.

Küchler, U. (2016) Signs, images, and narratives – climate change across languages and cultures. In S. Siperstein, S. Hall, & LeMenager, S. (Eds.). *Teaching climate change in the humanities* (pp. 153–160), London: Routledge.

Lindgren, N., & Öhman, J. (2018). A posthuman approach to human-animal relationships: Advocating critical pluralism. *Environmental Education Research.* doi: 10.1080/13504622.2018.1450848

Morton, T. (2013). *Hyperobjects: Philosophy and ecology after the end of the world.* Minneapolis: University of Minnesota Press.

Marland, P. (2013). Ecocriticism. *Literature Compass*, *10* (11), 846–868.

Shell Youth Study (2019). Summary Shell Youth Study, pp. 13–34. Retrieved from: *https://www.shell.de/about-us/shell-youth-study/_jcr_content/par/toptasks.stream/1570708594823/cc089c96f35209143fdfdcbead8365dc26f9a238/shell-youth-study-2019-summary-en.pdf.*

Skutnabb-Kangas, T., Maffi, L., & Harmon, D. (2003). *Sharing a world of difference: The earth's linguistic, cultural, and biological diversity*. Paris: UNESCO Publishing.

UNESCO. (2017). *Education for sustainable development goals: Learning objectives.* Paris: UNESCO.

Volkmann, L. (2021). Internationalisierung der Lehramtsausbildung: Neue Optionen durch digitale Formate. *Zeitschrift für Hochschulentwicklung*, *16* (2), 93–105.

World Commission on Environment and Development (WCED). (1987). *Report of the world commission on environment and development: Our common future.* Oxford: Oxford University Press.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14475

BYOD as a gamification tool for improving learning of an experimental subject in Chemistry Degree

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Abstract

Given the impact of smartphones in all areas of society, the education at the university should not be conceived without the use of technological tools inside classrooms. The present study examines the use of "Bring Your Own Device-BYOD" using Kahoot! as a gamification tool to explore possible benefits in learning and continuous assessment of an experimental subject in the Degree of Chemistry. An empirical analytical methodology was used among different groups of students: one in which Kahoot! was used daily in laboratory lessons and other groups in which it was not employed as a training before final subject evaluation. The aim was to measure the extent to which the students´ knowledge had developed. The academic results has shown that the use of BYOD has had overall positive effects on the academic results. Thus, student's learning and grades have been improved, particularly, those who have achieved a better score using Kahoot!

Keywords: *BYOD; Experimental subject; Kahoot!; University students; Chemistry; Gamification.*

1. Introduction

Tecnological advances respond to the society on continuos move and constant needs as for example access to information and communication. The widespread use of Information and Communication Technologies can also affect to learning (Carneiro & Díaz, 2012). Interactivity and collaboration inside classrooms can be improved using technology (Gros & Contreras, 2006) and university must integrate it as a new types of learning and transmission of knowledge. Educational institutions should pursue training autonomous, creative and motivated students who must be prepared to face the society changing in the current climate. One innovation increasingly used is taking advantage of mobile devices (tablets, smartphones or laptops) in the classroom (Ali *et al.*, 2017) to explore its employment in teaching as rethinking of methodologies, modernization of instructional designs and communication with students (Ng & Nicholas, 2013). Bring Your Own Device (BYOD), is a massive trend, where people bring their personal mobile devices to use in their workplace. This can be implemented in education environment to engage learners and enhance teaching-learning process (Umezu & Onwodi, 2015). Mobile devices provide applications to be used in experimental and theorical lessons, being this a valuable complement to the student's training and learning. The virtual atmospheres created by BYOD model allows acces to information and promotion of new communication models with immediate feedback. In a similar fashion, it is possible to set up previous and continuous evaluations and to increase motivation and participation, making the student have an active role in the learning process. Gamification can be applied with mobile devices and it is understood as the use of mechanisms and thinking in order to draw students attention and motivate them, encouraging action, promoting learning and solving problems (Murillo-Zamorano, 2021; Rodríguez-Fernández, 2017). One of the most popular and user-friendly gamification tools among teachers following their simplicity is *Kahoot!*. This application is based on creating questionnaires by teachers and students will answer them using their own mobile devices. Teachers ensure that all students participate and receive information on their progress and can perform an automatic analysis of the answers. By the same token, students can receive feedback about the right answer, leading to a collaborative environment in the classroom. These entertaining activities allow teachers to face two vital challenges (Hussein, 2015): (i) Being able to follow the student's learning process in a real and continuous way and guarantee that they are achieving the specific knowledge and the proposed competences; (ii) Having constant and agile information on the level of global knowledge and skills of the group so that teachers can detect student' strengths and weaknesses and thus be able to give feedback to influence, review or highlight those aspects. In this sense, the present work proposes the study of the influence of using BYOD and specifically *Kahoot!* application as a gamification tool. Our aim is to boost the student's learning and the implementation of this project as an evaluation

instrument in an experimental subject of analytical chemistry within the Degree in Chemistry at the University of Valladolid. An empirical methodology was used among three different groups of students. In Groups 1 and 2, ones in which *Kahoot!* was not used daily in laboratory practices and in the third one it was employed. The difference between the first and second one is that only one of them (Group 2) was aware of the existence of the final partial exam at the end of the practical sessions. The aim was to study the potential benefits associated with the use of this tool and measure the extent to which the students' knowledge had developed.

2. Objectives and Hypotheses

2.1. Objectives

The main goal set in this project is introducing a new pedagogical approach using gamification as a teaching-learning tool based on the *Kahoot!* application. It has been applied for an experimental analytical subject of the second course of the Degree in Chemistry. This approach is considered as an alternative method of teaching and evaluation of an experimental subject with respect to traditional methods which are usually employed. In order to fulfill this general objective, the following secondary objectives have been proposed:

- Compare the learning results using BYOD in relation to traditional methods in experimental laboratory classes.
- Promote the use of new technologies and digital games in teaching-learning processes via *Kahoot!* in experimental subjects.
- Encourage an entertaining and attractive learning environment that captures the attention, interest and motivation of the students.
- Facilitate the self-assessment of the student for knowing daily progress of their learning and its evolution.
- Obtain feedback of the learning process of the students and allow teachers adapt and redesign the development of experimental classes and place greater emphasis on the points where the students find it more difficult or consider that the explanations should be more extensive.
- Improve the understanding of the *Kahoot!* application in order to use it as an evaluation tool in experimental subjects included in the Degree of Chemistry.

2.2. Hypothesis

Taking into account the conclusions reached in a previous work related to a different theoretical subject of the Degree in Chemistry (Ares, 2018), this study embarks upon a series of initial hypotheses:

- Using BYOD methodology gives students autonomy and confidence to carry out the laboratory experimental practices.
- *Kahoot!* facilites students' study process owing to it contributes to improvement in memorising concepts.
- Learning through gamification allows get better results with students more motivated and involved in teaching-learning process.
- Frequency of questionnaires is paramount for the learning process by virtue of the feedback and additional explanations given by teachers
- The scores of students who have participated in the *Kahoot!* quizzes are higher than those of students who have been attenting in conventional classes.

3. Methodology

The present study approaches using BYOD methodology for searching information and using gamification applications as a learning and evaluation tool in the university laboratory classroom. An empirical-analytical methodology is applied, utilizing *Kahoot!* questionnaires on every single day of the laboratory experimental lessons as a continuous training before doing the final exam. The contents of this test are the same as the questionnaire perform in the last practical session. Three groups of students are evaluated with two types of teaching methodologies: using or not BYOD and gamification. The groups were similar ages, conditions and background scores in other subjects of the Degree in Chemistry. Teachers described the same laboratory experiences for all groups involved using the same methodology. Using the blackboard, they explained the theoretical contents and the steps to carry out the laboratory practices before doing the experimental application. One group (Group 1; 10 students) did not played *Kahoot!*, and it was not informed about a final partial exam. In contrast, the other two (Group 2; 7 students and Group 3; 9 students) were previously notified that it would be a partial exam in the last day of experimental sessions. Plus, only in Group 3, *Kahoot!* was used as an evaluation tool during the laboratory lessons. Additionally, this group had the opportunity to use the mobile devices to search for information and compare their own results with bibliographic pages recommended by the teacher. For the learning and evaluation via *Kahoot!*, the developed work plan was as follows:

- *Kahoot!* questionaries were done every day at the beginning of the lessons for reviewing the practices carried out on the previous day. The total number of experiments in this subject was 8 (30h / 6 days).
- The teachers designed several multiple-choice questionnaires (four possibilities or true/false choice) related to the rationale, the methodology and the calculations of each laboratory practice in the Experimental Chemistry I subject. The number of

questions was between 8 and 10. Duration of each question was between 30-90 seconds, which depended on the difficulty.

- Day by day, the students accessed the questionnaire with their own mobile devices and selected the corresponding quiz through a code provided by the teacher. Later, they logged in with their names/last names. When all the students were registered in the virtual game, the teacher projected the questions in the blackboard with the help of a projector.
- Once the time for each question was over, the correct answer was shown, and students got points if they have chosen the right option. The faster you answered correctly, the more score you received.
- Next, the teacher briefly debated with the students each question and gave them a short feedback.
- Once the test is finished, each student receives on their mobile device the number of right and wrong answers and the position in the ranking according to the rest of participants. In parallel with that, the application creates an Excel file with an accurate summary of the questionnaire for each student.

To verify if *Kahoot!* contributed positively to learning outcomes, a partial test (10 questions with four options) was done by the three groups of students at the end of the experimental laboratory lessons.

4. Results and Discussion

The use of *Kahoot!* allows teachers to get immediate feedback on the students progress and correct concepts that were not clear much faster than if the teacher did not use this methodology or applied a traditional one. At the same time, when the *Kahoot!* game finishes, the students receive their scores and allow them to identify the strengths and weaknesses points to prepare properly for the final exam. The results of a partial exam and the subject final score were compared between Group 1 (*Kahoot!* was not used; students did not know about the final partial exam), Group 2 (*Kahoot!* was not applied; students knew about a final partial exam) and Group 3 (*Kahoot!* was used daily; students knew about a final partial exam) in order to assess the evolution of the students' academic performance. Likewise, an evaluation of the students' final grades for the subject has been checked. It should be clarified that the partial and final theoric exam in both groups were rather similar in terms of topic and difficulty of the proposed questions. As can be observed in **Figure 1**, students' overall scores were the highest in Group 3 in which *Kahoot!* questionnaires were employed, and they were also more prevalent among students who had achieved a better *Kahoot!* performance. Conversely, the scores were significantly better in Group 2 than Group 1 in which difference between them is the knowledge (Group 2) or not (Group 1) of the final partial exam at the end of the practices. The average of the scores

obtained in all cases were 3.3, 4.3 and 7.0 for Group 1, 2 and 3, respectively. The difference could be explained by the knowledge about the final exam (Group 1 vs Group 2), and/or the use of BYOD model and *Kahoot!* quizzes (Group 3 vs Group 1/2) for learning and assimilation of concepts.

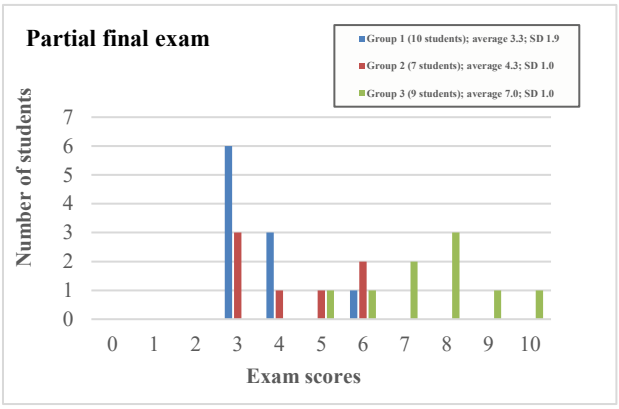

Figure 1. Comparison of the partial exam results of three groups of students.

The results can not be extrapolated to the final subject grade, as it is indicated in **Figure 2**, in which in Group 3 the average score is maintained but not for the case of the other two groups. This might be explained due to the fact that the results of gamification were shown in the short term and that the final exam took place one month after the laboratory practices.

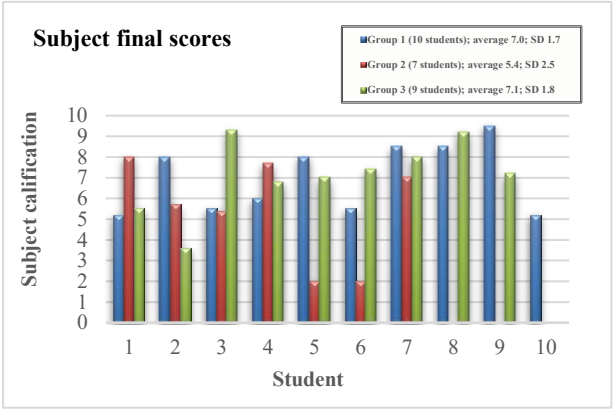

Figure 2. Comparison of the subject scores of three groups of students.

5. Evaluation by participants

At the end of the academic course, a satisfaction survey was carried out among the students of Group 3 to know their opinion regarding the methodology and the *Kahoot!* Application (see **Figure 3**). The most valued characteristics were that 100% of students: i) Thought Kahoot! application has been useful because its use had a positive impact on their learning; ii) Recommended to other teachers the use of *Kahoot!* application; iii) Considered *Kahoot!* breaks the routine dynamics of the conventional classes.

The only slight downside remarked by the students was the available time for answering the questions.

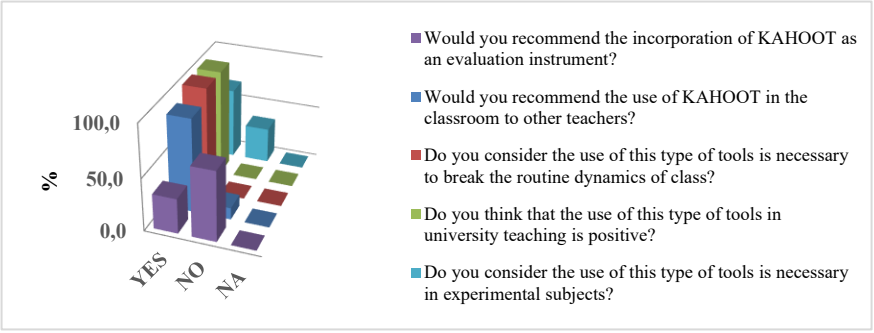

Figure 3. Comparison of the subject scores of three groups of students.

Among the most relevant findings, it could be stated that the degree of satisfaction with the application was high or medium-high for 100% of students. The 38% of students showed a degree of satisfaction high or medium-high with the procedure used to assimilate concepts and in learning the theoretical subject. Impressively, 100% of them considered that the use of the questionnaries via *Kahoot!* has helped them to get better results on the final test exam. Regardless of that, *Kahoot!* has vertiginously increased competition between students for 25%. Finally, yet importantly, all the teachers involved in the innovation activity considered that BYOD methodology raised the attention and motivation of the students, and it has helped to make classes more interactive as well as collaborative.

6. Proposal for the future

During the next academic course, the use of *Kahoot!* tool will be carried out together with the use of audiovisual material about theoretical-experimental aspects which will be provided to the students before starting the laboratory lessons. Still further, the main project goal will involve all the students of the subject (around 40 students) and arouse their motivation and desire to continue studying and improving their performance in the experimental subject.

7. Conclusions

The use of BYOD model using gamification in an experimental subject of the Degree in Chemistry, has had a significant and positive impact for the students. The results obtained in this teaching innovation project confirmed that the *Kahoot!* application was a valid and effective tool for evaluation processes continuous as it provides better academic results. This fact has been demonstrated comparing student groups using or not gamification during the experimental lessons. The degree of student satisfaction with the methodology used was medium-high (50%) or high (50%) and 100% of students considered positive *Kahoot!* application for their learning. Hence, it may be concluded that the objetives and hypotheses proposed were successfully achieved and verified. Be that as it may, it is pivotal to extend and obtain an exhaustive research with more students involved.

Acknowledgements

Authors gratefully acknowledge funding to the University of Valladolid, Training and Innovation Teaching Area (Project Nº 11).

References

Ali, G., Mbabazi, B. P., , Lawrence, N., Geoffrey, A. (2017). Use of mobile devices by students to support learning in universities: a case of muni university. *International Journal of Research in Engineering & Technology*, 5(6), 69-80.

Ares, A.M, Bernal, J., Nozal, M. J., Sánchez, F.J, Bernal, José. (2018). Results of the use of Kahoot! Gamification tool in a course of Chemistry. *4th International Conference on Higher Education Advances (HEAd'18)*, 1215-1222. doi: 10.4995/HEAd18.2018.8179

Carneiro, R., Toscano, J.C., & Díaz, T. (2009). Los desafíos de las TIC para el cambio educativo. Madrid: Organización de Estados Iberoamericanos para la Educación, la Ciencia y la Cultura, OEI, Servicio de Publicaciones.

Gros, B., & Contreras, D. (2006). La alfabetización digital y el desarrollo de competencias ciudadanas. *Revista Iberoamericana de Educación*, 42, 103-126.

Hussein, B. A. (2015). A blended learning approach to teaching Project management: A model for active participation and involvement: Insights from Norway. *Education Sciences*, 5(2), 104-125.

Murillo-Zamorano, L. R., López Sánchez, J. A., Godoy-Caballero, A. L., Bueno Muñoz, C. (2021). Gamification and active learning in higher education: is it possible to match digital society, academia and students' interests?. *International Journal of Education Technology High Education*, (18:15), 1-27. https://doi.org/10.1186/s41239-021-00249-y

Ng, W. & Nicholas, H. (2013). A framework for sustainable mobile learning in schools. *British Journal of Educational Technology*, 44, 695-715.

Rodríguez-Fernández, L. (2017). Smartphones y aprendizaje: el uso de Kahoot en el aula universitaria. *Mediterranean Journal of Communication*, 8(1), 181-190.

Umezu, Ch., Onwodi, G. (2015). Bring Your Own Device in Education: A Review of Challenges. *International Journal of Innovative Science, Engineering & Technology – JISET*, 2(9), 351-354.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14656

Using error analysis sheets to improve learning in higher education

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Abstract

We developed and evaluated the effectiveness of a new teaching strategy aimed at improving students' learning in a Research Design degree module with high mathematical content. The strategy involves presenting students with case studies based on published research and a set of questions to answer, following which they are given error analysis sheets detailing the correct answer for each question, the most common incorrect answers, and an explanation of why these answers are wrong. These sheets were created based on students' answers to the case-study questions and were used with the aim of helping them learn from their mistakes. A high proportion of students perceived the error analysis sheets to have been useful for improving their learning and understanding, and this was especially the case for those with a higher level of math anxiety. In addition, students' final grades were positively related to their attendance at classes in which error analysis sheets were used.

Keywords: *Academic achievement; Higher education; Error analysis sheet; Math anxiety.*

1. Introduction

Many students find subjects with mathematical content difficult, and hence it is essential to develop innovative ways of supporting their learning (Núñez-Peña et al., 2013a; Núñez-Peña et al., 2015). Indeed, it is important not only to increase students' motivation and interest for these subjects (Garfield, 1995) but also to help them approach assessment or examinations with confidence (Nagi et al., 2010). By doing so, students will be more likely to acquire a good level of knowledge and skill and be able to demonstrate what they have learned. Given that emotional factors also play a role in the learning process (Cassady, 2010; Núñez-Peña & Bono, 2019; Thomas et al., 2017), it is important, in the case of subjects with mathematical content, to consider the possible impact of math anxiety. Math anxiety is defined as feelings of tension and apprehension that interfere with the ordinary manipulation of numbers and the solving of mathematical problems (Ashcraft & Faust, 1994). It has been observed among students from elementary school through to higher education (Beilock & Willingham, 2014), and it negatively affects academic achievement in subjects involving mathematics (Ashcraft & Krause 2007; Zhang et al., 2019).

In this study we describe a new teaching strategy implemented in the context of a psychology degree module with mathematical content: *Research Design*. The strategy involved: 1) producing a series of case studies based on published research in different areas of psychology (clinical, educational, social, etc.), 2) devising questions for each case study that students had to answer, and 3) creating an error analysis sheet for each case study based on students' answers to the questions. The case studies were chosen to reflect the syllabus of the Research Design module and also addressed topics that students had encountered in other course modules. Error analysis sheets detailed the correct answer for each question, the most common incorrect answers given by students, and an explanation of why these answers were wrong. The goal of this new teaching strategy was to help students analyze and learn from their own mistakes, and ultimately to become more confident in the subject. This would, we hoped, allow them to feel better prepared and to approach assessment with more confidence and less anxiety. Our expectation was that error analysis sheets would be particularly useful for highly math-anxious students.

The effectiveness of this new teaching strategy was evaluated by exploring students' perceptions regarding the extent to which the use of error analysis sheets had helped to improve their learning and understanding. We also examined the relationship between math anxiety and the perceived usefulness of error analysis sheets.

2. Method

2.1. Participants

Participants were 66 students (68.9% female, 31.1% male; age range 19-56 years) who were enrolled during the 2018-2019 academic year in the Research Design module of the Degree in Psychology offered by the University of Barcelona. All students signed informed consent before participating.

2.2. Material

Case studies. Eight case studies were created based on studies published in different areas of psychology. Research papers were summarized and adapted to the syllabus requirements of the Research Design module. A database was also simulated for each case study so that the results of the original studies could be reproduced. Therefore, each case study included a summary of the original research, a database, and a series of questions for students to answer. This material is available in the OMADO collection, the University of Barcelona's digital repository of teaching materials.

Error analysis sheets. During the 2018-2019 academic year, students enrolled in the Research Design module were presented with the case studies and asked to answer the corresponding questions during a practical class. They also had to send their answers to teaching staff via one of the university's digital platforms (Virtual Campus or Learning Management System). Teachers reviewed students' answers for each case study and drew up the corresponding error analysis sheet showing the correct answer, the most common incorrect answers, and an explanation of why these answers were wrong.

Questionnaire to assess the usefulness of error analysis sheets. A questionnaire was developed ad hoc to evaluate the perceived usefulness of error analysis sheets. The seven items, each rated on a Likert-type scale from 1 (totally agree) to 5 (totally disagree), were as follows: (1) Error sheet classes have helped me to learn the subject, (2) Error sheet classes have improved my learning, (3) Error sheet classes have given me a better understanding of the assessment criteria, (4) Error sheet classes have allowed me to self-assess, (5) Error sheet classes have helped me to feel less anxious when preparing for exams, (6) In general, I think the error sheet classes have been very useful, and (7) I would like there to be error sheet classes for all the degree modules.

This questionnaire also recorded students' frequency of attendance at different types of classes (theory, practical, and those involving error analysis sheets).

Shortened Math Anxiety Rating Scale, sMARS (Spanish version by Núñez-Peña et al., 2013b). The sMARS comprises 25 items, each of which describes a situation that may generate math anxiety (e.g., "Entering a math class"). For each item, respondents indicate using a 5-point

Likert-type scale (1, no anxiety; 5, a lot of anxiety) how much anxiety they would feel in that situation. The sMARS includes three scales: math test anxiety (score range: 15-75), numerical test anxiety (score range: 5-25), and math course anxiety (score range: 5-25).

Assessment for the Research Design module. At the end of the module, students were given a test comprising 15 theory/practice questions.

2.3. Procedure

During the 2018-2019 academic year the case studies were used in conjunction with the error analysis sheets in teaching the Research Design module. Each week, students were given one of the case studies and asked to answer the associated questions. In the following class they were given the corresponding error analysis sheet, thus providing them with feedback on their performance and giving them the opportunity to learn from their mistakes (hereinafter, error sheet classes). At the beginning of the Research Design module, all students completed the sMARS in their usual classroom setting; one of the researchers was present to answer any queries and to ensure that their responses were individual. At the end of the module, students were asked to complete the questionnaire about the perceived usefulness of error analysis sheets and their frequency of attendance at different types of classes. They also sat the 15-question exam to assess their learning.

3. Results

The proportion of students who always or regularly attended the different types of classes was 97% for theory classes, 97% for practical classes, and 92.4% for error sheet classes. As regards the perceived usefulness of error sheet classes, over 80% of students agreed or strongly agreed that these classes had helped them to learn the subject, to improve their learning, to understand the assessment criteria, and to self-assess.

We then calculated Spearman correlations between responses to the items exploring the perceived usefulness of error sheet classes and scores on the sMARS (math anxiety). Responses to item 3 ("Error sheet classes have given me a better understanding of the assessment criteria") were positively correlated with sMARS total scores (r = .299, p = .030) and with scores on its math test anxiety (r = .287, p = .037) and math course anxiety scales (r = .382, p = .005). A positive correlation was also observed between responses to item 6 ("In general, I think the error sheet classes have been very useful") and scores on math course anxiety (r = .287, p = .037). There were no correlations between responses to any of the remaining items and scores on the sMARS.

Finally, students' exam grades were positively related to their frequency of attendance at theory (r = .273, p = .029), practical (r = .257, p = .040), and error sheet classes (r = .347, p = .005).

4. Conclusion

Our primary aim in this study was to develop a new approach to teaching a Research Design module with high mathematical content. This involved presenting students with case studies based on published research and a set of accompanying questions to answer, following which they were given an error analysis sheet. After implementing this approach, we explored students' perceptions regarding the extent to which the use of error analysis sheets had enhanced their learning. We also examined the relationship between the perceived usefulness of error analysis sheets and math anxiety.

A high proportion of students considered that the error sheet classes had helped them to learn the subject, to improve their learning, to understand the assessment criteria, and to self-assess, indicating satisfaction with this new approach. Importantly, students' final grades were associated not only with their attendance at theory and practical classes but also, and more strongly, with their attendance at error sheet classes. Previous studies have shown the usefulness of providing students with tools that can help them to feel better prepared and more self-confident when it comes to assessment. For instance, Bono and Núñez-Peña (2019) and Nuñez-Peña et al. (2015) demonstrated the effectiveness of a formative assessment system based on feedback and rubrics in improving the performance of undergraduates.

As for the relationship between the perceived usefulness of error analysis sheets and math anxiety, students with higher levels of math anxiety were those who considered that the error sheet classes had been most useful and had given them a better understanding of the assessment criteria. This suggests that the use of error analysis sheets could help highly math-anxious students to gain confidence in their ability to learn subjects of this kind, thereby reducing the negative impact of math anxiety on their performance.

In conclusion, the results suggest that this new teaching strategy based on the use of error analysis sheets could help to improve students' learning of subjects with high mathematical content, especially in the case of highly math-anxious students. Importantly, students' final grades were positively related to their attendance at error sheet classes.

Acknowledgements

This research was supported by the Consolidated Group for Innovation in Teaching GINDOC-UB/099 at the University of Barcelona and by grants 2017PID-UB/01 from the University of Barcelona and PSI2015-69915-R (MINECO/FEDER) from the Spanish Ministry of Economy and Competitiveness and the European Regional Development Fund.

References

Ashcraft, M. H., & Faust, M. W. (1994). Mathematics anxiety and mental arithmetic performance: An exploratory investigation. *Cognition and Emotion, 8*, 97-125.

Ashcraft, M. H., & Krause, J. A. (2007). Working memory, math performance, and math anxiety. *Psychonomic Bulletin and Review, 14*(2), 243–248. https://doi.org/10.3758/bf03194059.

Beilock, S. L., & Willingham, D. T. (2014). Math anxiety: Can teachers help students reduce it? *American Educator*, *38*(2), 28–32.

Bono, R., & Núñez-Peña, M. I. (2019). Rubrics and in-class feedback on a higher education course with statistical content. *REIRE Revista d'Innovació i Recerca en Educació, 12*(1), 1-14. https://doi.org/10.1344/reire2019.12.122560.

Cassady, J. C. (2010). *Anxiety in schools. The causes, consequences, and solutions for academic anxieties.* New York: Peter Lang Publishing.

Garfield, J. (1995). How students learn statistics. *International Statistical Review, 63*, 25- 34.

Nagi, G., Watt, H. M. G., & Eccles, J. S. (2010). The development of students' mathematics self-concept in relation to gender: Different countries, different trajectories? *Journal of Research on Adolescence, 20*(2), 482–506. https://doi.org/10.1111/j.1532-7795.2010.00644.x.

Núñez-Peña, M.I. & Bono, R. (2019). Academic anxieties: Which factor contributes the most to low academic achievement in methodological courses? *Educational Psychology, 39*(6), 797-814. http://doi.org/10.1080/01443410.2019.1582756.

Núñez-Peña, M. I., Bono, R., & Suárez-Pellicioni, M. (2015). Feedback on students' performance: A possible way of reducing the negative effect of math anxiety in higher education. *International Journal of Educational Research*, 70, 80-87. http://dx.doi.org/10.1016/j.ijer.2015.02.005.

Núñez-Peña, M. I., Suárez-Pellicioni, M., & Bono, R. (2013a). Effects of math anxiety on student success in higher education. *International Journal of Educational Research, 58*, 36-43. http://dx.doi.org/10.1016/j.ijer.2012.12.004.

Núñez-Peña, M. I., Suárez-Pellicioni, M., Guilera, G., & Mercadé-Carranza, C. (2013b). A Spanish version of the short Mathematics Anxiety Rating Scale (sMARS). *Learning and Individual Differences, 24*, 204 -210. http://dx.doi.org/10.1016/j.lindif.2012.12.009

Thomas, C. L., Cassady, J. C., & Heller, M. L. (2017). The influence of emotional intelligence, cognitive test anxiety, and coping strategies on undergraduate academic performance. *Learning and Individual Differences, 55*, 40-48. https://doi.org/10.1016/j.lindif.2017.03.001.

Zhang, J., Zhao, N., Kong, Q. P. (2019). The relationship between math anxiety and math performance: A meta-analytic investigation. *Frontiers in Psychology, 10*, Article 1613. https://www.frontiersin.org/article/10.3389/fpsyg.2019.01613

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14428

Reaching out through the MOOC Introduction to Calculus

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Abstract

The MOOC Introduction to Calculus was launched in December 2018, in time for students, in transition from school, to use for satisfying mathematics prerequisites for tertiary-level degrees. The MOOC was conceived holistically, contributing towards improving diversity and inclusion, creating opportunities for participants throughout the world, including those from regions suffering from political or economic instability. The MOOC facilitates pathways towards higher education through greater awareness of mathematics and its usefulness. This became acutely relevant for students facing disruptions from COVID-19 and forced into remote learning. Historical narratives permeate the MOOC, providing students with perspectives that they might not see in typical classrooms or textbooks. The MOOC alleviates frustration from students who have difficulty navigating online material or who have had negative experiences in learning mathematics. It uses a mastery model of learning and was designed using principles from the theory of threshold concepts and learning phases in the SOLO taxonomy.

Keywords: *MOOC; calculus; mastery learning; threshold concepts; SOLO taxonomy.*

1. Introduction

This article provides background and a snapshot of progress of a recent initiative by Sydney University, in launching the Massive Open Online Course (MOOC) *Introduction to Calculus,* in December 2018. This course combines flexible online technology with the common language and culture of mathematics and calculus. Course materials are freely available and designed and developed with the intention of promoting inclusion and bringing people together from diverse backgrounds as part of a global community of learners.

This project gained particular importance at the time of the launch, due to the introduction of mathematics prerequisites at Sydney University for certain courses, in science, business and economics, commencing in 2019 (University of Sydney, 2019). The MOOC was especially aimed at providing opportunities for students from disadvantaged backgrounds, from rural or remote areas, or from schools lacking resources or qualified mathematics teachers, to study at the Sydney University from First Semester 2019. Completion of the MOOC has been accepted as equivalent to satisfying mathematics prerequisites for enrolment. This pathway has been taken successfully now by several hundred students, in preparing for enrolments in First or Second Semester in courses at Sydney University, over the period 2019-2022. Processes have been put in place to continue to provide these opportunities to prospective students in future semesters.

The MOOC has been conceived and designed holistically and has had other significant benefits, in particular,

- to help teachers in the secondary and tertiary sectors upgrade their skills and become better qualified to teach calculus and foundational mathematics, and,
- to provide outreach to people of all ages and backgrounds from all over the world.

The MOOC has been adopted widely, even by participants from regions experiencing political or economic turmoil or upheaval (see Table 1). The only technical requirements for participation are reasonable internet access and use of an electronic device that can view videos, view or download notes in pdf format, interact with online multiple-choice quizzes and make posts on threads in the discussion forums. Even though the MOOC is formally constructed as a 'five-week' course (see below), students may work at their own pace, and pick up from where they left off if there is a delay in their participation for any reason.

The MOOC fits neatly within the transition mode from school to tertiary studies. It also reinforces and aids the preparation of students already in the tertiary system, who need mathematics for their chosen area of study but may find entry difficult and mastery of the methods and techniques problematic. The MOOC creates a flexible and collegial online learning environment, lubricating pathways for students through their individual *liminal*

Table 1. MOOC cumulative active learners. Source: (Coursera Analytics, 1 February 2022).

India	31,394	Portugal	273	Mauritius	46
United States	31,043	Tunisia	248	Mongolia	46
Australia	6,532	Hungary	247	Tanzania	44
Philippines	5,727	Ethiopia	246	Yemen	44
Canada	4,983	Somalia	242	Bhutan	44
Pakistan	3,340	Oman	235	Bahamas	41
United Kingdom	3,309	Finland	223	Maldives	38
Nigeria	3,281	Denmark	203	Macao	38
Bangladesh	3,244	Norway	193	Grenada	36
Turkey	2,762	Uzbekistan	189	Luxembourg	36
Egypt	2,605	Austria	180	Slovenia	34
Brazil	2,585	Czech Republic	175	Bosnia	32
Mexico	2,452	Bolivia	174	Angola	30
China	1,992	Jordan	173	Namibia	30
Germany	1,966	Qatar	157	Iceland	29
Indonesia	1,559	Costa Rica	146	Moldova	27
Hong Kong	1,523	Bulgaria	144	Belize	26
Russian Federation	1,423	Guatemala	142	Cote d'Ivoire	24
Singapore	1,398	Kuwait	134	Lesotho	23
Colombia	1,262	Dominican Republic	127	Brunei	23
Thailand	1,136	Venezuala	124	Malawi	22
France	1,030	Georgia	120	Malta	20
Netherlands	1,005	Cambodia	120	Fiji	19
Italy	941	Armenia	116	Liberia	19
Saudi Arabia	912	Panama	115	Senegal	18
United Arab Emirates	904	Trinidad and Tobago	115	Gambia	18
South Africa	899	Serbia	113	Mozambique	17
Taiwan	845	Zambia	108	Papua New Guinea	16
South Korea	821	Estonia	97	Republic of Congo	14
Japan	790	Uganda	97	Madagascar	13
Spain	760	Jamaica	96	Guam	13
Vietnam	756	Kyrgyzstan	89	Swaziland	13
Nepal	731	Honduras	84	Kosova	13
Malaysia	697	Lithuania	83	Tajikistan	12
Ghana	691	Sudan	82	Lao	12
Sri Lanka	612	Libya	77	Mauritania	11
Morocco	598	Croatia	76	Turkmenistan	10
Peru	546	Puerto Rico	75	Montenegro	10
Israel	516	Albania	75	Dominica	8
Kazakhstan	505	Macedonia	73	Cayman Islands	7
Kenya	491	Belarus	72	Antigue and Barbuda	7
Ukraine	487	Bahrain	72	South Sudan	7
Poland	482	Slovakia	70	Bermuda	7
Greece	474	Uruguay	68	Burkina Faso	7
Myanmar	467	Latvia	66	Togo	6
Argentina	440	Paraguay	65	Mali	6
Chile	439	El Salvador	65	Niger	6
Switzerland	405	Botswana	61	Eritrea	5
Guyana	405	Cyprus	58	Cape Verde	5
Azerbaijan	370	Palestinian Territory	56	Tonga	5
New Zealand	365	Afghanistan	55	Saint Kitts and Nevis	5
Romania	339	Saint Lucia	53	Jersey	5
Ireland	337	Rwanda	52	Benin	5
Lebanon	328	Barbados	51	Turks and Caicos Islands	5
Ecuador	315	Nicaragua	50	Vanuatu	5
Sweden	301	Cameroon	50	Burundi	5
Algeria	298	Sierra Leone	50	Aruba	4
Iraq	292	Zimbabwe	49	Sint Maarten	
Belgium	277	Haiti	46	Seychelles	

spaces (in the sense of Cousin, 2006) leading to satisfying experiences and mastery of key *threshold concepts* (in the sense of Meyer and Land, 2003) in foundational mathematics.

2. Background and motivation

The discovery of calculus independently by Newton and Leibniz, in the Seventeenth Century, was one of the most profound and influential human intellectual achievements of all time, setting off chain reactions of scientific progress and developments that continue to accelerate (Sandlands, 2013). Calculus and its ramifications form the backbone of almost all applications of mathematics to physical and biological sciences and engineering (see, for example, Stewart, 2016; Stewart & Day, 2016; Kreyszig *et al.*, 2011; Spivak, 2019; and Courant & Robbins, 1996).

The MOOC explores and develops powerful themes and narratives, emphasising connections and historical contexts or underpinnings, giving participants opportunities to learn in the higher relational and extended abstract phases of the SOLO taxonomy (Biggs & Collis, 1982). The logo (Figure 1) encapsulates the unity and depth of connections as participants move from precalculus (theory of functions) into differential calculus (theory of derivatives). It depicts the graphs of the natural logarithm and exponential functions, which are mutually inverse, obtained from each other by reflection in the diagonal. These have the crucial properties that the tangent lines to both curves at the intercepts with the axes have slope one. These imply that the exponential function to the base e reproduces itself exactly under differentiation, and the derivative of the natural logarithm is the reciprocal function.

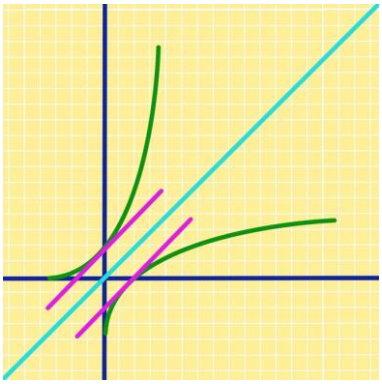

Figure 1. MOOC logo. Source: Timothy Harland.

There is an overwhelming abundance of material on the internet related to elementary calculus and precalculus, so one may ask whether this MOOC might become a superfluous addition to an already cluttered milieu. In fact, the volume of existing material on the internet may be overwhelming to a novice or naïve student, who is unable to tell in advance what

material could be of good or high quality, and then know how to effectively navigate through it. Too much choice can lead to paralysis, and poor choices in navigating the internet can trip people up and even exacerbate phobias or learning difficulties in mathematics.

The MOOC *Introduction to Calculus* however provides an integrated and concise course that encourages depth of learning and guides students to see and experience connections. It looks at calculus from standpoints that may depart considerably from what pupils typically see at school or read in textbooks. A central theme is the way areas and perimeters of regions in the plane are connected by the derivative (in fact the central idea behind the Fundamental Theorem of Calculus), and, stepping up a dimension, also between volumes and surface areas of regions in space. A subtle example discussed in the MOOC, that explores interplay between finite and infinite mathematics, is the melting ice block problem (see Figure 2), predicting how long it takes for an ice block to disappear completely. The rate of melting is proportional to surface area, and the mathematics determines that the width of the ice block diminishes at a constant rate, so indeed it really does disappear after a finite amount of time. If the rate of melting had been proportional to the volume of the cube (analogous to decaying radioactive material) then the mathematics would produce an exponential decay model so that the ice block, though becoming vanishingly small, would never completely disappear (shades of Zeno's Paradox!).

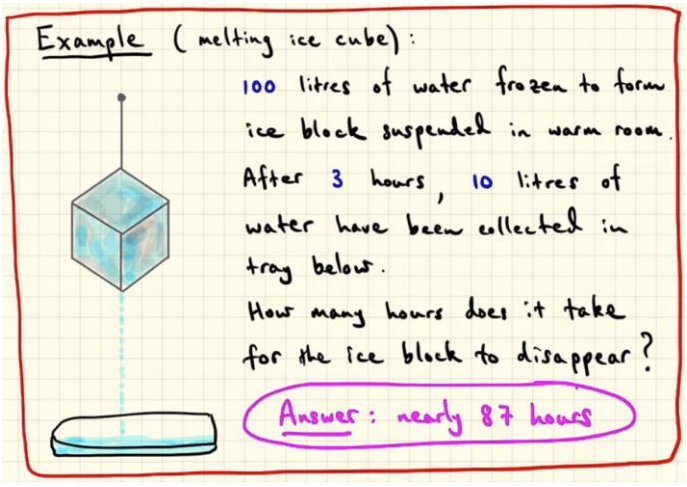

Figure 2. Melting ice cube problem. Source: MOOC Introduction to Calculus.

3. Structure and content

The 'five-week' course repeats indefinitely and is divided into five modules, each of which corresponds nominally to a 'week' of participation and study. These fixed features of the MOOC are glued together by interactive Discussion Forums that enable students to discuss

problems and issues with instructors and other students and to create new threads or respond to existing threads. Participation in the Discussion Forums greatly enhances the learning experience as participants wrestle with and articulate ideas and stumbling blocks in an interactive collegial online environment. Students taking the MOOC

- gain familiarity with key ideas of precalculus, including the manipulation of equations and elementary functions (‘first two weeks’);
- develop fluency with the preliminary methodology of tangents and limits, and the definition of a derivative (‘third week’);
- develop methods of differential calculus with applications (‘fourth week’);
- develop methods of the integral calculus, and see the underlying reasoning behind the Fundamental Theorem of Calculus and original thinking and philosophy of Newton and Leibniz as they explored the origins of calculus (‘fifth week’).

For each module, there is one introductory video and cascades of triplets of materials,

- where each triplet typically comprises one video (sometimes split into two parts), followed by one set of notes, followed by one formative quiz,

finishing with one final summative quiz. The MOOC uses a *mastery learning* model (Bloom, 1968), with the intention that participants use thorough practice and review to move carefully through the *unistructural* and *multistructural phases of learning* in SOLO (Biggs & Collis, 1982), to finally spend time exploring ideas, theories and novel applications in the *relational* and *extended abstract phases*. All multiple-choice quizzes require seventy per cent of answers to be correct, to be regarded as demonstrating a satisfactory passing performance. Students need to pass summative quizzes to progress through the modules, and at the end of the last (fifth) module to be regarded as having completed the MOOC. Multiple attempts are allowed, though each summative quiz may not be attempted more than three times in eight hours. Alternatives for each question are randomised for each attempt. The MOOC develops mathematical writing and communication skills, by participation in the Discussion Forums, which permeate the MOOC, of which there are now thousands of archived threads, attracting contributors on a daily basis.

4. Demographics

At time of writing there have been over 145,000 enrolments, of which over 90,000 are active, completing assessment tasks, with over 12,200 completions. Of the active participants, there is a 70% male to 28% female split. There are significant numbers of teenagers taking the MOOC, even as young as 13-17, which relates to the need for improving pathways from secondary to tertiary mathematics. There are significant numbers of older participants, related

to the use made by teachers to upgrade their skills in imparting calculus to their own students, but also to people in retirement. It is important and beneficial to the community and society that awareness of mathematics is valued by people of all ages. The largest proportion of participants reside in North America, though there are significant proportions from Asia, Europe, Africa, South America and Oceania (see Table 1). Trends in daily and monthly active learners, since May 2019, can be viewed from Figure 3, and the peaks and troughs correlate roughly with the huge waves of infections from COVID-19 and its variants, since early 2020, and imperatives for many educational institutions to use remote learning.

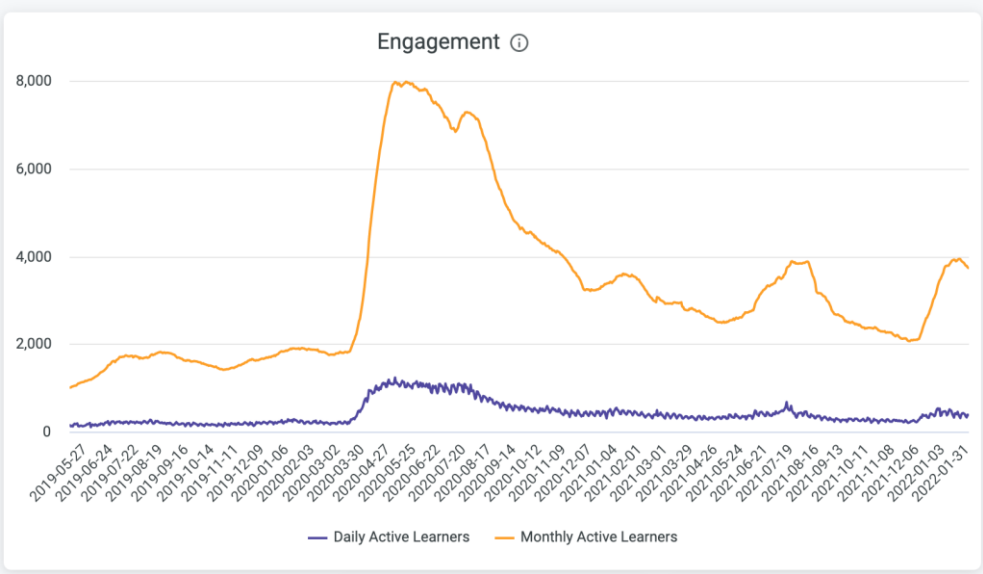

Figure 3. Daily and monthly active learners. Source: Coursera Analytics (1 February 2022).

5. Feedback

At time of writing there have been 2,721 ratings for an average of 4.8/5. Since the launch of the MOOC there have been 837 reviews and 157 learner stories received as well as thousands of comments in the Discussion Forums and through feedback mechanisms related to course development and improvement. The reviews may be read from the following link:

https://www.coursera.org/learn/introduction-to-calculus

Almost all of the comments have been highly positive and constructive. Occasionally there are comments asking for the inclusion of more involved topics or difficult exercises, or for advice or recommendations about continuations in mathematics. It is especially gratifying to hear of teachers who find the materials useful in their own professional development, leading

to improvements in passing on the knowledge and understanding to their own students, and also from students who had previously struggled with mathematics but found the MOOC liberating or revelatory or useful in their academic pathways and professions.

6. Conclusion

The MOOC *Introduction to* Calculus, launched in December 2018, fulfilled an immediate and urgent imperative for an alternative pathway for students who had not studied calculus at school but needed appropriate mathematics prerequisites to enrol in courses at Sydney University from 2019. The MOOC however had been conceived and constructed more broadly and holistically, and emphasises important themes and ideas in mathematics and their historical context and underpinnings. It therefore appeals to a very wide audience, including teachers and other professionals needing to upgrade their skills, and people of all ages throughout the world, who may be simply curious about mathematics and one of the greatest intellectual feats of humanity, the creation of calculus.

References

Biggs, J. B. & Collis, K.F. (1982). *Evaluating the Quality of Learning: The SOLO Taxonomy*. New York: Academic Press.

Bloom, B. S. (1968). Learning for Mastery. *Instruction and Curriculum.* Regional Education Laboratory for the Carolinas and Virginia, Topical Papers and Reprints, Number 1.

Courant, R. & Robbins, H. (1996). *What is Mathematics?* Second Edition, revised by Ian Stewart. Oxford University Press. New York.

Cousin, G. (2006). An introduction to threshold concepts. *Planet* (17). Higher Education Academy. [online: https://www.tandfonline.com/doi/full/10.11120/plan.2006.00170004, 01/02/2022].

Kreyszig, E., Kreyszig, H & Normington, E.J. (2011). *Advanced Engineering Mathematics.* John Wiley. Hoboken, New Jersey.

Meyer, J.H.F. & Land, R. (2003). Threshold concepts and troublesome knowledge (1): linkages to ways of thinking and practising, in Rust, C. (ed.), *Improving Student Learning — ten years on.* Oxford: OCSLD.

Sandlands, R. (2013). *Mathematics. Trust me. It's important in your life.* ABC Science. Australian Broadcasting Commission. [online: https://www.abc.net.au/science/articles/2013/01/23/3674843.htm, accessed 01/02/2022].

Spivak, M. (2006). *Calculus.* Corrected Third Edition. Cambridge University Press. Cambridge, UK.

Stewart, J. (2016). *Calculus.* Eighth Edition. Cengage Learning. Australia, Brazil, Mexico, Singapore, United Kingdom, United States.

Stewart, J. and Day, T. (2016). *Biocalculus: calculus, probability and statistics for the life sciences.* Cengage Learning. Boston, MA, United States.

University of Sydney (2019). Mathematics course prerequisites. All you need to know about our mathematics prerequisites. University of Sydney. [online: https://sydney.edu.au/study/how-to-apply/undergraduate/mathematics-prerequisite.html, accessed 01/02/2022].

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14197

Online team working with emerging technologies in a university math class

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Abstract

This work presents a new approach devoted to recreating a team working situation in a STEAM university mathematics class by using Engageli, an e-learning platform for real-time online higher education courses. A particular experience is considered, in order to understand the core tenets to construct a fruitful online group activity in mathematics. The success of such an activity depends on both the usage of an intuitive software user-friendly and the creation of suitable and stimulating learning paths. The analysis is based on the well-known SWOT analysis concerning the students' comments, integrated by the answers of four multiple choice questions and the analytics provided by Engageli. The outcome of the work suggests that the online experience has potential, but further improvements are needed.

Keywords: *team working; math class; emerging technologies; STEAM courses.*

1. Introduction and theoretical background

Active learning methodology allows students achieve higher conceptual understanding compared to other students, who study the same courses according to the traditional learning approach (Pundak et al., 2010). The main reason is that student-directed instruction favors the development of conceptual knowledge (Gamer & Gamer, 2001). In particular, group working activities improve many educational aspects such as students' involvement, development of cooperation and collaborative qualities, meaningful learning, and achievements in conceptual and quantitative tests (Pundak et al., 2010). However, some studies (e.g., Andrà et al., 2020a) show that, in mathematics, a good performance with groups is all but easy to foster, because self-confidence and confidence-in-peers are fundamental in the group dynamics and in the task understanding.

Moreover, instructors resort online resources for their teaching inside and outside the classroom, to place the student in the central role of the learning process. Such a trend is rooted in the continuous spreading of technology on the educational field: from online resources that students can obtain in a few clicks almost on every topic, to the e-learning platforms, and the relatively new Massive Open Online Courses (MOOCs) (Andrà et al., 2020b). Despite many e-learning platforms provide collaborative activities, e.g., Persuall (https://perusall.com/), the way promoting group work online is still an open issue in educational field because it depends, for instance, on the learners (van de Sande, 2011).

Nevertheless, such a need, that was quite limited in the past, became more and more relevant in the last two years when the remote teaching was the predominant educational format. Technology provides the technical way to reach students in synchronously, thanks to web-conference platforms. However, many teachers migrate online turning student-centered lessons into teacher-centered (Brunetto et al., 2021).

This paper concerns the designing, setting and delivering group work activities through web-conference platforms, focusing on the students' perspective and feedback.

To that end, our theoretical background is based mainly on the "SWOT Analysis", that stands for 'strengths', 'weakness', 'opportunities' and 'threats' analysis. This tool is usually used for strategic planning and strategic management in organizations (Gürel and Tat, 2017). Although such analysis is strongly related to business field, we adapt its four components to the educational field, because understanding a 'story' involves evaluating the strengths, weaknesses, opportunities, and threats (Gürel and Tat, 2017). Therefore, we adapt the four SWOT components to the educational field. More precisely, we consider the lesson delivered remotely as an 'experience', composed of several elements, such as the task, the interactions and the platforms. In our context, *strength "S"* and *opportunity "O"* are positive components of the experience itself and its elements, which are related to a characteristics and condition of an element that add value "S" and are more advantageous

"O" compared to something else. Whilst *weakness "W"* and *threats "T"* are negative components, that concern to elements that remove value "W" and jeopardize "T" the experience (Gürel and Tat, 2017).

2. Research methods

In this work, data was collected during the university first year course named "Elements of Mathematics" that involves linear algebra and calculus. The whole course is a one-semester long mathematics course (September-December) devoted to Architecture students. The total number of students enrolled is about 164, with 65% of female students. The course is 14 weeks long and split in two equal parts according to the topics (*Linear Algebra* and *Calculus*). The students attended 3hrs of lectures delivered online, and 3hrs of tutoring/exercises delivered in presence and streamed online. The institutional web-conference platform is Cisco-WebEx meetings (https://www.webex.com/), integrated within the LMS of the university. The structure of the course and the web-conference platform are the same as the previous year, but this academic year (2021/22) instructors explored one of the newest platforms, called *Engageli* (https://www.engageli.com/), with the cooperation of Engageli developers, who are interested in improving the platform taking into account the opinions of both students and instructors.

Figure 1. Engageli's layout in tables mode (on the left) and the classical layout of almost all online platforms with windows of share cameras (on the right). Source: by Engageli.

Engageli is an online software launched at the end of 2020, which proposes a e-learning platform for real-time online courses (Adams, 2020). The most important feature that differentiates Engageli from others web-conference platforms is certainly the function "*tables*". Even if the classical online platforms have a function that allows a breakout groups, with Engageli such a division seems more likely to a face-to-face classroom experience (see Figure 1). Indeed, during the session, the instructor could keep blocked such a division choosing to speak to the all audience or just dropping to one table (typically with a size of at most ten attendants) coordinating the work according to the needs of the specific group. Since practically most of the used online platforms tend to be optimized for one-to-many lectures, Engageli seems to be of particular interest, especially for delivering online group work activities.

This led us to formulate the following research questions: *To what extent Engageli allows students to collaborate in online math classes?*

2.1. Data gathering

Our pilot study is based on a learning experience delivered in December 2021 and described in detail in the next section. Students were informed by email about the experimental use of the new web-conference platform (Engageli) and the need of collect their feedback about the whole learning experience. Their feedback was collected at the end of the lesson by Socrative (https://www.socrative.com/).

The recorded lesson and the analytics provided by Engageli are part of data. The class was attended online by 63 students. The survey contained four multiple choice questions (reported below) answered by around 45 students, and the open question "*leave a comment about the activity on the Engageli platform"* was replied by 35 students.

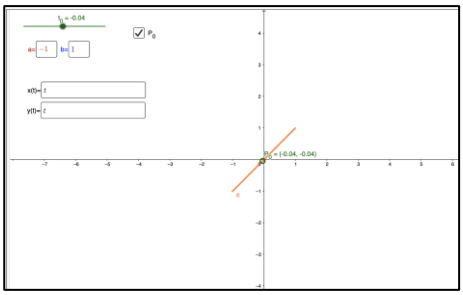
2.2. The learning experience

The learning experience proposed was about *Parametric Equations*. This topic is a novelty for the most majority of the students of the course. Parametric equations are another way to represent geometrical object, such as lines, functions, and curves, with respect the first approach based on the Cartesian form. In this new formalization, we exploit a variable (called "parameter"), which represents a sort of "time" describing the evolution of the figure on the plane (but also on the three-dimensional space). For instance, the Cartesian equation of a circumference is $x^2 + y^2 = 1$, while a possible parametric form (the parametrization is not unique) is given by following expression:

$$\begin{cases} x(t) = \cos(t) \\ y(t) = \sin(t) \end{cases} \text{ with } t \in [0,2\pi].$$

In the previous years, this topic was taught as a frontal lecture, but for this AY (20/21) the experience was designed according to the "optimal experience" principles (Liljedahl, 2020): 1) clear goals every step of the way, 2) immediate feedback on one's actions, and 3) a balance between the ability of the doer and the challenge of the task. We use the fact that such a subject is not so studied before, and it is possible to formulate more challenging tasks, which could require the cooperation between the students to solve the problems. Moreover, this topic has both a computational part and a conceptual part. The latter can be developed by using also interactive software as GeoGebra (https://www.geogebra.org/), thanks to which the students can try to understand the dynamics of parametric equation by comparing the graphical results and adjusting them by keeping in mind the suggestions of their colleagues.

For the sake of clarity, we report in Figure 2 the first task (out of three) of the experience, as shown it involves the usage of GeoGebra.



Set in [the predesigned] GeoGebra's layout the following equations:

$$\begin{cases} x(t) = 2\cos(t) - 1 \\ y(t) = \quad 1 - \cos(t) \end{cases} \qquad \text{with } t \in [0, \pi].$$

Then, address the following questions:

1) What kind of geometrical object do you get?
2) What are its extremes?
3) How much does such a geometrical object measure?
4) For which value of t_0 *do we get the point* $P_0 = (-1,1)$*?*

Figure 2. GeoGebra's layout with the parameter settings on the left. Source: by authors.

3. Data analysis and results

The *Engageli analytics* report the number of interactions (in terms of chat messages) between the participants, distinguishing between the number of messages sent to the instructors and within tables. There were 63 participants to the lecture and 37 messages within tables and 1 message toward the instructors. The data show that there could be the potential to provide a cooperative learning activity based on the collaboration between the students. However, we see in the following lines that this number of interactions is revealed to be still not sufficient for an optimal experience.

The analysis of students' feedbacks is summarized in Table 1, where we report the number of comments that belongs to the four SWOT components (a comment may contain statements concerning all the four components). Nevertheless, some comments do not contain useful information (e.g., "nothing to say").

Table 1. Summary SWOT scheme of students' outcomes.

Strengths	Weaknesses	Opportunities	Threats
8	**9**	**6**	**6**
5	**8**	**5**	**9**

Source: by authors.

For instance, the comment C1 “it is interesting because allows mates to collaborate for solving the task” is labeled as “S” and “O” because the student recognizes positive value to the platform Engageli and the condition in which can be used. On the other hand, the comment C2 highlights “W” and “T”: “quite complicated and ‘unstable’ on the web-browser. I do not think it offers more option with respect the usual lesson on WebEx that is more intuitive and stable”. Indeed, the comment refers on two elements of the experience: the student does not recognize a value of the task (‘usual lesson’) and the tool (‘unstable’) is negative compared with the usual platform. Moreover, the following comment C3 contains “S”, “O” and “T”: “the platform is based on the strong idea to interact and discuss with mates, but I prefer WebEx for the usual lesson”, the student recognizes the positive value of the platform for the group work activity, but the threat rises when the lesson is the usual. We think that such preference can be explained by the comment C4 concerning “O” and “W”: “I don’t like the experience due to technical problems, the idea is good, but the platform is less user-friendly".

To dig deeper into this aspect, we focus on the responses to multiple choice questions. Figure 3 shows the students’ feedback about the platform. Most of them perceived this web-based platform as not user-friendly because of the technical issues during the lesson. Analyzing the records of the lecture, we figure out that there were two main problems: 1) audio issues, and 2) internet connection, revealing that the problems do not depend on the platform itself.

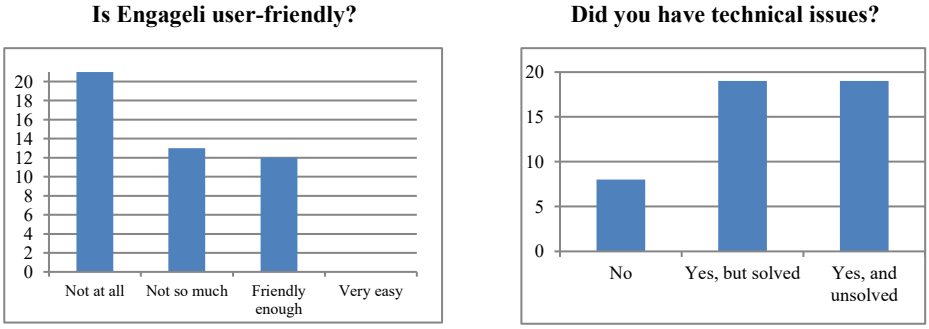


Figure 3. Histograms providing the number of students selecting the corresponding answer. Source: by authors.

Moving back to the whole experience, students’ responses (see Figure 4) show that the majority did not have an optimal experience due to the lack of interactions, as the comment C5 witness: “the experience was interesting, but I did [the task] by myself due to technical problems”. This student highlighted an opportunity “O” that is threated by the audio issues “T”. On the other hand, some students liked the experience because they interacted with mate, as proved by the message within the tables.

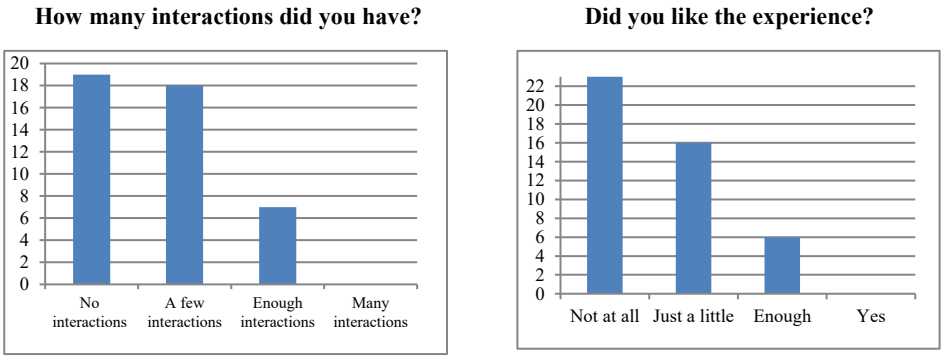


Figure 4. Histograms providing the number of students selecting the corresponding answer. Source: by authors.

4. Discussion and conclusions

This pilot study aims to prove the specific possibility to construct a suitable team-working activity for mathematical contents by using emerging technologies. The preliminary results highlight some technical difficulties that still occur despite almost two years of remote learning ("W" and "T"). Clearly, these difficulties, which are due to both the usage of a new platform and the typical technical issues of the online lectures (as the internet connection and the older computer hardware), contribute to limit the learning experience. However, beyond the technical difficulties, a good experience is allowed also for math classes, where the use innovative learning methodologies is still much less used. Despite Engageli has the strength and the opportunity to emulate online the in-presence class characteristic, instructors must not be mistaken that anything changes, because the medium is changing. Such a change brings the weakness due to the difficulties linked to the usage of a new software and the threat regarding the low-quality internet connection and the lack of hardware requirements. It is important to notice that many of the insights presented in this work can be translated to other online activities that has intrinsically most of the characteristics analyzed.

The case study presented in this work is based on a typical teacher-centered activity, redesigned (and not just migrated) to exploit the platform strength and opportunities ("S" and "O"). The data can be interpreted in terms of "instrumental genesis" (Béguin & Rabardel, 2000). The SWOT analysis allows to identify the two dimensions of the "instrumentalization" (potentialities and constrains) of the artefact, that is both the platform and the task. Moreover, the analysis shed a light on the "utilization scheme" by observing how students interact and how they feel in the use of the platform. We observed the first stage of instrumental genesis, where difficulties arise physiologically. Nevertheless, the specific team-working feature developed by Engageli's staff allow us to conclude that Engageli is undoubtedly an intriguing option for proposing a more cooperative experience also for STEAM, but instructors must commit themself to design suitable tasks and should

cooperate with the software developers to produce an optimal experience. To conclude, we argue that further interactions with the platform will enhance the utilization scheme and, as consequence, the online team working learning experience.

References

Adams, S. (2020, October 14). Coursera Founder Launches Zoom Challenger For Higher Ed, *Forbes*. From: https://www.forbes.com/sites/susanadams/2020/10/14/coursera-founder-launches-zoom-challenger-for-higher-ed/?sh=49121077a45a.

Andrà, C., Brunetto, D., & Kontorovich, I. (2020a). Designing Mathematics Hybrid Classrooms in High School. In: *Teaching and Learning Mathematics Online*. http://hdl.handle.net/11311/1143571.

Andrà, C., Brunetto, D., Parolini, N., & Verani, M. (2020b). Four fundamental modes of participation in mathematics group activities. *International Journal of Science and Mathematics Education*, 18(1), 123-143. doi: https://doi.org/10.1007/s10763-018-09940-5.

Brunetto, D., Bernardi, G., Andrà, C., & Liljedahl, P. (2021). Teaching as a system: COVID-19 as a lens into teacher change. *Educational Studies in Mathematics*, 1-17. doi: https://doi.org/10.1007/s10649-021-10107-3.

Gamer, B. E., & Gamer, L. E. (2001). Retention of concepts and skills in traditional and reformed applied calculus. *Mathematics Education Research Journal*, 13(3), 165-184. doi: https://doi.org/10.1007/BF03217107.

Gueudet, G. (2008). Investigating the secondary-tertiary transition. *Educational studies in mathematics*, 67(3), 237-254, 2008. doi: https://doi.org/10.1007/s10649-007-9100-6.

Gürel, E., & Tat, M. (2017). SWOT analysis: a theoretical review. *Journal of International Social Research*, 10(51), 994-1006.

Liljedahl, P. (2020). *Building thinking classrooms in mathematics, grades K-12: 14 teaching practices for enhancing learning*. Corwin Mathematics Series.

Pundak, D., Herscovitz, O., & Shacham, M. (2010). Attitudes of Face-to-Face and e-Learning Instructors Towards Active Learning. *European Journal of Open, Distance and E-learning*, 13(2), 1-12.

Béguin, P., & Rabardel, P. (2000). Designing for instrument mediated activity. *Scandinavian Journal of Information Systems*, 12, 173-190.

van de Sande, C. (2011). A description and characterization of student activity in an open, online, mathematics help forum. *Educational Studies in Mathematics*, 77, 53-78. doi: https://doi.org/10.1007/s10649-011-9300-y.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14279

Team-Teaching in a Matrix Style: Addressing wicked-problems of MNEs in the context of sustainability

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Abstract

While developing a new module on applied sustainability at a German University of Applied Sciences, in the study program Bachelor International Business as an elective, our planning was interrupted by the pandemic and we took this as a chance to adapt our teaching approach accorcingly. As sustainability management is a complex and multidimensional field we decided to implement a virtual team teaching approach, with three lecturers bringing in distinct knowledge. We developed a matrix team structure across students and lecturers. The aim of our approach was to equip students with knowledge from different sub-disciplines related to sustainability and to foster problem-solving competencies through both a team-oriented assignment and team-teaching. We demonstrate our approach and students' evaluation on it. We show that working in a matrix is a challenge for some students, which encourages us to continue with this approach in order to foster students employability.

Keywords: *team-teaching; inverted classroom, sustainability; bachelor level.*

1. Introduction

While developing a new module on applied sustainability at a German University of Applied Sciences, our planning was interrupted by the pandemic-induced move from in-class teaching to distance learning at German higher education institutes. We took this as a chance and adapted our teaching approach from scratch. As sustainability management is a complex and multidimensional field addressing so-called wicked-problems (van Tulder, 2018) we decided to implement a virtual team-teaching approach, with three lecturers that bring in distinct knowledge and topics. We developed a matrix team structure across students and lecturers, which we want to present in the following. Students worked in teams and had the task to plan a sustainability-oriented approach to a market entry for an exemplary large Multinational Enterprise (MNE) into a market in the global south. Each team member had a different focus area to address, while at the end, all individual components were to to be combined to a larger and concise strategy. The aim of our approach was to equip students with knowledge from different sub-disciplines related to sustainability and to foster problem-solving competencies through not only a team-oriented task/assignment but also team-teaching.

We demonstrate our teaching approach and the related literature in the following. Afterwards we use student evaluations to discuss whether our teaching experiment is suitable to tackle the identified challenges.

2. Team-teaching in a matrix structure

When designing our course on applied sustainability at a German University of Applied Sciences, we were confronted with several challenges. The course is planned as an elective course in the 4th or 5th semester of a 7-semester (210 ECTS) English speaking bachelor program on International Business. The course is planned with 5 ECTS and 180min classes per week. The students had no previous knowledge on the topic from their so far completed modules. The challenges can be grouped into three main dimensions:

1. Sustainability management is a complex, multidimensional field that needs interdisciplinary input.
2. Our module should represent the complexity of decisions a sustainability manager faces to increase employability of our students (Dacre Pool & Sewell, 2007).
3. The pandemic increased uncertainties, especially in the planning phase, on whether teaching would be on campus or digital or hybrid (Zawacki-Richter, 2020).

The first challenge let us to try out a team-teaching approach, as team-teaching contributes to an improved teaching strategy planning (Marzocchi, Druken, & Brye, 2021), motivation and skill learning among students (Minett-Smith & Davis, 2020; Vesikivi, Lakkala, Holvikivi, & Muukkonen, 2019). Two of us had first experience in co-teaching

(Wohlgemuth, Saulich, & Lehmann, 2019), but none of us had experience with a full team-teaching approach, especially as our administrative procedures disincentives team-teaching (Wohlgemuth, Lehmann, & Ammeraal, 2020). Each of us would get only a third of the course accredited in her teaching hours, hence, all hours spent jointly in class would be unaccredited teaching obligation for us. Hence, most input sessions were designed as a 'parallel model' form of team-teaching, where "each member teaches only those sessions assigned to them due to expertise or availability" (Minett-Smith & Davis, 2020).

Following recent developments in the sustainability teaching field (Carey, Beitelspacher, Tosti-Kharas, & Swanson, 2021; Keeley & Benton-Short, 2020), we decided to form a team of three lecturers with distinct expertise. One of us is an expert in sustainability management and sustainable supply chain management, one is an expert on environmental and energy policies, and the third one on sustainable development and development cooperation. Although most sessions were held by only one professor, the introductory session and the sessions at the end of the semester, when students presented the results of their assignments, were spend jointly, stressing an 'interactive' and interdisciplinary approach (Minett-Smith & Davis, 2020).

The second challenge let us to a matrix structure. A matrix organization structure is common organizational form in business organizations. As flexibility and projects play a larger role in highly volatile environments, more and more organizations reform their organizational structures into a matrix structure (Burton, Obel, & Håkonsson, 2015). Simplified, a matrix structure is two dimensional, and in many organizations cross-functional. This reduces line-thinking and increases cooperation and communication between functional departments (Joyce, 1986; Kolodny, 1979). We figured that the matrix structure would first contribute to our goal of increased employability, as it models the common structure in many organizations and provides the potential to model the complexity of the field. At the same time, it seemed an interesting way to structure our team-teaching as well as the assignment the students had to complete. This means, not just the teaching team was split in the three areas of expertise but also the student groups. Hence, students formed groups of three and had the task to plan a sustainability-oriented approach to a market entry for an exemplary large Multinational Enterprise into a market in the global south. In each student team, one student was responsible for deriving insights on how this corporate task relates to the existing sustainability strategy for the MNE, one was responsible to analyse sustainability-oriented policies that would influence the market entry (e.g. GHG reduction targets, etc.), and one was responsible to look at specificities of the target market and identify potential stakeholders in the field of development cooperation. Each student group dealt with a different case. Each group addressed all three aspects and they were asked to provide a joint presentation at the end of the semester. In addition, each student submitted a short written summary on their respective

findings. Table one demonstrates our structure, which we have not seen in any other teaching approach discussion.

Table 1. Matrix teaching structure.

	Group A (Case A)	Group B (Case B)	Group C (Case C)
Lecturer 1 (Topic 1)	Student A1	Student B1	Student C1
Lecturer 2 (Topic 2)	Student A2	Student B2	Student C2
Lecturer 3 (Topic 3)	Student A3	Student B3	Student C3

Source: Authors own.

To cope with the third challenge, we conceptualized the course as an online course, based on an inverted classroom approach, which has been demonstrated to produce intensified and active learning (Foster & Stagl, 2018; O'Flaherty & Phillips, 2015). This implied that for each week, students received literature, videos, or interactive presentations as asynchronous teaching material a week before class and had the task to work through this material to prepare for the next live online class. In the online class meetings, we asked students to participate actively and with cameras on. The focus was on conducting exercises which reflected the previously consulted material.

We followed the approach of parallel team-teaching based on the inverted classroom approach for two-thirds of the semester. The last weeks of the semester were spent in individual consultancy sessions. Hence, each lecturer would have a consultancy session with her students (i.e. referring to table one, Lecturer 1 would meet with Student A1, Student A2, and Student A3). This way, all students focusing on the same field but different cases could also exchange their knowledge and the lecturer could work on the specificities of the topic in preparation of their respective assignment tasks.

The student teams had two exam components. They had to hold a joint presentation combining all three areas to present a stringent market entry plan. Additionally, each student had to prepare a hand-out with details on the strategy reflecting on the specific topic they had chosen.

3. Evaluation

Even though the class was small (n=9), we conducted a detailed evaluation of the module. We decided to provide an anonymous feedback option via an online collaboration tool during

a specific dedicated time in the last session of the semester. We asked students to answer four standard evaluation question on a five point Likert scale, afterwards we asked for open text feedback on the three above identified issues: team-teaching, matrix structure, online inverted classroom. Students were incentivized to participate in this session as they received their grade and initial feedback by the lecturers at the end of that session.

The students rated the course as generally good. Especially the teaching concept and the structure were rated as "good" by five to six participants of the evaluation (n=9), but by none as very good. The lecture support was considered "good" or "very good" by five out of nine participants. However, the rest of the students were less satisfied. If this was related to a specific lecturer, remains unclear.

Concerning the team-teaching approach, the student feedback was generally positive. Most students valued the different perspectives, which is in line with previous research (Minett-Smith & Davis, 2020; Vesikivi et al., 2019), as the following statement represents:

"Positive are the different perspectives and more expertise on a topic provided by several lecturers. Also maybe some people feel more comfortable with certain lectures so that can be a benefit."

Even though almost all comments stated an appreciation of the team-teaching approach, several statements also pointed to a lack of cooperation between us lecturers as the following statement exemplifies: "*I really enjoyed having different perspectives. Although I think that there could me more building the expertise with each other.*" In line with Keeley and Benton-Short (2020), we conclude that a lead-lecturer is indispensable.

Concerning the matrix structure in our team and assignment, the opinions were mixed. Some students appreciated a new approach: "*it is refreshing and something new*";

"It was clear, once I knew the topics I'm writing about I knew to which professor I should talk to."

However, several student were rather lost and confused by it:

"I think the matrix structure with the different topic led to the task being quite unclear. My team members and I were really not sure what to include in the handout and how much overlap in content there was allowed."

"It was clear, but I don't know if it was helpful, because the individual tasks were pretty different but at the same time it also had to follow a red line"

"I liked that it was divided for us, compared to other projects that are done in groups, so it kind of took away the first step of the group work. Timing wise, the fact that the third person had to wait for the inputs of the other students slowed down the process."

These statements showed us, that we do not only need to intensify our within-teaching-team cooperation, but also need to work on communicating our expectations on the assignments more clearly. However, some students seemed overburdened with a matrix structure and the communication needs entailed. We found this to be an alarming sign, considering that matrix structures are a common organizational structure (Burton et al., 2015).

Concerning our online inverted classroom approach, the feedback of the students was as divided as in most of our classes currently and as others have demonstrated before (Ryan, Hodson-Carlton, & Ali, 2005). About half of the class appreciates the flexibility and learning style of an online course setting, while the other half would have preferred on-campus classes and assumed that there would have been more intense discussions in an on-campus setting.

In addition, we self-reflected on the module. We concluded that we need to be more specific when it comes to describing the assignment. Although we initially believed that providing a certain degree of "freedom" for the students on how to solve the assignment and to derive solutions for the task assigned is beneficial to solving wicked problems (von Tulder, 2018), it occurred that this may be overburdening students at the Bachelor level. On the positive side, we saw cross-disciplinary solutions within the different sub-categories by the students, which supports our idea of inter- and transdisciplinary teaching and the development of the respective competencies and is in line with previous research in team-teaching in sustainability (Carey et al., 2021; Keeley & Benton-Short, 2020).

4. Conclusion

The feedback received, even though the class was small with only 9 actively participating students, was evaluated rather as encouraging to teach the module again in the upcoming semesters. We see a need to adapt our approach and to refine our requirements, and potentially we need to provide more time during class-time for the different groups to work on their assignment. We observed that the participating students developed cross-disciplinary ideas to solve the provided task during their assignment. The notion of the role-play included in the assignment would also need to be strengthened in the next round of this module, as we feel that the students did not see themselves as being "inside" a business were this task was given to their team to solve in a given amount of time.

Despite the positive feedback and our own increased motivation to team-teach, we would feel more encouraged to try innovative forms of co-teaching if such approaches would be better-reflected in the administrative processes, as others have discussed before us (Härkki, et al., 2021; Ryan et al., 2005; Wohlgemuth et al., 2020).

References

Burton, R. M.; Obel, B.; Håkonsson, D. D. (2015): How to get the Matrix Organization to Work. In: *JOD* 4 (3), 37. DOI: 10.7146/jod.22549.

Carey, J. C.; Beitelspacher, L. S.; Tosti-Kharas, J.; Swanson, E. (2021): A Resource-Efficient Modular Course Design for Co-Teaching Integrated Sustainability in Higher Education: Developing the Next Generation of Entrepreneurial Leaders. In: *Entrepreneurship Education and Pedagogy* 4 (2), 169–193. DOI: 10.1177/2515127420969967.

Dacre Pool, L.; Sewell, P. (2007): The key to employability: developing a practical model of graduate employability. In: *Education + Training* 49 (4), 277–289. DOI: 10.1108/00400910710754435.

Foster, G.; Stagl, S. (2018): Design, implementation, and evaluation of an inverted (flipped) classroom model economics for sustainable education course. In: *Journal of Cleaner Production* 183, 1323–1336. DOI: 10.1016/j.jclepro.2018.02.177.

Härkki, T.; Vartiainen, H.; Seitamaa-Hakkarainen, P.; Hakkarainen, K. (2021): Co-teaching in non-linear projects: A contextualised model of co-teaching to support educational change. In: *Teaching and Teacher Education* 97, 103188. DOI: 10.1016/j.tate.2020.103188.

Joyce, W. F. (1986): Matrix Organization: A Social Experiment. In: *AMJ* 29 (3), 536–561. DOI: 10.5465/256223.

Keeley, M.; Benton-Short, L. (2020): Holding Complexity: Lessons from Team-Teaching an Interdisciplinary Collegiate Course on Urban Sustainability. In: *Social Sciences* 9 (5), 76. DOI: 10.3390/socsci9050076.

Kolodny, H. F. (1979): Evolution to a Matrix Organization. In: *AMR* 4 (4), S. 543–553. DOI: 10.5465/amr.1979.4498362.

Marzocchi, Alison S.; Druken, Bridget K.; Brye, Michelle V. (2021): Careful Co-Planning for Effective Team Teaching in Mathematics. In: *INT ELECT J MATH ED* 16 (3), em0663. DOI: 10.29333/iejme/11299.

Minett-Smith, C.; Davis, C. L. (2020): Widening the discourse on team-teaching in higher education. In: *Teaching in Higher Education* 25 (5), 579–594. DOI: 10.1080/13562517.2019.1577814.

O'Flaherty, J.; Phillips, C. (2015): The use of flipped classrooms in higher education: A scoping review. In: *The Internet and Higher Education* 25, 85–95. DOI: 10.1016/j.iheduc.2015.02.002.

Ryan, M.; Hodson-Carlton, K.; Ali, N. S. (2005): A Model for Faculty Teaching Online: confirmation of a dimensional matrix. In: *The Journal of nursing education* 44 (8), 357–365. DOI: 10.3928/01484834-20050801-06.

van Tulder, R. (2018): Business & the Sustainable Development Goals: A framework for effective corporate involvement. Rotterdam School of Management, Erasmus University, Rotterdam.

Vesikivi, P.; Lakkala, M.; Holvikivi, J.; Muukkonen, H. (2019): Team teaching implementation in engineering education: teacher perceptions and experiences. In: *European Journal of Engineering Education* 44 (4), 519–534. DOI: 10.1080/03043797.2018.1446910.

Wohlgemuth, V.; Lehmann, T.; Ammeraal, A. (2020): Challenges in Higher Education Teaching Collaborations – a CAGE distance framework analysis. In: 6th International Conference on Higher Education Advances (HEAd'20). Sixth International Conference on Higher Education Advances, 02.06.2020 - 05.06.2020. Valencia: Universitat Politècnica de València.

Wohlgemuth, V.; Saulich, C.; Lehmann, T. (2019): Internationalising education – Cross-country co-teaching among European higher education institutions. In: 5th International Conference on Higher Education Advances. Fifth International Conference on Higher Education Advances, 6/26/2019 - 6/28/2019. Valencia: Universitat Politècnica de València.

Zawacki-Richter, O. (2020): The current state and impact of Covid-19 on digital higher education in Germany. In: *Human behavior and emerging technologies*. DOI: 10.1002/hbe2.238.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14436

Business programme dropout causes and the ceiling of retention

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Abstract

Dropping out of school is traditionally frowned upon by judging the individual and pointing out supply-side waste – resources have been spent without the intended output of a capable graduate. This paper analyses views of dropouts from a local business administration undergraduate programme in Estonia. The survey and interviews focused on ex-students 2-15 years post-leave to chart a spectrum of dropout causes, resulting impacts and personal reflections. The data suggests the majority of students perceive significant value in their cut-short college experience, while a minority expressed various hard feelings. The paper discusses the extent to which student retention can be increased in the focal case (retention ceiling around 75%) and anticipated improvement actions. The data shows that learning without diploma is still perceived as valuable learning, which fits modern business education paradigm. Therefore the paper argues against viewing graduation rate as the main KPIs in business studies at publicly funded school.

Keywords: *undergraduate business education; student attrition; college dropout causes; programme development; value of learning.*

1. Introduction

To drop out from college is a phrase often attached with negative judgement – referring to waste and inefficiency. An extreme but familiar discourse suggest it involves both individual failing, the failing of teachers as well as "process defect" of school. In situations when funding of education is scarce, efficiency is put to pedestal. A common efficiency KPI in HEIs is graduation rate. An array of incentives is often applied in public universities both for students as well as faculty to lower student attrition. While improving efficiency, it reinforces negative connotation towards attrition, even up to suggesting that the value of education is binary – you either have reached the diploma, which proves ones worth, or you have not. As counterpoint, the actual reasons for dropping out are diverse, including socio-cultural, structural, policy, institutional, personal and learning factors (Quinn, 2013). These are a combined result of multi-level influences with only some under the school's influence. Thus, the ability of the school to impact drop-out rates is somewhat limited (Gupta et al., 2020).

This study challenges the centrality of graduation rate in evaluating the strength of business programmes. The aim is to identify how dropouts from one focal business programme evaluate their programme experience, view their causes of leaving, assess the impacts experienced after and value their personal development in their limited stay long after the dust has settled. Based on this feedback, the study charts school improvement actions and estimates reasonably obtainable graduation rate. First, a literature review is presented on causal factors of student attrition. In methodology, the programme and learning environment is introduced, to make the point that business school influence over student attrition is heavily dependent on local characteristics, and detail mixed methods approach of survey and interviews. A selection of findings is then covered and key patterns identified, which are discussed on the levels of student experience and programme development.

2. Literature review

A founding view to student attrition postulates academic, environmental and social integration to boost student commitment to goals. In this model, key criteria of dropout are falling out of academic and accompanying social circles (Tinto, 1993). A 2013 study commissioned proposed six contributors to attrition and evaluated their role (Quinn, 2013). The mix is complex, but in general institutional and learning factors are more under school control, personal and socio-cultural can be partially influenced, whereas policy and structural factors largely are outside school influence. The study points out that widening intake per se is not increasing attrition risk, given proper attention and student-centered focus. (Ibid.)

Among some key levers of student retention are teaching and learning innovation, refining programme value proposition and customer focus throughout the programme (Thomas et al., 2015). These are common themes in business student feedback, along with interactivity,

flexibility and practical focus (Bennett et al., 2020). On one hand, career-conscious students are more committed to graduating (Fényes et al., 2021). On the other, one challenge of such practical focus tends to be that most students focus on their performance on their first job (Bennett et al., 2020) – understandable, but also short-sighted from programme viewpoint.

Expectation management, personal assistance, involvement in academic activities and developing learning skills all influence academic adjustment, which in turn lowers dropout (Raza et al., 2020). Potentially critical mediator is student motivation, especially considering a non-linear relationship, which has been described as "*student motivation being contagious*" (Krishen, 2013). Wardley et al. have expanded on that and viewed student engagement in the centre of retention and that skill variety, autonomy and customer service are key factors in increasing student commitment (Wardley et al., 2021). Particularly business students need to experience how their work impacts others (company or community) to avoid demotivation and dropout, as by default "*business students do not see the value in their degrees*." (Ibid.)

Gupta et al. have pointed out that universities might assume dropout reasons through indirect means, as directly asking a student is perceived as delicate and with high rate of refusal to comment. This leads to missing the root causes and often just attempting to provide some support without understanding context or strategy. (Gupta et al., 2020). Their study presents 22 dropout factors and evaluates their controllability and influence potential with one key being motivation (high influence, low controllability). Across all factors, the overall ability to impact dropout is still seen intermediate at best (Ibid.).

This study is contributing to the literature on means to impact attrition based on dropout feedback from students leaving the school at later stages of their studies, on perceived value of the diploma, on the learning experienced before leaving and on the maximum achievable graduation rate via programme experience development in our environment *ceteris paribus*.

3. Methodology

The focal programme of this study is one of the largest of its type in Estonia, with population of 1.3 mln. The 3-year programme hosts approx. 460 students with annual intake approx. 120. A typical entrant is 19 years old, slightly more likely female, with decent math and language skills. Recent data on graduation rate is based on 2017 cohort. As of autumn 2021, 63% of students have graduated (which locally is seen strong, also accounting for pandemic), 25% of students have dropped out and remaining 12% are still active students. Going back in time, the graduation rates have been comparable, if a bit lower. Estonia converted from student-funded to state-funded education in 2013. Pre-reform, the average graduation rate was around 40%. Notable decrease in attrition is not only due to tuition-free model (including complex combination of "carrot and stick" incentives to students) but also from closing distance-learning track –some efficiency has been achieved by trading off flexibility.

This study was launched on spring 2020. All students that had dropped out 2002-2016 were identified, with around 2/3 being "early drop-outs" (collected < 50% of credits) and the remaining 1/3 of late dropouts – the focal population. It is central to make this distinction, because with early attrition, the questions of wasted effort and regrets are relatively marginal, the feedback is less comprehensive and adjusting to a new path is assumedly objectively easier and emotionally less stressful. The study included only students of "marketing" and "management" branches, omitting two others. After further clean-up (double-checking that all students who had later graduated were removed), a database of 150 dropouts remained: 84 management and 66 marketing. At study launch, the age range across population was [25; 54], 56% females and 44% males, with average grade of 2.78 (on a 5p scale where "5" marks the best). This is notably lower than average grade across programme graduates (3.46), so clearly lower grades indicate dropout risk. The average person in population had started the programme 11-12 years prior and had left 8-9 years prior.

The first round was a Google Forms survey sent to 132 working e-mail contacts. The survey was endorsed by school as a form of outreach to motivate respondents to return to the programme. 55 answers were collected (response rate 42%), suggesting the study was met favourably. The most represented cohorts in the sample were of 2007-2011 intake and the sample was representative in terms of gender, specialization choice and cohort spread. The main survey themes were dropout causes, programme value, emotional state, the programme and dropout impact to career, the attitude towards lifetime learning and towards returning to graduate. The survey allowed a motivated respondent to share personal contact for an interview to discuss their further reflections. From willing responses, a further sample was selected (over the diverse spectrum of survey answers) and 13 respondents were interviewed.

4. Results

The survey explored 11 dropout causes, presented as frequency distributions in Table 1. It appears most causes of leaving are not directly related to studying, but reflect a broader shift in priorities (mainly lines a, c and e). Lines a and d indicate a majority perception that school had already filled the role in career launch, so a diploma was no longer strictly relevant. This is also linked to statement b, which points to difficulties in finding pragmatic workplace and career value in a typical thesis research project, though it suggests also a supply problem and the faculty is taking the criticism present (lines b, g and h foremost) as valuable feedback. A few responses indeed were vocal in the comments, revealing that the programme had not met their workplace practice related expectations. Others were milder, pointing out difficult courses or certain inappropriate teachers, but not the package as a whole. The notably low number of responses on lines i and j seem encouraging – line i suggests that students mostly value the programme, while line j proposes there is no major capability-related obstacle, so a return of a portion is not ruled out, should conditions and motivation take a favourable turn.

Table 1. Stated causes of late-stage dropout, n = 55.

Listed cause	Respondents	Relative share
a) Work required too much of my time	31	56%
b) Difficulties with launching thesis research project	25	45%
c) Changes in family arrangements	20	36%
d) My workplace did not require / expect a diploma	16	29%
e) Personal financial challenges	9	16%
f) Loss of interest toward studying	9	16%
g) Lack of flexibility of study arrangements	8	15%
h) Teaching staff lacked competence	8	15%
i) The programme seemed no longer personally relevant	5	9%
j) Studying appeared overly difficult	2	4%
k) Launched career as entrepreneur	1	2%

Source: authors' survey.

The modest share of responses on lines g, h and j suggest that only a few students have left with "hard feelings". When asked to evaluate programme learning experience on a 5-point scale, the common answer was "4" (45%), followed by "3" (42%). Furthermore, next question was even broader – to evaluate total university contribution to personal development. 75% responded as "rather valuable" or "very valuable". So only the remaining 25% can be labelled as somewhat critical, partially frustrated or even truly disappointed.

The survey also queried on individual financial situation back in the day. Unsurprisingly, the spectrum is diverse with 42% responding "good" / "very good", while 34% marking it as poor. This indicates that for some, the decision to leave might have been "life forcing their hand". Another clear division was evident on perceived stress level pre-leave. 49% of respondents indicated notable stress, with 40% expressing only minor stress. The high stress level appeared to be more linked to work and financial challenges than to learning obstacles. However, these categories are not mutually exclusive.

High diversity of responses was also evident in terms of current job. 30% were working as mid- or top managers, so diploma has not been t a strict requirement in these companies (it was checked that respondents hadn't graduated somewhere else). 22% found that their work is only distantly related to what they studied. It is not easy to speculate, if situation would have been different for them with a diploma. It seems to be close to inevitable characteristic

of business studies that some graduates end up with careers not close to their major. While this seems a bit wasteful, it is also a strong point to focus even more on transferable skills.

To the question whether leaving school had any perceived career impact, 45% answered "no perceived effect", while a further 20% noted "mild positive" or even "strong positive" effect. Possibly for some of these people school had nothing substantial left to provide them that they would have valued. This can be seen as criticism towards typical thesis projects (due to perceived lack relatedness to solving real company problems) but also of some courses and possibly of a lack of transferable skill development. Curiously, the answers were rather dependent on student major. The management students leaned more towards negative career impact, whereas marketing students saw mostly positive net impact from leaving. This is a combination of factors. It is relatively easy locally to get a starter marketing job, it is often assumed most upfront skills are learned through practice and some of the conceptual matters taught by faculty might not appear overly relevant to the employee nor their employer. Further explanation might lie in a more generalist orientation of management studies and in better linkage to lifelong learning capability (60% assessed this as strong)

Tracing answers, it appears likely that some students reporting positive impact from leaving might have still felt giving up remaining courses and a diploma as a noteworthy loss, only that it was more than offset by positive impacts on career development, less stress and time challenges, not to mention higher earnings. In contrast, 35% pointed out mild or even strong negative effect. In this segment, the leading cause was mostly something external that made school continuation difficult while also jeopardizing career opportunities – both having children as well as hitting financial obstacles are common explanations here.

On evaluating relevance to return to school, 75% responded positive. The only dominant inhibiting factor noted was lack of time (51%). Only 9% were blunt: "C*urrent teaching level does not meet my expectations*". The respondents expressed three main expectations to boost their motivation – individual consultation, easier access to supervision and more emphasis on distance- and e-learning. These themes fit faculty development activities. To improve return rates, the low-hanging fruit seems to be consultation to formulate thesis plans with personal relevance. Additionally, the pandemic era has shown there ought not to be clear line between classroom and distance learning and often the optimal solution lies in middle ground.

One ought to keep in mind that this study might have had a notable sample bias – it is possible that more distant and disappointed dropouts just didn't bother to respond. So the true landscape of attrition might be somewhat more conflicting than it looks on paper. This feedback is based on learning experiences from 8-10 years ago, so many developments the school has made in the last decade are not reflected here – perhaps the situation isn't so problematic. Furthermore, the return of long-gone students to the focal programme has become a touch more frequent recently.

5. Discussion and conclusion

The main value of this study is in demonstrating the practical ceiling of student retention in a business programme in a context of local environment. The study indicated three main causes of attrition: career-related (the most frequent), personal and school-related reasons. By far the dominant obstacle in the latter category was difficulties with thesis research. While the reasons are clearly combined for many, mixing positive with negative, it seems the majority of emotional backdrop is positive – not only because of new enthusiastic challenges (such as new job or kids, which clearly present new trade-offs), but because the perceived loss of giving up school seems secondary. Students have not overly focused on the diploma, but more on competences, echoing Wardley (Wardley et al., 2021).

Criticism to programme value was not widespread statistically but rather loud when present. One can argue that even given perfect programme for an individual, the choice between new opportunities versus diploma would still remain as would the majority of attrition. There is a broad array of possible careers around in the case of local labor market that are not strictly requiring a diploma so the personal career acceleration trajectory is not much inhibited at least in short-term. In the long term, the school door is still open for return should the relevance reappear, so not much is truly lost.

From programme management view, with assuming maximum development effort, one could avoid 1/3 of late-stage dropouts or approx. 10-15% of total attrition. Managing early-stage dropouts was not in scope here, but from limited evidence the main transfer here is not program-career or program-family, but program-program. It could be influenced many ways but the total impact to attrition assumedly would not be higher than 1/3. This draws the conclusion that in focal programme context, with current graduation rate 60-65%, the practical ceiling to achieve without environment shifts would not be over 75%.

The conclusion for students is that at the time and age when the paradigm of business education revolves around entrepreneurial attitudes, seeks interdisciplinary connections and life-long learning, relies on intrinsic motivation and constant personal re-evaluation of desired development, then indeed achieving the diploma is slightly secondary. While diploma is hugely co-important in the schools of highest renown in the world (with actually minimal attrition), the context of the programme of this study is much different. As long as an adequate package of attitudes and meta-skills are obtained, our alumni as well as late-stage dropouts can follow their own compass and the main mission of school would still be accomplished. This would not even undermine the relevance of a traditional thesis project, for it can similarly be adjusted to imbue career development goals and personal relevance.

So it appears that separate diploma value lies only in a smaller subset of jobs as well as in continuation studies, especially when these are pursued internationally outside of the country's boundaries. No decline in these is predected, but also substantial growth is difficult

to foresee. The local labour market is not requiring a diploma as widespread entry standard and later on, workplace-learning usually contributes enough to allow career advancement on its own. Alongside, functional sub-fields of business have their own standards, relevant and valuable. If a student opts for a more specialist profile, a broad range of third-party certificates become relevant. But modern business and enterpreneurship approach in general should not be fully standardized in terms of one-size-fits-all evaluation purpose.

In summary, a majority of undergraduate business programme value can be achieved before graduation. To drive graduation rate higher just because of KPI appears of secondary importance as this can dilute focus from what is actually essential. While graduation rate is still an informative metric, it is not always about wasted effort as sometimes there is none.

References

Bennett, D., Knight, E., Jevons, C. & Ananthram, S. (2020) Business students' thinking about their studies and future careers. *Perspectives: Policy and Practice in Higher Education*, 24(3), 96-101. doi: 10.1080/13603108.2020.1757530

Gupta, S. K., Antony, J., Lacher, F. & Douglas, J. (2020) Lean Six Sigma for reducing student dropouts in higher education – an exploratory study. *Total Quality Management & Business Excellence*, 31(2), 178-193. doi: 10.1080/14783363.2017.1422710

Fényes, H., Mohácsi, M., & Pallay, K. (2021). Career consciousness and commitment to graduation among higher education students in Central and Eastern Europe. *Economics and Sociology*, 14(1), 61-75. doi:10.14254/2071-789X.2021/14-1/4

Krishen, A. S. (2013). Catch it if you can: How contagious motivation improves group projects and course satisfaction. *Journal of Marketing Education*, 35(3), 220–230. https://doi.org/10.1177/0273475313495857

Quinn, J. (2013). Drop-out and completion in higher education in Europe among students from under-represented groups. Plymouth: Network of Experts on Social aspects of Education and Training (NESET). Digitally publicly available at www.nesetweb.eu

Raza, S. A., Qazi, W., Yousufi, S. Q. (2020) The influence of psychological, motivational, and behavioral factors on university students' achievements: the mediating effect of academic adjustment. *Journal of Applied Research in Higher Education*, 13(3), 849-870. doi: 10.1108/JARHE-03-2020-0065

Tinto, V. (1993), Leaving College: Rethinking the Causes and Cures of Student Attrition, University of Chicago Press, Chicago.

Thomas, A., Antony, J., Francis, M., & Fisher, R. (2015). A comparative study of lean implementation in higher and further education institutions in the UK. *International Journal of Quality & Reliability Management*, 32(9), 982–996. doi: 10.1108/IJQRM-09-2014-0134

Wardley, L. J., Nadeau, J., & Bélanger, C. H. (2021). A comparative analysis of institutional commitment: are business students different? *Journal of Marketing for Higher Education*, 1-21. doi: 10.1080/08841241.2021.1977449

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14654

Innovative Teaching and Learning Practices: The Student Perspective

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Abstract

As educators we are interested in continuous improvement; we want our teaching to be more impactful, to be engaging and innovative, culminating in students developing skills that facilitate lifelong learning. To date significant research has been conducted on innovative teaching and learning practices that educators may adopt to achieve these aims. However, fewer studies have focused on teaching and learning practices from the student perspective. This paper, reporting findings from a larger study, seeks to address this gap. An online survey was conducted across the student cohort in the School of Business of an Irish higher education institution (HEI). The findings show that students favour a mix of innovative practice and traditional teaching in helping them to learn effectively. Case studies and recorded lectures are the most popular choice of innovative teaching practice and students favour methods that help them to understand, thus leading to deep learning. Additionally, traditional teaching practices are still important to students, particularly first year undergraduates.

Keywords: *Traditional teaching practices; innovative teaching practices; student perspective; higher education.*

1. Introduction

Higher Education Institutions (HEIs) face continual change. Each academic year a new cohort of learners commence their studies replacing those who have graduated. Change is also apparent in teaching approaches where educators engage in innovation voluntarily to improve student learning, or perhaps necessarily, due to circumstances beyond their control such as larger participant numbers (Hannon, English, & Silver, 1999). Innovation is described as the implementation of new and improved ideas, knowledge, and practices (OECD, 2005). Innovation in Education may take the form of "a new pedagogic theory, methodological approach, teaching technique, instructional tool, learning process, or institutional structure that, when implemented, produces a significant change in teaching and learning" (Serdyukov, 2017, p. 8).

In Ireland, the National Forum for the Enhancement of Teaching and Learning in Higher Education (National Forum) provides resources to promote and develop an inclusive, collaborative, and innovative culture to maximise learning impact for all students. The HEI that is the subject of this paper, secured funding from the National Forum which was used to explore and share innovative teaching and learning practices in the School of Business. A study was designed to identify and document teaching and learning practices that were considered innovative by staff and students. This paper presents initial results describing key findings from the student perspective, which was based on an online survey completed by undergraduate and postgraduate students across the HEI. Future work will compare these findings to the HEI staff perspectives of innovative teaching learning practices.

While there is a substantial body of prior research in relation to innovative teaching and learning practices these have focused primarily on the perspectives of educators. Fewer studies have addressed student experiences and opinions of innovative teaching and learning practices (Walder, 2017). This paper provides two contributions to the extant research. First, it responds to calls for more studies reflecting student perspectives of innovative teaching and learning practices (Walder, 2017). Second, it provides additional insights into student opinions about innovation in teaching and learning practices and their views on the effectiveness of these practices.

2. Literature

This study explores two broad approaches to teaching and learning, traditional and innovative practices. Traditional teaching and learning practices are straight forward, based on the delivery of notes by a lecturer with (perhaps) a question and answer session included (Ebert-May, Brewer & Allred, 1997). To describe innovative teaching and learning practices, first the element of innovation must be addressed. Innovation involves the implementation of new and improved ideas, knowledge, and practices (OECD, 2005), which may be something novel

in one situation, a departure from what has been done before, or it may be something that is established in another situation (Hannon et al., 1999). Serdyukov (2017) proposes that innovation comprises three aspects, an idea, its implementation and the outcome of executing the idea that results in a change. In terms of education, innovations aim to raise productivity and efficiency of learning and/or improve the quality of learning. Educators often engage in innovation voluntarily to improve student learning and the quality of their teaching. (Hannon et al., 1999; Walder, 2017). They may innovate with the specific intention of "captivating, supporting, improving, problem solving, readapting, creating and communicating" (Walder, 2017, p. 74). Von Stumm, Hell, and Chamorro-Premuzic (2011, p. 574), explored the concept of curiosity in enhancing student learning, and found that intellectual curiosity "is a core determinant of individual differences in academic achievement". In an earlier study, Weimer (2002) criticized regimes that do not pique students' curiosity in creating mature responsible learners.

Previous research capturing student perspectives have reported on the types and innovative teaching and learning practices that are effective and engaging. Revell and Wainwright (2009), in their study of what makes lectures unmissable, found that the use of real world examples and current case studies in class was rated highly by students and considered powerful in encouraging deeper approaches to learning. Additionally, in a study conducted by Trinidad, Ngo, Nevada, and Morales (2020) students confirmed that the use of teaching practices involving real life applications and examples (such as case studies) was both engaging and effective. Research conducted prior to the onset of Covid-19 showed some different results regarding student views of traditional and innovative teaching and learning practices. A study based on undergraduates in the UK, Europe and South Africa over a two-year period, highlighted that prior to the onset of Covid-19, 54 per cent of students preferred traditional teaching and learning practices using face-to-face lectures/classes, with textbooks and recommended resources (Cengage, 2020). An earlier study by Lawler, Mara Chen, and Venso (2007), found that almost half of all respondents, preferred a ratio of 10 per cent group work and 90 per cent formal lecture. In terms of online learning, a pre-pandemic Australian study found that only one out of three students preferred live lectures (Wolff-Boenisch, 2021). Research indicates mixed views regarding the use of videos in class. While there is evidence to confirm that shorter videos improve learning outcomes (Carmichael, Reid, & Karpicke, 2018) in a Covid-19 online learning environment, YouTube videos were not popular among students (Chen, Landa, Padilla, & Yur-Austin, 2021).

In terms of how teaching practices may help students to learn, prior studies suggest that a clear structure to lectures is preferred by students (Lawler et al., 2007; Revell & Wainwright, 2009) and not presenting too much information all at once allows information to be prioritised and assimilated to reveal the big picture (Revell & Wainwright, 2009). A study based on undergraduates in the UK, Europe and South Africa over a two-year period confirmed that

students prefer their learning to be structured for them but also that they preferred to work independently rather than collaborating with others. The study also found that first year students were consistently looking for support with basic aspects of their course, suggesting more instructor-led involvement and preference for traditional ways of learning (Cengage, 2020). This contrasts strongly with Revell and Wainwright (2009), who claim that pedagogic scholars are now emphasising the role of the lecturer as a facilitator rather than teacher, whose primary role is to give students the tools to learn for themselves.

The Covid-19 pandemic forced HEIs to move to online teaching and academics to their adapt practices. This created more familiarity of online teaching practices and resources and altered opinions. In the UK, European and South African study noted above, the findings indicate that due to imposed remote learning as a result of the pandemic, the preference for traditional teaching practices had fallen slightly to 47 per cent (Cengage, 2020). Conversely, the Australian study showed that since the onset of Covid-19, 40 per cent of students preferred face to face lectures (Wolff-Boenisch, 2021), suggesting a negative impact of the pandemic on online learning. Additionally, in their study of online learning during the pandemic, Chen et al. (2021) also note that students strongly favour face to face instructional format rather than fully online or a hybrid.

3. Methodology

This study was submitted to and approved by the School of Business ethics committee prior to commencement of the research. An online questionnaire was developed to collect data for this study. A purposeful random sampling approach was used in compiling the questionnaire. The researchers sought to understand students' views of innovative teaching and learning practices. The study took place within the School of Business in an Irish HEI. The population for this survey was 1,196 students including both undergraduate, postgraduate and part-time students. The questionnaire was prepared based on themes drawn from teaching and learning literature, and a prior study of staff perspectives regarding innovative teaching and learning practices. (A list of teaching and learning practices was compiled comprising case studies, recorded lectures, YouTube and other videos, Online resources such as blogs, forums and Padlet, guest lectures, work placement, mentoring, reflective practice, lecturer shared delivery, problem based learning, simulations, learning portfolios and traditional teaching). To facilitate their completion of the questionnaire students were provided with the list of teaching and learning practices including a short explanation of each type. While students may have been aware of a variety of these teaching practices, they may not have had direct experience of all of those included in the listing. The questionnaire was pilot-tested in advance to ensure that it "operated as designed" (Bryman & Bell, 2007).

The online questionnaire consisted of 18 questions. 15 were closed questions (including nominal, multi response ordinal and ranking questions) while three questions were open ended. A link to an online survey platform was made available to students through the virtual learning environment Moodle. The link was released on 22nd November 2021 and the collection period remained open until 25th January 2022. The response rate was 23 percent with 93 per cent from undergraduates and 7 per cent from post-graduates. This is broadly in line with the numbers enrolled on the School programmes. Responses came from across the range of programmes in the School of Business. The data collected was analysed using the analysis tools of the online survey platform and descriptive statistics were derived from the data, and this helped to develop the narrative of the study.

The main limitation of the methodology applied to this study is that both researchers are academics in the School of Business and are known to many study participants. To mitigate against this, the researchers maintained participant confidentiality as a priority during data gathering and analysis.

4. Findings

Initially students were asked to rank (based on the list of teaching and learning practices noted above), the ***teaching practices that were most effective for their learning***. The findings indicate that students consider case studies and recorded lectures to be most effective with almost 36 per cent of participants selecting these as either their first or second choice. Work placement and YouTube videos were ranked equally in third place. The least effective methods as ranked by students were learning portfolios, simulations and shared delivery. Traditional teaching methods ranked surprisingly high, coming in fifth out of 13 possible practices. When these results were further analysed by year of study, the findings show that traditional teaching methods were highly favoured by first year students but were the second least preferred method for postgraduate students. Aside from the teaching methods listed and specified in the survey, other practices noted by students as being helpful to their learning included group discussions, tutorials, and project work/labs. Group discussions were mentioned most often suggesting that students learn effectively from each other when given the opportunity.

In terms of ***what had influenced student's choice of effective learning practices***, over 90 per cent of participants either agreed or strongly agreed that they had selected practices that helped them to score well in assessments and that helped them to remember the topic later. Teaching practices that helped them to see the relevance of class material in the real world was also an important factor for 78 per cent of participants, with one participant remarking "When an abstract concept is explained to me in a real-life scenario it helps me to understand it and piques my interest. I also grow in confidence around that subject". However, 35 per

cent of all participants did not agree that the teaching practices would encourage them to learn more about the topic. Looking only at post-graduate level, this view had fallen to 25 per cent.

In addressing ***how specific practices help them to learn more effectively***, almost all of the students indicated that the teaching practices that they had highlighted made it easier for them to understand the module material and this led to a deeper understanding of the topic. The findings also indicate that the majority of students had selected specific innovative practices because they allowed them to learn at their own pace.

In terms of ***how effective learning practices help to engage in class***, the findings suggest that innovative teaching practices help students to engage in active learning. One student commented that, "doing actual exercises keeps me much more engaged". When asked *how* this happens, approximately half of the participants strongly agreed that being actively involved in exercises captured their attention and made them more alert. The majority of students agreed that active involvement kept them stimulated and motivated to learn. Over 68 per cent of students agreed that interacting with classmates made learning more interesting while 63 per cent of respondents agreed that innovative teaching practices just "make learning fun".

Finally, there were mixed views relating ***to the effectiveness of online remote teaching, (for example during the COVID19 pandemic lockdown period)***. There were equally strong opposing views on whether or not, online teaching improved the ability to learn. Overall, the study found that online lectures did not affect the ability to learn with up to 73 per cent of respondents agreeing that online teaching does not in itself improve learning, it is simply a channel for delivering material. There were, however, some calls for online assessment and for access to recorded lectures as a study/revision tool.

5. Discussion

The study highlights case studies and recorded lectures as innovative practices that are most effective for student learning, which confirms the findings of Revell and Wainwright (2009) and Trinidad, Ngo, Nevada & Morales (2020). Additionally, in this study work placement and the use of short videos were also found to be effective learning tools. However, this finding both supports and contradicts extant research that presents mixed views regarding the effectiveness of using videos in class. While there is evidence to confirm that shorter videos improve learning outcomes (Carmichael, Reid and Karpicke, 2018), when situated in a Covid-19 online learning environment YouTube videos were not popular among students (Chen, Landa, Padilla and Yur-Austin, 2021).

The research suggests that students welcome innovative teaching approaches to support their learning yet continue to place significant value on the importance of traditional practices to support their learning. This finding is most applicable to first year undergraduates and concurs with a study conducted by Cengage (2020), which highlighted that this student cohort prefer their learning to be structured, and require support with basic aspects of their course. This suggests that first year undergraduates require more instructor-led involvement and prefer traditional ways of learning. In contrast, Lawler et al. (2007) found that almost half of all students surveyed favoured 90 per cent or more as formal structured lectures and 10 per cent or less as student group work.

In attempting to understand what influenced students' choice of effective teaching, the findings indicate that students prefer innovative practices that help them to score well in assessments, to remember the topic later and to relate academic theory to the real world. These findings support the work of Revell and Wainwright (2009) who found that applied methods and the use of real-life examples are powerful ways of encouraging deeper approaches to learning. However, the research also found that innovative practices did not always pique a students' desire to learn more and could limit true understanding, particularly at undergraduate level. These findings echoes earlier research of Von Stumm (2011) who found that curiosity or a desire to learn more, is a core determinant of academic achievement.

In contrast with Cengage (2020), who found that students preferred to work independently rather than collaborating with others, this study finds that innovative practices that foster peer-to-peer interaction were particularly effective in promoting student engagement and real learning. Whether it was the collective intelligence or the opportunity to spend time together, interacting with each other was found to be very important for effective learning. This finding supports the work of Revell and Wainwright (2009) and suggests that students can learn effectively from each other, when the lecturer moves from instructor to facilitator and provides students with the tools to learn for themselves. The onset of the COVID 19 pandemic accelerated the move from traditional face-to-face teaching to online teaching. The study finds that although online teaching has benefits, (specifically in the form of recorded lectures as a study tool), online approaches do not necessarily improve learning. The findings suggest that they are simply a channel for communicating a teaching approach. In a study of student perception of online learning following the Covid-19 pandemic, Wolff-Boenisch (2021) also found that one out of three students preferred face to face lectures and this increased after Covid-19 thus suggesting a negative impact of pandemic on online learning.

Similar to prior research, primary data was collected using a survey requiring students to assess the effectiveness of teaching practices on their learning, there was no independent measure of their performance (Lawler et al., 2007; Trinidad et al., 2020). Consequently, the question remains, do students' perceptions of their learning outcomes really correlate with their actual learning? This suggests an avenue for future research.

References

Bryman, A., & Bell, E. (2007). *Business Research Methods* (Second ed.). Oxford: Oxford University Press.

Carmichael, M., Reid, A.-K., & Karpicke, J. D. (2018). Assessing the impact of educational video on student engagement, critical thinking and learning: the current state of play. *SAGE Whitepaper*.

Cengage. (2020). *Student voices EMEA 2020-21*. In Cengage (Series Ed.)

Chen, C., Landa, S., Padilla, A., & Yur-Austin, J. (2021). Learner's experience and needs in online environments: adopting agility in teaching. *Journal of Research in Innovative Teaching and Learning, 14*(1), 18-31.

Ebert-May, D., Brewer, C. and Allred, S. (1997) "Innovation in Large Lectures: Teaching for Active Learning*" BioScience*, 47(9):601-607.https://doi.org/10.2307/1313166

Hannon, A., English, S., & Silver, H. (1999). Why innovate? Some preliminary findings from a research project on "Innovations in Teaching and Learning in Higher Education". *Studies in Higher Education, 24*(3), 279-288.

Lawler, E. M., Mara Chen, X., & Venso, E. A. (2007). Student perspectives on teaching techniquesand oustanding teachers. *Journal of the Scholarship of Teaching and Learning, 7*(2), 32-48.

OECD. (2005). Oslo manual: guidelines for collecting and interpreting innovation data. Paris.

Revell, A., & Wainwright, E. (2009). What makes lectures 'unmissable'? Insights into teaching excellence and active learning. *Journal of Geography in Higher Education, 33*(2), 209-223.

Serdyukov, P. (2017). Innovation in education: what works, what doesn't and what to do about it? *Journal of Research in Innovative Teaching and Learning, 10*(1), 4-33.

Trinidad, J. E., Ngo, R. G., Nevada, A. M., & Morales, J. A. (2020). Engaging and/or effective? Students' evaluation of pedagogical practices in higher education. *College Teaching, 68*(4), 161-171.

Von Stumm, S., Hell, B., & Chamorro-Premuzic, T. (2011). The hungry mind: intellectual curiosity is the third pillar of academic performance. *Perspectives on Psychological Science, 6*(6), 574-588.

Walder, A. (2017). Pedagogical innovation in Canadian higher education: professors' perspectives on its effects on teaching and learning. *Studies in Educational Research, 54*, 71-82.

Weimer, M. (2002). *Learner-centered teaching: five key changes to practice*. San Fransisco: Jossey-Bass.

Wolff-Boenisch, D. (2021). *A case study on student perception of online learning*. Paper presented at the 7th International Conference on Higher Education Advances, Valencia, Spain.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14622

Geopolitics and business: the implications for management education

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Abstract

In this paper we identify the need for management education to incorporate a greater consideration of geopolitics. We do this by first of all noting some recent events that indicate the fundamental complex inter-connectedness of the geopolitical and the economic. We discuss some trends which underpin this (notably changes to the patterns of economic globalization and global governance, and the increased importance of the nation state), before going on to expore the prospects for continuing on-going uncertainty and volatility in the global economy. We identify areas that should be discussed with reference to the role that business plays in geopolitics, and the geopolitical plays for business. We call for an emphasis on interdisciplinarity to assist the integration of geopolitics into management education.

Keywords: *Management education; business; geopolitics; sustainability; human security; crisis.*

1. Introduction

In September 2021 the United Kingdom (UK) was confronted with a sudden shortage of carbon dioxide gas that threatened to disrupt the British food industry. Used for a range of processes – from the carbonation of beer to stunning animals prior to slaughter, and to freeze food – British production of carbon dioxide is heavily dependent on two plants owned by the United States (US) firm CF Fertilizers (Thomas and Sheppard, 2021). The plants produce ammonia, primarily for agricultural use, with CO2 as a bi-product (Terazono, 2021). CF Fertilizers shut down production at these plants because the price of wholesale natural gas, an input to the production process, had risen 70 per cent between August and September (Sheppard, 2021b), rendering the ammonia produced unprofitable. On 22 September the UK government agreed to provide financial support to CF Fertilisers to restart ammonia (and so CO2) production. This entailed a substantial UK subsidy to an American multinational corporation (Terazono, Pickard, and Evans, 2021)

One reason for the gas price rise was that European stocks had dwindled, largely because Russia cut supply to Europe (Sheppard, 2021b). This was most likely a consequence of the dispute over the Nord Stream 2 pipeline intended to supply Germany and the rest of Western Europe with Russian gas without using alternative transit countries, notably Ukraine. The US government has opposed Nord Stream 2, fearing that Russia could weaponise the pipeline, even isolating former Eastern bloc countries as part of its strategic ambitions in the region (Evans, 2020). The rise in gas prices also follows the switch from coal fired energy production intended to reduce carbon emissions. The natural gas provides cover when renewable sources of electricity production prove variable (Sheppard, 2021a).

On 16 September there was a fire at an electricity connecting station in Kent, where subsea electric cabling connects France to the UK electricity grid. This reduced electricity imports, placing more pressure on natural gas used to produce UK electricity (Thomas, Wilson, and Sheppard, 2021). UK dependency on imported energy was underlined when France appeared prepared to use the fire and the price spike as a bargaining lever in the dispute over post-Brexit fishing rights (Boffey, 2021).

The interconnected complexity of these events highlights how geopolitics is central to everyday business operations. The geo-strategic use of energy supply by Russia; the effects of intergovernmental agreements on climate change policy; the impact of energy security concerns on post-Brexit trading relationships; ongoing debates about national and international state aid and corporate welfare are all essential to understanding the difficulties faced by the UK food industry in September 2021 and the UK government response.

At the core of these concerns is how state and non-state actors exercise power, how and where decisions are taken, and their consequences both intended and unintended. In short, politics: the processes that determine who gets what, when and how (Laswell, 1939). This has

implications for businesses and management, and therefore for management education. Graduates ill-equipped to interpret, respond to, or anticipate the impact of geopolitics will be less effective than those better prepared.

2. All things do not remain the same

Politics is concerned with the multiple intersectionality between national interests, state-level decision-making, intergovernmental bargaining, domestic as well as global business, and impacts on various actors, employees, and consumers throughout the networked structures of contemporary economic globalisation.

Two interlocking trends under-gird this. The first is that, as the pandemic has revealed, global supply chains and economic relationships remain highly interconnected, with widespread contingent effects of crisis and/or disruption. The second is that although economic globalization remains deeply embedded, the institutional politics of globalization have gone into reverse. Global economic institutions such as the World Trade Organization (WTO) and the International Monetary Fund (IMF) have become less important or are unable to exercise decisive actions to mitigate negative outcomes, at least in the case of a pandemic. The UK's leaving the European Union in 2020 (Brexit) resulted in the first substantial example of political-economic disintegration in the bloc since 1951, undermining an integration process which accelerated following the end of the Cold War. And, though the EU successfully absorbed ten former Communist states as members, there remain problems associated with the legacy of Communism (Garton Ash, 2019). Likewise, though the advent of the Euro in 2002 has facilitated capital flows and trade within Europe, sovereign debt crises on the Eurozone periphery following the Global Financial Crisis threatened to upset economic and monetary union. The policy preference of Germany and the ECB to deal with these crises was for austerity to be imposed, the impact of which in countries such as Greece and Spain caused considerable social hardship, and has tested the durability of the European project.

Across the same period, there has been an intensification of dirigiste economics within the national political realm, especially among economies with enough international heft to exert hegemonic influence, notably the United States and China. Nation state assertiveness manifests in several ways, but perhaps most important is states are increasingly inclined towards national self-interest, protectionism and direct interventions in response to increasingly populist politics (Rodrik, 2018; Blyth, 2016; Thompson, 2021). States' preparedness to exercise hegemonic power across various dimensions – political, economic, and military – reinforces a realist analysis of international affairs (Krauthammer, 1990; Kagan, 2004; Mearsheimer, 2001; Yu, 2019; Tooze, 2022).

Secondly, governments have become more influential *within* their domestic economies. Recent crises demonstrate this: bailouts and quantitative easing (QE) following the Global

Financial Crisis in 2007/8 (Bell and Hindmoor, 2015; Braun, 2016; Reisenbichler, 2020); or economic support to businesses and households through lockdowns and other impacts of Covid-19 (Stuart et al., 2021). Additionally, the increased influence of state capitalism — from China's Belt and Road Initiative (BRI) to the importance of sovereign wealth funds to capital markets — indicates a decisive change in the international business environment (Alami and Dixon, 2020a; Alami et al., 2021; Alami and Dixon, 2020b).

3. The coming storms

The global economy and international society will confront substantial challenges in the coming decades. The climate emergency will impact the entire global population to varying degrees. Responsibility for dealing with this is shared by all governments, enterprises, and institutions. Citizens will bear the brunt of the consequences of inaction and will also have to absorb the impact of measures undertaken to mitigate climate change.

There is already evidence that states may turn inwards, and electorates may revert to a naïve trust in nostalgic and nationalist tropes (Blyth, 2016; Rodrik, 2018). A turn away from international institutions and increased friction in the international sphere will, potentially make dealing with global crises that require unity and partnership much more difficult. A beggar-thy-neighbour approach of every state for itself would be catastrophic.

Other threats may distract governments and institutions from doing what is required. We are already witnessing military rivalry, a new arms race, regional conflicts and local wars over resources, cyber (in)security, disruption of sub-sea infrastructure, satellites and communication systems, hybrid-warfare, and influence operations (Siman, 2022). These dangers risk catastrophic consequences, as small fires may lead to a conflagration.

Geopolitics impacts the systems and processes on which business and society depends for living standards and life's necessities, broadly encompassed in the notion of human security (Kaldor, 2007; Acharya, 2017:482). The UNDP (1994) Human Development Report referred to seven dimensions of human security:

Economic security basic income from remunerative work, or from a public safety-net

Food security physical and economic access to adequate nourishment

Health security minimum protection from disease and from unhealthy lifestyles

Environmental security shielding people from man-made threats in nature and a deterioration in the natural environment

Personal security protection from physical violence from others, including state authorities

Community security safeguarding traditional relationships and values from sectarian or ethnic violence

Political security protection of basic human rights, including ensuring that individuals and groups are free from arbitrary government control over ideas and information

A narrow business education—especially that which adopts ceteris paribus assumptions of a stable external environment, and prioritises internal managerial decision-making—avoids debate about how to live with the turbulence and impact of geopolitical structures and events. Business education must address the nature and consequences of policy choices, ideological preferences, political leadership (or lack of it) and the impact of events. Studying and better understanding issues like the onset, experience and recovery from financial crisis, the management of the Euro, the aftermath of Brexit, or the response to a global pandemic will help us to better address future challenges. Business leaders and anyone working in public sector organisations needs adequate preparation to meet future challenges.

4. A geopolitical turn for our curricula, a new pedagogy

We argue that business and management education must embrace geopolitical themes and a multidisciplinary curriculum to better equip graduates with the tools and insight required to be responsible citizens, and competent managers in a sustainable and human-centred business and organizational culture. Our central argument is that business and management education needs to adapt its curriculum to better comprehend the geopolitics of the global economy, and the fundamental relationship between business, environmental sustainability and human security. Relevant topics include:

Trade policy, trade agreements, impact of Brexit

Populist politics and the role of mainstream and social media

Energy, energy security and the transition to renewable energy

Climate crisis and the business response

Cyber security and influence operations

China's Belt and Road Initiative

Human rights and labour relations

Loophole capitalism – tax avoidance/evasion and free ports

Crypto currencies and blockchain technology

Consumption and sustainability

Corporate responsibility and sustainable economics

Business and management schools should therefore ensure that topics such as those listed above are integral to the curriculum of the degrees we teach. The weighting between these topics, and indeed the choice of what to include, will depend upon available staff expertise. But it is in recruitment to faculty and in programme design that business and management schools must respond to the call for geopolitical content in what we teach. This should not be optional. It is of paramount importance that business and management schools accept responsibility for raising awareness of contemporary geopolitical challenges, above all that of environmental sustainability, in our graduates. We must provide students with the tools to bring about change in how corporations and organisations behave. This means going beyond paying lip-service to critical thinking and analytical skills. We should aspire to raise consciousness and instil commitment to making the world a better and more sustainable place. We urge a core strand of geopolitical content should run throughout degree programmes from the first year through to completion. In their final year students should have the scope to pursue special project or dissertation-type studies that explore contemporary issues of the kind indicated above and affecting the firm, the organization, governance, and/or wider society.

Finally, we recognise pedagogical implications of broadening the business and management curriculum. Much business school education has relied on core economic principles of free-markets, and consumption-oriented economic growth, regardless of the environmental and natural resources impact. Business school education has been in thrall to this economic orthodoxy, which since the 1980s consists of neoliberal ideology (Parker, 2018), and urgently needs re-thinking (Sweeney, 2017). Successive financial crises already indicated this. Now the entire ecosystem is imperilled by climate change (Stern, 2007; Rachman, 2021).

We therefore call for a pedagogy that develops graduates' geopolitical knowledge given the importance of the field to businesses and the environment in which they, and all kinds of management (public sector, NGOs, charities, social enterprises, SMEs, corporations, manufacturing and services) operate. This will require more focus on what is outside the firm rather than what is inside. This demands approaches to strategy that can secure value in terms not merely of profit, but of sustainability, human security and societal wellbeing. It will require a greater and integrated understanding of political, social, cultural, and economic complexity of the contemporary international political economy.

The final pedagogical implication is to underscore the importance of interdisciplinary studies. Business and management education should reach out more to other social sciences (sociology, social policy, politics, economics, psychology), humanities (business history, human geography) and environmental science. A holistic, societally sustainable, community-oriented, multi- or trans-disciplinary education will better meet the needs of tomorrow's business and organisational leaders.

References

Acharya, A. (2017). Human Security, Ch. 30 in Baylis, J., Smith, S. and Owens, P. (eds.) *The Globalization of World Politics: Introduction to Internation al Relations*. Oxford: Oxford University Press. 480-96.

Alami, I. & Dixon, A.D. (2020a). State Capitalism(s) Redux? Theories, Tensions, Controversies. *Competition & Change* 24 (1): 70–94.

Alami, I. & Dixon, A.D. (2020b). The Strange Geographies of the 'New' State Capitalism. *Political Geography* 82 (102237): 102237.

Alami, I., Dixon, A.D., Gonzalez-Vicente, R., Babic, M., Lee, S.-O., Medby, I.A., & de Graaff, N. (2021). Geopolitics and the 'New' State Capitalism. *Geopolitics*, July, 1–29.

Bell, S. & Hindmoor, A. (2015). *Masters of the Universe, Slaves of the Market*. Boston, MA: Harvard University Press.

Blyth, M. (2016). Global Trumpism. *Foreign Affairs* https://www.foreignaffairs.com/articles/2016-11-15/global-trumpism.

Boffey, D. (2021). France Threatens to Cut UK and Jersey Energy Supply in Fishing Row. *The Guardian*, 5 October. https://www.theguardian.com/world/2021/oct/05/france-uk-jersey-eu-energy-supply-fishing-row-channel.

Braun, B. (2016). Speaking to the People? Money, Trust, and Central Bank Legitimacy in the Age of Quantitative Easing. *Review of International Political Economy*. https://www.tandfonline.com/doi/abs/10.1080/09692290.2016.1252415.

Evans, C. V. (2020). Future Warfare: Weaponizing Critical Infrastructure. *The US Army War College Quarterly: Parameters* 50(2), 6.

Garton Ash, T. (2019). *The Magic Lantern: The Revolution of '89*. London: Atlantic Books.

Kagan, J. (2004) *Paradise & Power: America and Europe in trhe New World Order*. London: Atlantic Books.

Kaldor, M. (2007). *Human Security*. Cambridge: Polity Press.

Krauthammer, C. (1990) 'The Unipolar Moment' *Foreign Affairs* 70(1) 23-33.

Laswell, H. (1936). *Who Gets What, When and How*. New York: Whittlesey House.

Mearsheimer, J. (2001) *The Tragedy of Great Power Politics*. New York: W.W.Norton.

Parker, M. (2018). *Shut down the Business School*. Chicago: University of Chicago Press.

Rachman, G. (2021) COP26: Success or Failure? *Financial Times*, 18 November. https://www.ft.com/content/291a8de1-6184-4761-962a-e5788fc800f5

Reisenbichler, A. (2020). The Politics of Quantitative Easing and Housing Stimulus by the Federal Reserve and European Central Bank, 2008–2018. *West European Politics* 43(2), 464–84.

Rodrik, Dani. (2018). Populism and the Economics of Globalization. *Journal of International Business Policy* 1(1–2), 12–33.

Sheppard, D. (2021a). Gas Crunch Tests the Old Cure for Higher Prices. *Financial Times*, 10 August 10. https://www.ft.com/content/7bf23d64-4891-44d2-8c02-16df432193d2.

Sheppard, D.(2021b). Why Europe Fears a Gas Crunch Even before Winter Demand Begins. *Financial Times*, 14 September. https://www.ft.com/content/7c31ca15-aa4f-4a32-bb90-ebc1341ed374.

Siman, B. (2022) Hybrid Warfare is not Synonymous with Cyber: The threat of influence operations. *Security Policy Brief* 155 February. Brussels: Egmont Institute. https://www.egmontinstitute.be/content/uploads/2022/02/spb155-siman-final-version_0222.pdf?type=pdf

Stern, N. (2007). *The Economics of Climate Change: The Stern Review*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511817434

Stuart, M., Spencer, D.A., McLachlan,C.J. & Forde, C. (2021). COVID-19 and the Uncertain Future of HRM: Furlough, Job Retention and Reform. *Human Resource Management Journal* 31(4), 904–17.

Sweeney, S. (2017). A New Economics for a Better World. *Hindu Business Line* 5 May. https://www.thehindubusinessline.com/opinion/a-new-economics-for-a-better-world/article9680997.ece

Terazono, E. (2021). CO2 Crisis Set to Spread to Europe, Big Distributor Warns. *Financial Times*, 22 September. https://www.ft.com/content/475ca564-66b1-49b7-b6ce-f6f682deeac8.

Terazono, E, Pickard, J. & Evans, J. (2021). CO2 Producer to Restart Operations after UK Minister Strikes Deal. *Financial Times*, 21 September. https://www.ft.com/content/991db1b7-ab0e-49fb-999c-3bf5bef2a93a.

Thomas, N., & Sheppard. D. (2021). Gas Price Surge Triggers UK Fertiliser Plant Closures and Crop Warnings." *Financial Times*, 16 September. https://www.ft.com/content/b2e7b6ed-fa14-48e1-a463-4d3b09c654dd.

Thomas, N., Wilson, T. & Sheppard, D. (2021). Fire at UK-France Electricity Subsea Cable Triggers New Price Surge. *Financial Times*, 15 September. https://www.ft.com/content/b5a5e29a-9556-4d07-882b-10b1749efced.

Thompson, H. (2021). The European Geopolitical Space and the Long Path to Brexit. https://www.repository.cam.ac.uk/handle/1810/316836.

Tooze, A. (2022) 'John Mearsheimer and the dark origins of Realism' *New Statesman*. 8 March. https://www.newstatesman.com/ideas/2022/03/john-mearsheimer-and-the-dark-origins-of-realism

UNDP (1994) *Human Development Report*. Oxford: Oxford University Press.

Yu, FL.T. (2019) 'Neo-Mercantilist Policy and China's Rise as a Global Power'. In: Yu, FL., Kwan, D. (eds) *Contemporary Issues in International Political Economy*. Palgrave Macmillan, Singapore. https://doi.org/10.1007/978-981-13-6462-4_8

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14687

A European perspective on the internationalisation strategies and accreditation of Business Schools

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Abstract

Internationalisation is a key component of higher education institutions that nowadays is embedded in their teaching and research activities, as well as their strategies. In Europe, since the Bologna process in 1999, universities and governments have tried to align their policies, to make procedures more homogenous across the countries. However, for business schools undertaking an accreditation process, it can be challenging to fully comply with both the European and the national guidelines, and the requirements issued by the accreditation agency. This study aims to explore the internationalisation process of higher education institutions, with a focus on business schools' accreditation process. Through document analysis, the comparison between the recommendations issued at the European and at the national levels, and the quality standards and criteria of the accreditation agencies is meant to understand which strategies should be promoted in the future internationalisation agenda of business schools.

Keywords: *Internationalisation; Accreditation; International strategies; Quality standards; European guidelines; Globalisation.*

1. Introduction

In Europe, the internationalisation of universities has started to play a key role since the 1990s (European Commission, 2020a). One of the most recent and complete definition of this phenomenon, describes it as: "The intentional process of integrating an international, intercultural or global dimension into the purpose, functions and delivery of post-secondary education, in order to enhance the quality of education and research for all students and staff and to make a meaningful contribution to society" (de Wit *et al*. 2015, p. 29). According to Knight (2008, pp. 22-24), the main components of internationalisation can be split into two: 'internationalisation abroad' and 'internationalisation at home'. The former defines all the cross-border educational initiatives such as mobility of students and faculty, and joint and double degree programmes; while the latter encompasses the activities meant to foster students' intercultural skills and understanding of international issues, thanks to *ad hoc* changes in the universities' curricula and their teaching and learning practices. These two components are both embedded into the strategies and policies of higher education institutions, which depend on internal and external factors such as universities' strategic plans, national regulations and the guidelines of the European Commission (2013). In particular, business schools are highly influenced by internationalisation policies, for a series of reasons, such as the need to compete against other institutions to offer the highest quality of research and education, and attract the best students and faculty (Hawawini, 2016). Moreover, the nature of business schools is deeply influenced by the global economy, since the knowledge of foreign markets, the growth of technologies and the current environmental issues represent some of the challenges that business schools' graduates need to be able to tackle (cf. Kedia & Englis, 2011).

One of the strategies for business schools to increase their reputation and gain legitimacy (cf. Guillottin and Mangematin, 2015) is to receive the accreditation of a reputable international agency, so as to prove the quality of their education also through their membership among other prestigious business schools. In Europe, one such agencies is the EFMD (European Foundation for Management Development) that issues the EQUIS certification, whose guidelines provide indications on the requirements of the accreditation process (cf. EFMD, 2022). However, since institutions are rooted in their national and socio-economic context, and in their historical traditions, their strategic choices are also defined by their government's policies (at a national and regional/supranational level). Both international accreditation agencies and national guidelines constitute forms of external pressure which may oblige single institutions to modify their strategic agenda to conform to their norms, through isomorphic processes (cf. Di Maggio & Powell, 1983). This study aims to contribute to the literature concerned with the internationalisation of higher education institutions, and specifically, of business schools, to discover how institutions can cope with the challenge of balancing both the requirements set by their supranational and national guidelines, and those

established by the accreditation agency, with regards to their internationalisation strategies. This contribution is organised as follows: first, a brief description of the internationalisation practices that have been implemented in Europe in these years, in comparison with a national perspective, and the quality measures used by business schools to foster their international dimension. In the analysis, the strategies recommended at the European and national levels will be compared with the accreditations guidelines given by a European accreditation agency. The result of the comparison may inform the practices that could be taken into consideration to improve the quality of the internationalisation process for university business schools.

2. Literature review

In Europe, the Bologna process in 1999 represents a turning point for the expansion of the internationalisation phenomenon because, with the aim of creating a common European Higher Education Area (EHEA), the differences across the European higher education systems were made more homogenous. Moreover, since 2009 until today, one of the main priorities for the internationalisation of European universities has been student mobility, with the target that by 2020, at least 20 % of students graduating in the EHEA should have had a study or training experience abroad (European Commission, 2020a). As a consequence, numerous bilateral agreements have been developed to ease student exchanges and knowledge transfer between institutions (European Commission, 2020b). Another effect was the implementation of English-taught programmes also in countries where English is a second or a foreign language, as a way both to attract international students and scholars, and to prepare local students for the globalised labour market (Knight, 2008). Over the past 20 years, the European Union has invested 1.7 billion Euros in the mobility of students, allowing more than 24,500 people to study in Europe thanks to scholarships (European Commission, 2020b, p. 10).

However, despite all these measures to standardise it, the European scenario remains quite fragmented because of the various national legislations about the Erasmus+ and the difficulties in the implementation of joint and double degrees (European Commission, 2020b). This fragmentation is reflected in the heterogeneous approaches to internationalisation across different European countries and types of institutions (cf. de Wit, Hunter and Howard, 2015). For instance, the Italian higher education system, though having a long-standing academic tradition, has lagged behind other countries from the point of view of internationalisation policies (cf. de Wit *et al*., 2015). The reforms made in the past 60 years, as an attempt to modernise its centred governance to a system that enhances more autonomy for the single institutions has not been realised to its full potential (Hunter, 2015). Among other factors, there has been some resistance on the part of the academic community, who perceived the international dimension of higher education as an interference more than

an opportunity (de Wit *et al*. 2015, p. 117). Notwithstanding the lack of a comprehensive national strategy, a series of measures have been developed to improve the higher education system, giving internationalisation a greater importance (Hunter, 2015; cf. MIUR, 2017).

In the field of business education, being awarded by an international accreditation agency is a way for business schools to have their quality standards for education recognised (cf. Kaplan, 2014) and foster their reputation worldwide. Accrediting associations such as the EFMD (European Foundation for Management Development) founded in 1972 , the AACSB (Association to Advance Collegiate Schools of Business) founded in 1916 in the USA, or the British AMBA (Association of Masters of Business Administration), created in 1967 to accredit graduate business programmes, issue detailed sets of quality standards and criteria that provide clear indications on how to evaluate different aspects of a school's organisational structure, mission, educational programmes, staff qualifications and learning outcomes. In Europe, the EQUIS (EFMD Quality Improvement System) certification was launched in 1997, as a means to counterbalance the overarching presence of American standards for the accreditation of business schools (cf. Kaplan, 2014). One of the features that differentiate EQUIS from other accreditations is the attention given to three main transversal dimensions, namely "Internationalisation, Connections with Practice, and Ethics, Responsibility & Sustainability" (EFMD, 2022, p. 5). According to the guidelines, EQUIS aims at enhancing the internationalisation of business schools, a dimension that is reflected all throughout the chapters of the guidelines, where the schools are guided through a process of self-reflection on their current practices and strategies, as they are expected to "attract students and faculty from other countries, deliver programmes up to internationally accepted standards, effectively prepare their graduates for international management and maintain connections with academia and practice outside their home country" (EFMD, 2022 p. 68). It is relevant to explore the impact of the accreditation agencies, alongside other external agents – namely the European Commission and the national government – on the internationalisation strategies of higher education institutions, by comparing the recommendations issued in their guidelines or policies, to understand how university business schools can cope with the pressures exerted by these external agents.

3. Method

The method selected is the document analysis (Given, 2008, p. 230-231) as it is suitable for qualitative research in which rich descriptions of a single phenomenon or organisation are produced. The documents for the analysis have been selected for their relevance in helping the researchers to uncover hidden meanings and agenda, and to develop a better understanding of the phenomenon observed (cf. Atkinson & Coffey, 2004). Multiple types of documents have been consulted: The European Commission's documents on internationalisation strategies and policies (2013, 2020a, 2020b, 2022a, 2022b), the Italian

government's national guidelines and strategic approaches (MIUR, 2017, 2021; CRUI, 2019), EFMD's EQUIS guidelines (2022). The systematic review of the documents provided the background information that was necessary to understand the regulatory, sociocultural, educational and political contexts in which the internationalisation agenda of business schools should be set, and how it could be developed in the future.

4. Analysis

The documents observed through comparative analysis (cf. Gibbs, 2007) highlighted some differences and some similarities between the internationalisation strategies promoted at the European level, the Italian national guidelines, and EQUIS' criteria. Over the course of the years, one of the most evident consequences of the internationalisation strategies adopted by universities in non-Anglophone countries concerns the introduction of English-taught programmes, especially at the master's level (European Commission, 2020a). This main change represents a way to attract a more international audience (cf. Wächter & Maiworm, 2014), but can also benefit local students who are interested in working abroad or in more international working environments where English is used as a lingua franca among speakers of different languages. Since English is already the most widely used language in the academic field of business education, having a number of programmes taught in English is also among the requirements for a business school's accreditation (EFMD, 2022). However, at national level, a law issued in 2018 by the Italian State Council stated that teaching only in English is an unconstitutional act and that the priority should be given to the national language. To meet all these requirements, business schools within the Italian higher education system may decide to offer similar Master's Degree Programmes both in Italian and in English, running parallel but tailoring the suitable and specific learning objectives of each programme. This strategy would not only allow students to choose which language they prefer for their degree programme, but also may help to prevent possible domain loss of the local language (cf. Sanden, 2020).

In the various documents consulted, the type of partnerships required at the level of joint and double degrees appears to be a challenging issue. According to the European Commission, higher education institutions should cooperate with other institutions in developing countries, to favour North-South and South-South collaboration (European Commission, 2013, p. 9). In line with these recommendations, in the Italian guidelines on internationalisation, the government and the universities will make future investments and build partnerships in countries that pertain to low and middle-income categories (cf. MIUR, 2017). In the EQUIS guidelines, it is suggested that business schools should have "high quality strategic partnerships" (EFMD, 2022, p. 71), meant to be with reputable and prestigious partners, as it is more suitable to have fewer but more relevant mobility and exchange agreements, that many but of lesser quality (cf. Hawawini, 2016). Thus, partnerships should be sought with

other accredited business schools displaying similar high standards of quality. Although the purpose is to have partnerships worldwide, in the end, partnerships in western, high-income countries are favoured because the majority of accredited business schools are located there.

For these reasons, the strategic choices of European business schools become particularly important when selecting the kinds of partnerships that should be established and maintained, being aware of the normative pressures exerted by the European and the national guidelines, but also by the international accreditation agency. Otherwise, uncertainties in the strategies may lead to mimetic isomorphism, when the adoption of the internationalisation practices of leading business schools occur (cf. Bradford *et al*. 2017), whether or not it is a rational choice at the organisational and strategic level (cf. Di Maggio & Powell, 1983).

Another relevant point in the document analysis concerns the presence of international students on campus. On the one hand, Italy does not represent one of the main study destinations for international students, as proved by the low numbers registered in the last years by the Conference of Italian University Rectors (CRUI, 2019). An analysis revealed that for students of some non-European countries, Italy is not a destination where to obtain a higher education diploma from an Italian institution, but it is attractive mostly for its institutions of higher artistic and musical education, or for short study periods (CRUI, 2019). On the other hand, a business school should prove its international status also thanks to the numerous presence of foreign students (cf. EFMD, 2022; Hawawini, 2016). Being international does not only mean having many international students (de Wit, 2013), since the amount of international students within an academic institution loses relevance if they do not feel part of the local student population, enhancing their social skills and cultural awareness thanks to their interactions. To favour students' integration and understanding, business schools located in non-Anglophone countries should not only include the provision of intensive language courses, both in English and in the local language, but also courses about the socio-economic and cultural context. Inserting these learning goals should become a requirement especially in international programmes, because it can favour the retention of foreign graduates who may want to find a job in the country in which they studied, instead of moving back home or going abroad after receiving their diploma.

Finally, one recurring theme that has become increasingly important is the need for more virtual and digitalised forms of higher education. Although it was already inserted as a feature of comprehensive internationalisation in the European Commission's document (2013), the digital transformation of education has gained relevance over time, thanks to distance education, blended and hybrid teaching and learning (cf. de Wit *et al*., 2015). The most recent version of EQUIS' guidelines (2022) considers digital learning and virtual mobility as an integral part of the international dimension of business school's activities. In the present time, virtual exchange may represent a valid opportunity, and a viable option that can substitute physical mobility, whenever the latter is not possible for shortage of funding or means.

However, there is still room for improvement, because the lack of interoperability between digital infrastructures of higher education institutions across the European Union has hindered the creation of European (virtual) inter-university campuses and platforms for joint digital or blended activities (European Commission, 2022a, p. 2). Moreover, the digitalisation of operations, namely the digital transition, can help higher education institutions "to provide high quality services across multi/virtual campuses which would be difficult to do as individual or smaller institutions or institutions with geographical disparate facilities" (European Commission, 2022b, p. 23). Digitalisation has the additional advantage of creating opportunities for more equal and sustainable approaches to internationalisation, because of its role in creating bridges between institutions, reducing the carbon footprint of on-site international meetings and conferences, and easing the exchange of information, and the knowledge transfer of learning and research contents. Therefore, to maximise their impact, higher education institutions should not only become more engaged, collaborative and open, but also build innovative and hybrid structures to combine physical and virtual places, to connect different sectors and transcend borders (European Commission, 2022b, p. 32).

5. Conclusion

The analysis has highlighted how different forces may regulate the decisions and the internationalisation agenda of higher education institutions, especially for university business schools that are undertaking an accreditation process. Some challenges have been observed when comparing the expectations expressed in the requirements set by the accreditation agency, and the recommendations at European and national levels, on matters related to the language used for teaching and learning, the types of partnerships established with other universities, and the numerous presence of international students on-site. Therefore, to comply with different expectations, universities' strategic decisions imply a constant balance between the quality of the education provided and the quantity, in terms of measurable outcomes, such as the number of English-taught courses, of international double or joint degree programmes, or of foreign students. When confronted with the expectations to conform to these normative pressures, it is important for a single institution to take a sustainable approach in the management of its internationalisation strategies. This requires any higher education institution to have a comprehensive internationalisation strategy (European Commission, 2013). In particular, for business schools that wish to be considered part of a 'world-class' institution, their strategy should always consider which resources they have at their disposal, and that "the strategic alignment of the internationalisation process with the general strategic plan is necessary for a successful implementation of the process" (Bradford *et al*. 2017, p. 449).

Moreover, it is crucial to remember that the intent of internationalisation process is not to make an institution international *per se*, but to use the 'integration of international, intercultural or global dimensions' to achieve its academic objectives, and to improve the socio-cultural, economic, or political goals of its country/region (Knight, 2015, p. 108). In fact, by setting a new agenda for the future, the European Commission's guidelines wish to inspire higher education institutions across the various European countries, having the goal to tackle the inequalities related to socio-economic and environmental problems through internationalisation policies (European Commission, 2013, 2020a). Within the Italian context, the latest guidelines released by the Italian Ministry of Education, University and Research (MIUR) aim at raising the quality of the academic system, to support universities in reducing these inequalities (MIUR, 2021, Ministerial Decree n. 289, of 23-05-2021). These local and global challenges are the object of business education as well (Bradford *et al*., 2017; Kedia & Englis, 2011), whose purpose is to have a positive impact on society (EFMD, 2022). Business education is thus required to take a wider and more international perspective (Hawawini, 2016), also thanks to a renewed attention towards ethical and sustainable practices (cf. European Commission, 2020a; EFMD, 2022). Therefore, every future step of the internationalisation strategy needs to be carefully pondered, so as to keep a balanced and equitable perspective, but also to preserve the autonomous and proactive capacity of creating positive change which pertains to business schools.

References

Atkinson, P. A. & Coffey, A. (2004). Analysing documentary realities. In D. Silverman (Ed.), *Qualitative research: Theory, method and practice* (2nd ed.), London: Sage, pp. 56–75.

Bradford, H. Guzmán, A. and Trujillo, M. A. (2017). Determinants of Successful Internationalisation Processes in Business Schools. *Journal of Higher Education Policy and Management*, 39(4), 435-52.

CRUI – Conferenza dei Rettori delle Università Italiane (2019). *L'internazionalizzazione della formazione superiore in Italia. Le università*. a cura di Fabio Rugge. Aggiornamenti e approfondimenti. https://www.crui.it/images/crui-rapporto-inter-digitale.pdf

de Wit, H. (2013). Internationalisation of higher education, an introduction on the why, how and what. In de Wit, H. (Ed). *An introduction to higher education internationalisation*. Centre for Higher Education Internationalisation. (CHEI), Università Cattolica del Sacro Cuore, Milano: V&P, pp. 13-46.

de Wit, H., Hunter, F., Howard L. and Egron-Polak E. (2015). *Internationalisation of Higher Education – Study*, Directorate-General for Internal Policies, Policy Department: Structural and Cohesion Policies, European Parliament, Brussels.

Di Maggio, P. and Powell, W. (1983). The iron cage revisited: institutional isomorphism and collective rationality in organizational fields. *American Sociological Review*, 48(2), 147-160.

EFMD – European Foundation for Management Development (2022). EQUIS - Standards & Criteria. EFMD Quality Improvement System. *The EFMD Accreditation for International Business Schools*. https://www.efmdglobal.org/accreditations/business-schools/equis/equis-guides-documents/

European Commission (2022a). *Proposal for a council recommendation on building bridges for effective European higher education cooperation*. Strasbourg, 18.1.2022, COM(2022) 17 final 2022/0008 (NLE).

European Commission (2022b). *Commission staff working document*. Accompanying the documents Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on a European strategy for universities and the Commission Proposal for a Council Recommendation on building bridges for effective European higher education cooperation. Strasbourg, 18.1.2022 SWD(2022) 6 final {COM(2022) 16 final}.

European Commission (2020a). *The European Higher Education Area in 2020: Bologna Process Implementation Report*. Luxembourg: Publications Office of the European Union.

European Commission (2020b). *Implementing Joint Degrees in the Erasmus Mundus action of the Erasmus+ programme*, report by the Education, Audiovisual and Culture Executive Agency (EACEA) of the European Commission Unit A3 – Erasmus Mundus, Sport.

European Commission (2013). "*European higher education in the world*", Communication from the commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Brussels, 11.7.2013, COM (2013) 499 final. https://op.europa.eu/s/sUsT

Gibbs, G. R. (2007). *Analysing qualitative data*. London: Sage.

Given, L. M. (2008). *The Sage encyclopedia of qualitative research methods*. Los Angeles, Calif: Sage Publications.

Guillotin, B., and Mangematin, V. (2015). Internationalization Strategies of Business Schools: How Flat is the World? *Thunderbird International Business Review*, 57(5), 343-357. doi: 10.1002/tie.21705

Hawawini, G. (2016). *The Internationalisation of Higher Education and Business Schools*. A Critical Review, Singapore: Springer.

Hunter, F. (2015). Internationalisation as a Lever for Change: The Case of Italy. In Curaj A., Matei L., Pricopie R., Salmi J., Scott P. (eds.), *The European Higher Education Area: Between Critical Reflections and Future Policies*, Springer Open, pp. 93-107.

Kaplan, A. (2014) European management and European business schools: Insights from the history of business schools. *European Management Journal*, 32, 529-534.

Kedia, B. L., and Englis, P. D. (2011). Transforming business education to produce global managers. *Business Horizons*, 54(4), 325-331. doi:10.1016/j.bushor.2011.02.006

Knight, J. (2015). International Universities: Misunderstandings and Emerging Models? *Journal of Studies in International Education*, 19(2), 107–121. https://doi.org/10.1177/1028315315572899

Knight, J. (2008). *Higher education in turmoil: The changing world of internationalization*. Rotterdam: Sense Publishers.

MIUR – Ministero dell'Istruzione, dell'Università e della Ricerca (2021). *Linee generali d'indirizzo della programmazione triennale del sistema universitario per il triennio 2021-2023*. Decreto Ministeriale n. 289 del 25-03-2021. https://www.mur.gov.it/it/atti-e-normativa/decreto-ministeriale-n-289-del-25-03-2021

MIUR – Ministero dell'Istruzione, dell'Università e della Ricerca (2017). *Strategia per la promozione all'estero della formazione superiore Italiana 2017/2020*, documento stilato in collaborazione con il Ministro degli Affari Esteri e della Cooperazione Internazionale (MAECI) https://www.esteri.it/mae/resource/doc/2017/04/strategia_fsi.pdf

Wächter, B. and Maiworm, F. (Eds.) (2014). *English-Taught Programmes in European Higher Education. The State of Play in 2014*, ACA Papers on International Cooperation in Education, Bonn: Lemmens.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14199

Team Formation and Project Assignment –the dilemma of assigning students to project groups

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Abstract

To meet the needs of globalization and change in higher education group work projects are increasingly used. However, there is many methods mentioned in literature to assign student teams but little guidance on how best to allocate students to groups with reference to the project itself.

The experience over a decade of teaching an IT (information technology) project course is shared with different team composition methods in the context of various project settings: first: teams and projects are self-selected, second: randomly assigned groups select the projects, and third: projects are selected individually followed by assigned team formation. The different methodologies are outlined in detail and the impact of the composition and assignment method on project results and individual learning progress and success is discussed.

Keywords: *student projects, group, team; team assignment, project assignment.*

1. Introduction

Unlimited access to information in a globalized environment requires the shift to a competency-based teaching model enabling students to take over responsibility and master their own learning process. One well acknowledged approach is project based learning that reinforces students` natural desire to learn: Gomez-Pablos et al. (2016), entails deeper learning outcome: Cuseo (1992) and gains skills above and beyond sheer theoretical and factual knowledge with improvement of interpersonal and interaction skills: Muller (1989).

However, forming teams and deciding on self-selection or assignment of group members remains a challenge for both, students and lecturers. To give weaker students a chance to learn from stronger group members and to meet important inter-student differences regarding skills, experience and confidence project groups may be formed referring to the individual student's learning background. Moreover, assigned groups more likely contain compatible people and a balanced distribution of student skills making the process of group work easier and more productive: Huxham (2020), Muller (1989) significantly improving the individual student performance: Pinto (2012). However, Muller (1989) observes tentative evidence in balanced groups that the more experienced students will be less satisfied and feel less challenged by the group: Muller (1989) and pedagogic difficulties arouse: Hübscher (2010).

Methods of team formation have been discussed widely: Layton et al. (2010), Hishon (2019). Wei et al. (2021). However, up to now there is no evidence in literature to connect team formation and project decision. In this paper we will give a brief insight of forming groups directly focusing on the project itself as means of strong team building criteria.

1.1. Methods to assign students to teams (Figure 1)

A) Self-selection: Students chose their group individually.
Pros: Students take over responsibility and control over learning experience with respect to accountability, cooperativeness and group cohesiveness: Layton et al. (2010). Decision-making and problem solving skills are enhanced: Hishon (2019).
Cons: Clique behavior erodes team cohesion and performance resulting in a lack of the teams` diversity: Razmerita and Brun (2011) and necessary skills: Layton et al. (2010). Some students might feel excluded, lonely, embarrassed or frustrated.

B) Assigning: assignment of groups by external force
Pros: Communication and problem-solving skills are earned by delegating work and navigating different styles of learning. Fast group selection is offered and students get to know each other early: Layton et al. (2010), Hishon (2019).
Cons: Students feel unhappy because being imposed upon. Problems such as rivalry, friendship, fights, conflicts, etc. may arise: Layton et al. (2010) because students feel lack of fairness regarding unequal distribution of skills in a team.

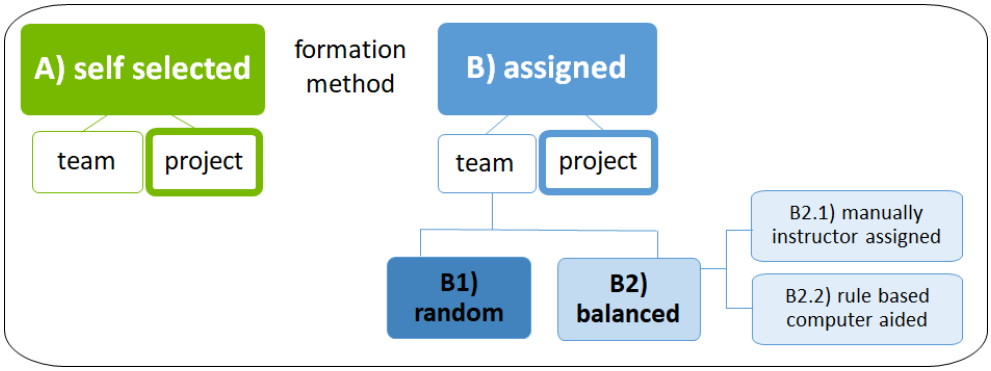

Figure 1. Schematic illustration of team formation and project selection. The team may be assigned (blue) or group members select their team individually (green). NEW: implementation of project decision into group formation procedure.

Assigning group teams may follow one of the following procedures:

B1) Random assignment: assignment to groups by random selection (e.g.: counting, etc.) The method is often mentioned as the simplest and most efficient approach but is found to have a number of disadvantages and no clear strengths not necessarily resulting in a team with any more diversity, balanced skills, or blend of personalities than does self-selection, but raises concerns about fairness: Layton et al. (2010), Reis (2016).

B2) Balanced assignment: assignment of groups by instructors or algorithms
B2.1 manually instructor assigned: When the instructor knows the students' background characteristics (e.g., grade point average, major subject, level of skills, etc.) the distribution of member resources can be balanced and improves student outcomes. However, instructor assignment may become dramatically complex and time consuming: Layton et al. (2010).

B2.2 rule-based computer-aided assigned: Computer-aided team-assignment helps the instructor to control and facilitate the selection process using instructor-specified criteria: Razmerita and Brun (2011) and increases the likelihood that instructors' team-formation criteria are met consistently: Layton et al. (2010). But, when the weights of certain criteria are set to be strong, the rank algorithm is not effective enough: Wei et al. (2021)

As one of our main propositions the project itself is indispensable for successful group work. Therefore, in Figure 1 we include not only the main team formation routes but also apply this selection procedure for projects. During self-selecting of projects students may decide to individually choose existing projects or choose the project as result of a group decision.

2. Course setting: project computer engineering

Up to now project assignment is not considered an important decision factor for team composition as in educational settings often all teams work parallel on the same task.

The project setting in our IT program is different. The new project course generally aims at the application of programming skills as well as at the self-exploration of new technology within a certain business context. The projects are conducted in cooperation with different external partners, e.g. companies, non-profit-associations or public authorities. The projects, though comparable by effort differ with respect to the product and the technology stack. The choice for a certain project has impact to the expertise gained as well as the personal network. Some students like to work together with big companies as Zalando, IBM or SAP others prefer to gain start up experience or work together with non-profit organizations. The same accounts for the technology stack – some students like to choose and explore new technology others want to get expertise in well-established often proprietary technology stacks.

The students in the IT program at HTW Berlin have to take the project course twice: already within their 3rd term and again much more experienced within their 5th semester: Siegeris et al. (2018). In the beginning of the semester the partners frame the goal of the project and pitch their idea. The student teams then work in a mainly self-organized way (following an agile process) throughout the entire semester. The expenditure of the project course is set by 10 ECTS, which implies an effort of about 300 hours per student and project.

The setting requires high motivation of the individual student and a good performance of the group. Here, the intrinsic motivation highly depends on the individual preferences for a certain project(partner) but the team performance is sensitively dependent on the team composition. This poses high requirements to the matching process in the beginning.

3. Approaches of assigning students to teams and projects

We present and reflect on team formation methods encountering the last decade (2010-2021) (Figure 2). During the first three years, the so-called “Table-Method” was used, leaving the choice for the group and project to the students:

Table method (2010-2013) fully self-selected (Figure 2, bottom):
Methodology: 1 day: pitch before team formation and choice of project. Teams are formed self-selected simultaneously to also self-selected project choice.

1. The partners pitch their projects. - after a short break (external partners leave)
2. The project names are pinned to different tables in front of the class.
3. The lecturer then signals the students to approach and write their names onto the project table until the team size was matched.

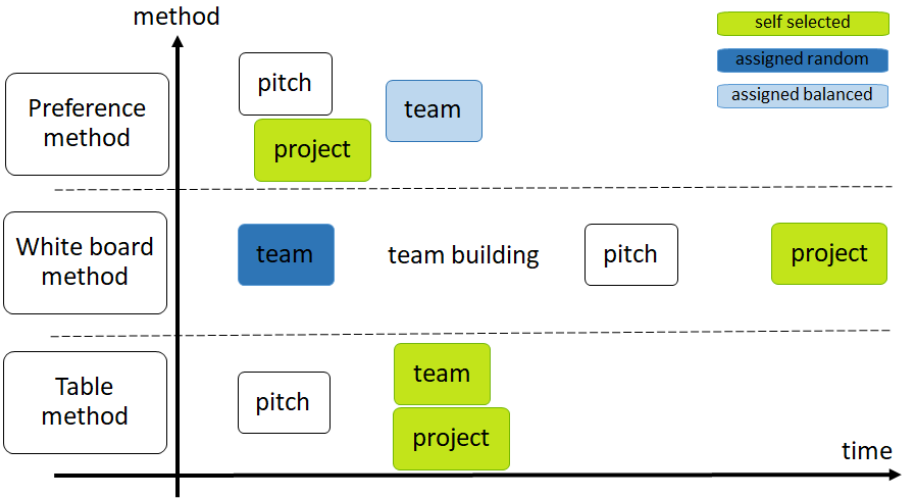

Figure 2. Comparison of team and project formation with regard to expenditure of time and formation method: self-selected, randomly assigned or balanced assigned. For project topics see: Siegeris et al. (2018).

Whiteboard method (2013-2020) assigned, only projects self-selected (Figure 2, middle):
Methodology: 3 days: Random teams are assigned before projects are pitched. Projects are chosen self-selected.

1. Teams are randomly chosen. In order to gain mixed teams, the projects were drawn from two prepared boxes, containing either 3rd term or 5th term student names.
2. The external partners pitch their project ideas in front of all teams.
3. Idle time (combined with a team building workshop) to facilitate discussion.
4. The actual assignment starts by putting project names onto a whiteboard.
5. First round: teams get sticky notes to mark down their decision by writing down their team's name and the preferred project.
6. Only if all notes have been collected, the papers are pinned to the whiteboard underneath the corresponding project names
7. Projects with only one team name underneath get assigned.

All other teams go for a second or a third round. In between rounds, time is given to enable discussion between teams. If the third round would not bring a result, the lot would decide.

Preference method (2021), assigned according to project (Figure 2, top):
Methodology: 1 day: Projects are pitched and self-selected. Balanced teams are assigned according to project preference.

1. External partners come and pitch their project ideas.
2. Meanwhile students list their preferences ranking 7 out of the 12 projects pitched.
3. Teachers use the individual rankings to build balanced teams.

4. Reflection on learning outcome versus group setting – individual needs

Table method (2010-2013) fully self-selected (Figure 2, bottom):

We rate the Table method a bit as a "first come first served" method: the fastest students get the project they like; the second fastest are able to sort their project by looking upon what their team mates decided; the undecided students looked what is left but benefit from choosing with respect to project and team.

One - to our experience negative - effect of this method is that students agreed for a certain project in advance. (Sometimes entire student teams compete for the same project. If no agreement is found, the lot decides.) This resulted quite often in very homogeneous teams with respect to migration background, age and expertise.

Students are highly dissatisfied and lack motivation when they were not quick enough to make it for the project and/or the team mates. Team formation according to the *Table method* resulted in very strong and very poor performing teams. The latter frustrated not only students but also the external partners. Especially in the 3rd term the frustration level was quite high as their naturally still low expertise did often not match the requirements. A pro: the whole procedure fit into one day.

Whiteboard method (2013-2020) assigned, only projects self-selected (Figure 2, middle):

As a first step to overcome these deficiencies, we decided to combine the courses to form mixed teams of 3rd and 5th term students. Homogeneous teams are avoided by assigning the teams randomly. Still, the teams should maintain the right to choose their preferred project.

From the lecturers` point of view this method was rated extremely smooth. Sometimes only two rounds were needed to succeed and whispering went through the rows as all teams were satisfied. To optimize the level of expertise we decided on two compartments in the lot boxes, ensuring that the stronger students would be spread out evenly over the projects. However, the duration of the whole team formation procedure (up to three days) is quite time extensive and needs a lot of organization beforehand.

Surprisingly, students reported a high level of stress. First, the random team composition results in uncertainty regarding team atmosphere: Layton et al. (2010). Second, the decision process was often decided by the loudest team members, who insisted on their choice leaving preferences of less assertive team members unconsidered. This led to ongoing discontent throughout the semester, especially if the arguments used did not come true.

Preference method (2021), assigned according to project (Figure 2, top):

In order to improve the situation for the students, we decided to give more scope to the individual preferences again. Conducting the new method, each student ranks the projects with respect to their own priorities. The subsequent composition of teams was surprisingly

smooth and guaranteed that every student got a match within their choice (around 90% of the students got one out of their preferred best three projects, only one student had to live with the seventh best choice.) This was also possible because we had two more projects than needed and could skip projects that gained not enough interest. Within this procedure again the semester and the expertise of the students were considered. Only after one hour the results could be communicated to the students. From the lecturer's perspective the method is very effective, as it took less than a day and resulted in even better-balanced teams.

Only two out of 31 (70%) students taking part in a mid-term questionnaire (44 students took part in the course) preferred the old method, one had no preference. The following quotes provide good examples for the opinion of the 28 proponents (90%): "My motivation to learn something is much higher, if I am interested in the topic. I also see more motivation in the team.", "… also better project start, as disputes in the beginning are avoided. " "You get a project, you are interested in. Team is important too, but prio 2"

Although the knowledge of teammates prior to team formation is associated with improved team performance: Gosenpud and Miesing (1984) students felt comfortable knowing the project and learning outcome right from the beginning - not necessarily their team mates. Most likely students hoped for fellow students with the same content interest will perform well naturally. In our project the shared interest in project content seems to outweigh that team mates were not known ahead and is therefore rated a strong and so far underestimated means in the process of team formation.

5. Conclusion

Based on more than 10 years of teaching practical project courses in IT education the methodology of group formation and project selection was identified as main reason for student motivation and performance throughout the one semester course. Usually team formation was followed by project assignment. But, this method frustrated both, students and lecturers as student motivation were low, student teams were extremely heterogeneous in terms of project progress and outcome and students lacked motivation. As a result of different procedures over various semesters in Winter semester 2021 students first rated their project choice and were then assigned to teams. According to recent questionnaires students were highly motivated, got good contact to fellow team mates and relied on their equal intrinsic motivation. Future research will focus not only on student performance and well-being but also on course assessment. However, it is highly important to understand that knowledge of the project seem to be outweigh team composition. Therefore, the project content is extremely important regarding student group performance and individual learning outcome in practical project courses.

References

Cuseo, J. B. (1992). Tips for students when forming learning teams: How to collaborate with peers to improve your academic performance. *Cooperative Learning and College Teaching* 7(3), 11-16.

Gomez-Pablos, V. B., Martín del Pozo, M., García-Valc, A., Munoz-Repiso, M. (2017). Project-based learning (PBL) through the incorporation of digital technologies. *Computers in Human Behavior,* 68, 501-512.

Gosenpud, J., Miesing. P. (1984). Determinants of performance in computer simulations. *Developments in Business Simulation & Experimental Exercises*, 10, 53–56.

Hishon, K. (2019). Classroom Management • Teaching Drama. Pros and Cons: Assigned Groups vs. Class-Chosen Groups. March 2. https://www.theatrefolk.com/blog/pros-and-cons-assigned-groups-vs-class-chosen-groups/, retrieved 23-11-2021.

Hübscher, R. (2010). Assigning Students to Groups Using General and Context-Specific Criteria. *IEEE Transactions on Learning Technologies*, 3(3), 178-189.

Huxham, M., Land, R. (2020). Assigning Students in Group Work Projects. Can We Do Better than Random? *Innovations in Education and Training International*, 37(1), 17-22.

Layton R. A., Loughry M. L., Ohland M. W., Ricco G. D. (2010). Design and validation of a web-based system for assigning members to teams using instructor-specified criteria. *Advances in Engineering Education*, 2(1), 1-9.

Muller, T. E. (1989). Assigning Students to Groups for Class Projects: An Exploratory Test of Two Methods. *Decision Sciences*, 20(3), 623-634.

Pinto, Y. (2012). The efficacy of homogeneous groups in enhancing individual learning. *Journal of Education and Practice*, 3(3), 25-28.

Razmerita, L., & Brun, A. (2011). Assigning Students in Groups: Self-formed Groups versus Automatically formed Groups. In TICE 2010: *7eme Colloque Technologies de l'information et de la communication pour l'enseignement*: Nancy-Metz, 6-8 decembre 2010 Nancy Université.

Reis, R. (2016). *Ways to form student groups*. Tomorrow's Teaching and Learning. Message Number: 1532 retrieved from Chapter 6, Stylus Publishing, LLC 22883 Quicksilver Drive Sterling, Virginia 20166-2102.

Siegeris, J., Steinseifer, R, Barke, H. (2018). Agile redesign of student projects in a women-only degree course. *Proceedings oft he 4th conference on Gender and IT*, Conference on Gender and IT 2018, New York, USA, 19-28.

Wei, S., Pramanik, A., Ohland, M. W., Ferguson, D. (2021). Design and Validation of a System to Assign Students to Projects Based on Student Preferences. 2021 ASEE Virtual Annual Conference Content Access. DOI: 10.18260/1-2—36914.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14673

A Quality Framework for HE Micro-Credentials

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Abstract

Micro-credentials are increasing in popularity due to their capacity to offer an award for a small volume of learning that is backed by an academic organization. HE has traditionally offered larger volumes of learning than micro-credentials, such as major and minor awards and has a QA system originally designed for such larger-volume awards. Offering micro-credentials along with the more traditional educational offering presents several logistical and QA challenges. QA Framework developments in this space are highly focused on digital awards, where a more holistic approach would be of greater benefit to the broader HE sector. This paper presents a quality framework for a HE to offer micro-credential awards, independent of delivery mode, while still maintaining educational standards and public faith in the quality of all of the HE's awards.

Keywords: *micro-credentials; HE quality framework.*

1. Introduction

Micro-credentials are small units of learning that are increasingly popular in Higher Education (HE), as they can facilitate the requirement of learners to engage with learning in small quantities. As such, they offer an alternative approach to personal, career and professional development, whereby an individual's development, skills, achievements, and accomplishments can be recognized, even at a granular scale. The development of a coherent, robust and innovative quality framework is important to support their validity, credibility and recognition, which is challenging for any HE institute (HEI), whose operation heretofore has been focused on the larger volumes of learning of major or minor awards. The purpose of this paper is to present a quality framework, which captures the existing know-how and long-established practice of HE validation, delivery, assessment and awarding but tailored to these new awards.

Other frameworks have already been proposed, especially at a European level. However, in the authors' opinions these do not sufficiently address the holistic quality requirements of a HE awarding body or mistakenly focus on digital delivery and assessment, where blended or on-campus delivery may be more appropriate for some micro-credentials. For example, the European approach described in *Towards a European approach to micro credentials,* focusses strongly on the QA of online micro-credentials, which, while an important contribution, is too narrow in focus for traditional HE, where the offering may be in classroom, blended or online (Orr, Pupinis, & Kirdulytė, 2020).

To engender credibility, all HE awards must be aligned to a qualification framework, be recognized internationally, and continue to be recognized in perpetuity. Bearing this in mind, this paper proposes key QA principles in the creation, validation and operation of HE micro-credential awards.

2. Micro-credentials in a HEI

Micro-credentials recognize modest, specific achievements of knowledge, skills or experience and the learning may be formal, informal or non-formal. They provide various learner opportunities, ranging from sampling a topic to embracing highly focused upskilling and, as such, lend themselves to reskilling, upskilling, and cross-skilling to in personal and professional development. A coherent, robust and innovative quality framework is important to support the validity, credibility and recognition of micro-credentials.

Internationally and especially in the European Union, there is a growing support for micro-credentials. The EU has included micro-credentials in its approach to education, training, skills development and digital education and this has been captured in the:

- Resolution on a Strategic Framework for European cooperation in education and training towards the European Education Area and beyond (2021-2030) (Council of the European Union, 2021)
- European Skills Agenda (European Commission, 2020)
- The Digital Education Action Plan (2021-2027) (European Commission, 2020)
- The European Commission proposed a European approach to micro-credentials for lifelong learning and employability (Orr, Pupinis, & Kirdulytė, 2020).

While micro-credentials may be credit bearing, and credit-bearing will be the focus of this paper, there is no general agreement on what might constitute a micro-credential in the case of credit bearing learning. For example, according to the Irish national Qualifications body, QQI, micro-credentials can be up to 30 ECTS: *The NFQ's minor, special purpose and supplemental award-types are examples of prototype micro-credentials and perhaps meso-credentials, though micro-credentials can be smaller than the smallest QQI minor awards* (Technical Paper on the Qualifications System, 2020).

Typically, in Ireland Higher Education has adopted respectively 10, 30 and 20 ECTS as the dominant award weightings (87% of awards in a QQI survey of HEs) (QQI early exploration into Micro-credentials in Higher Education, 2014–2020, 2021). On the other hand, the New Zealand Quality Authority defines them as being up to 20 ECTS credits (Orr, Pupinis, & Kirdulytė, 2020).

The choice of 10 ECTS and higher for such awards is understandable from a HE's perspective, where QA, delivery and administrative systems have built up around major awards and their constituent modular components. However, this number of ECTS seems high to warrant the name *micro-*. Recent EU-level research proposes that the minimum weighting be of 1 ECTS (MICROBOL Working Group on Qualifications Frameworks and ECTS, 2021). Such a low ECTS-weighting would normally require a re-evaluation of the HE's QA framework, designed as these have been typically for validating and operating higher-weighted awards and supporting students on longer-duration courses of study (Orr, Pupinis, & Kirdulytė, 2020).

Constructively aligning the learning around this single credit minimum weighting can be readily achieved through defining a learning outcome for the small amount of learning or achievement. Micro-credentials may be aligned to or even derived from existing modules, such as a lesser number of the existing module's total number of learning outcomes and in some HEIs may be stackable to accumulate module outcomes with or without Recognition of Prior Learning for complete module exemption.

This approach brings with it particular quality assurance demands, such as the validation process, which should be flexible and need not be as intensive as, for example a major award but nonetheless should be robust for the award not to be the source of future problems. For example, a key difference that will arise in the entry requirements for a student to be permitted to register on a micro-credential award. Entry requirements to a larger credit-bearing award are necessarily restrictive, in part to protect a student from selecting inappropriately and finding themselves wholly out of their depth. For the low credit-bearing micro-credential, relatively broad entry requirements are possible but must still be robust and credible.

There is also a logistical challenge to offering these awards from as low as 1 ECTS, as student record systems have been developed typically for larger credit weightings most often accumulating to a larger award, but this difficulty will not be explored further here.

2.1. Characteristics of Micro-credentials

Micro-credentials have specific characteristics (University of Melbourne, 2021) listed here:

Stackable credit: While some institutions offer stackable micro-credentials, whereby the individual credits may be accumulated to meet the outcomes of a higher award, in our HEI it is not proposed to offer this for micro-credentials of less than 5 ECTS. For micro-credentials of greater than 5 credits such accumulation may be offered subject to compliance with other institute regulations, including the Recognition of Prior Learning. This recognizes the existing approach to the QA of learning of 5 ECTS and higher.

Recognition of Prior Learning: Micro-credentials offer an excellent opportunity to gain a taster for a topic which may also be used to bridge an educational deficit in gaining entry to a major award by way of the Recognition of Prior Learning route.

Complementing graduate attributes: Often graduates are expected to have developed qualities outside of or more focused than their general award. Some of these qualities may be discipline specific, while others may be more related to soft skills, ethics or civic responsibilities. Micro-credentials by virtue of being small, discrete and focused can help graduates selectively upskill in similar fashion to the higher-weighted supplemental awards.

Professional bodies and accreditation: Professional bodies can be open to offering accreditation to graduates from disciplines outside of core identified areas, for example, where work experience means that candidates meet the bodies clearly identified characteristics of their members. Micro-credentials can be used by such applicants to overcome any concerns in relation to particular individual requirements.

3. Proposed Quality Framework Principles

The eight key features of our proposed micro-credential framework are drawn from the THEA Principles of Internal QA (Technological Higher Education Association, 2017).

1. Academic and Student-centered: Each HEI must offer an education that is relevant to students, staff and the wider public. This means including students in the award design, in the validation process, in student representation and in the periodic review panel.

2. Academic Freedom and Accountability: Every HEI values its right to offer its own awards. Hand in hand with such academic freedom comes the responsibility to maintain public faith in all of the HE's awards. Therefore, while a HEI is free to choose its own portfolio of micro-credentials, the micro-credential awards' process from creation, to oversight, to awarding, to review must be robust and transparent to all to view. External peer review should occur at the validation stage, with the evaluation report published on the HEI's website. Separate external peer review will occur at the assessment confirmation stage and in periodic reviews. While this form of external review is standard for larger credit-bearing awards, in the case of micro-credentials it makes more sense to review them as a portfolio.

3. Quality Culture: The HEI's micro-credentials should contribute to a HEI's quality culture being sustained, through the involvement of staff, students and stakeholders in their creation; contributing to a positive collegiate environment by offering awards of relevance; the awards being created and administered according to published quality assurance principles; and their contribution to the HEI's own community and other stakeholders' continuous professional and personal development, so that their value is obvious to all. These are essential criteria to be demonstrated by award proposers at the validation and periodic review stages.

4. Informed Practice: A HEI's micro-credential portfolio should be informed by the interests of all internal and external stakeholders, including the labor market. It should also be informed by the HEI's strategic, civic, regional and internationalization goals. The informed creation of these tiny awards introduce a dynamism and flexibility into the HEI's curriculum to help greatly in delivering key strategic goals. Informed Practice in the micro-credential awards should be demonstrated by award proposers at the validation and review stages.

5. Proportional Implementation: The creation, administration and validation of a micro-credential award should be proportionate, considering the volume of learning. This means the HEI offering validation and periodic review processes that are designed to be dynamic, flexible, and responsive to the needs of quality assurance and the ambitions of the credential proposers. Validation and periodic review feedback should be timely

in identifying key findings and afford appropriate scope to implement recommendations arising from micro-credential proposal evaluations.

6. Comprehensive and Publicly Accountable: The validation and awarding procedures for micro-credentials should be sufficiently comprehensive, transparent, and publicly accountable, which for example should mean that criteria and process for award creation, the external peer evaluations of micro-credential proposals and their periodic review, should all be published on a publicly accessible part of the HEI's website. Micro-credentials should also be clear in the learning, assessment mode, QA and student support offered.
7. Measurement, reporting and academic governance: Good academic governance in micro-credentials means that their performance should be monitored and relevant measurement data be collected through metrics including student retention figures; student engagement and satisfaction with the operation of and outcomes from, a micro-credential award; periodic evaluation of the awards portfolio; feedback from employers and comparisons with international benchmarks. These processes should not be arduous but sufficiently comprehensive to offer insights for inspiring confidence and fostering improvement. Finally, a HEI must be in a position to record for graduation and future record requests, all major-, minor- and micro-awards achieved by any student.
8. Consistency with Policy and International Effective Practice: Micro-credential policy should follow institute policy, including on affordability, inclusivity, and support for lifelong learning. It should also always be cognizant and mindful of international practice bearing in mind in particular how relatively new they are and the potential for policy and practice to change.

In terms of points 6 & 7, once fully established, the HEI should establish periodic peer review of the micro-credential QA system and portfolio by panels competent to make national and international comparisons.

4. Operation

As for any other HE award, micro-credential awards should be overseen by the Academic Council. Unlike major awards, it is proposed in our HEI that there be two distinct micro-credential approval windows per annum in September (for a January start) and March (for a September start), to allow for staff allocations, timetabling, marketing of the awards, etc.

All of our HEI's awards will be credit-bearing and will be aligned with the National Framework of Qualifications and should be constructively aligned. Therefore, normally each micro-credential award should have at least one clearly stated achievement/outcome. As they

are credit-bearing, the fundamental academic learning unit of achievement on a micro-credential award should be based on the HEI's implementation of the ECTS credit-model. Therefore, the effort hours for a micro-credential should be identified, in our case this would be 27 hours per 1 ECTS. These effort hours will generally include student independent learning, some academic input/delivery and assessment.

Applications to create a new micro-credential should clearly explain the rationale for the award, based on key stakeholder engagement and proposed benefits, alignment with HEI strategic goals, the entry requirements, the academic delivery and the assessment of achievement. Although it is expected that entry requirements would be broader than for major awards carrying much greater number of credits, nonetheless, to maintain the credibility of the award, these requirements should be clear and credible. All successful applicants should therefore have a realistic prospect of achieving the award.

Attainment of any micro-credential achievement/outcome of less than 5 ECTS should be on a Pass/Fail basis. The means of verifying this attainment must be clearly established at the new award validation stage. The academic responsible for delivery and assessment must be identified at the validation stage.

The HEI's micro-credential awards will be reviewed annually, and the awards should be overseen by a board, whose membership includes the academics responsible for the micro-credentials and chaired by the HEI's Registrar or their nominee. The micro credential portfolio should be reported on annually to Academic Council on delivery, retention/drop-out levels, Pass/Fail numbers and any other aspect that impacts the successful delivery of these awards.

Finally, micro-credentials are often associated with digital badges as the means of displaying a graduate's learning portfolio. It must be recognized, however, that HE's are more accustomed to exam results letters, European Diploma Supplement and award parchments. Furthermore, a graduate may have a mix of major, minor and micro-credentials from the same awarding institute. The HE must therefore be in a position to record and at any point subsequently confirm the entire combination of the graduate's learning achievements, (major-, minor- and micro-credentials).

5. Conclusion

This paper presents a quality framework for micro-credential awards that is comprehensive and offers both flexibility and appropriate academic governance. The framework is intended for use in HEIs, bearing in mind their existing experience in the Quality Assurance of major awards. Finally, the framework is independent of delivery mode so should be applicable for fully online, blended or on-campus delivery.

References

Council of the European Union. (2021, February 19th). *Council Resolution on a strategic framework for European cooperation in education and training towards the European Education Area and beyond (2021-2030)*. Retrieved from https://education.ec.europa.eu/document/council-resolution-on-a-strategic-framework-for-european-cooperation-in-education-and-training-towards-the-european-education-area-and-beyond-2021-2030

European Commission. (2020, September 30). *Digital Education Action Plan (2021-2027)*. Retrieved from https://education.ec.europa.eu/focus-topics/digital-education/about/digital-education-action-plan

European Commission. (2020, July 1st). *European Skills Agenda*. Retrieved from https://eufunds.ie/european-social-fund/operational-programmes/esf-2021-2027/european-skills-agenda/

MICROBOL Working Group on Qualifications Frameworks and ECTS. (2021). Retrieved from microcredentials.eu: https://microcredentials.eu/wp-content/uploads/sites/20/2021/07/Output_document_QFECTS-2.pdf

Orr, D., Pupinis, M., & Kirdulytė, G. (2020). *Towards a European approach to micro credentials: a study of practices and commonalities in offering micro-credentials in European higher education.* Retrieved from https://ec.europa.eu/education/sites/default/files/document-library-docs/towards-european-approach-micro-credentials-analytical-report.pdf

QQI early exploration into Micro-credentials in Higher Education, 2014–2020. (2021). Retrieved from https://www.qqi.ie/sites/default/files/2021-10/early-exploration-into-micro-credentials-in-higher-education-2014-20.pdf

Technical Paper on the Qualifications System. (2020, April). Retrieved from Quality and Qualifications Ireland: https://www.qqi.ie/sites/default/files/media/file-uploads/Technical Paper on Qualifications-Final.pdf

Technological Higher Education Association. (2017, April). *Part I: Principles of Internal Quality Assurance and Enhancement.* Retrieved from www.thea.ie/contentfiles/1B_v2.pdf

University of Melbourne. (2021). *Micro-credentialing*. Retrieved from https://about.unimelb.edu.au/teaching-and-learning/innovation-initiatives/pedagogy-and-curriculum-innovation/micro-credentialing

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14647

Empathic Communication Skill Training in Medical Education

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Abstract

Empathy plays an essential role in communication between doctor and patient, which can facilitate treatment. Therefore, it is crucial to develop communication and empathic skills of medical students through experiential role-playing at the Medical School. This study focuses on methods improving the empathy of medical students in doctor (student) - patient (actor) simulated role-plays. The purpose of our research was to identify factors that promote the development and expression of empathy in medical encounters. We aim to investigate the language of clinical empathy: how medical students can use the language to build empathetic communication. The authentic case-based role-plays provide sociolinguistic tools for interactions and for expressing empathy as well as reassuring the patient's emotions. Our study demonstrates how empathic communication skills form a more effective doctor-patient relationship, leading to greater patient satisfaction and better patient compliance.

Keywords: *Empathy training, the language of empathetic communication, medical education, simulation, verbal and non-verbal clinical communication.*

1. Introduction

The Medical School of the University of Pécs offers high-level professional training for medical students. As future doctors, it is paramount that they are proficient in medicine and confidently make a diagnosis and therapeutic plan. In addition, they need to communicate appropriately with both patients and their relatives, as a well-structured communication situation can significantly improve the outcome of therapy. The Department of Languages for Biomedical Purposes and Communication emphasizes the professional language training of Hungarian and international students, which helps them present their professional knowledge at a higher level of language proficiency. The pilot study directs our attention to the fact that it is not just what you say that matters but how you say it in doctor-patient interactions. The empathic communication used during the interactions significantly promotes therapeutic collaboration and understanding, which is essential for therapy. As an investigative situation, we chose the two most challenging situations in which empathy plays a significant role, the communication of bad news and persuasion. The main object of our pilot study was to evaluate students' communication focused on using the basic elements and techniques of verbal and nonverbal signs of empathic communication.

2. Specialties of doctor-patient communication

2.1. The dominant role of the doctor

It is paramount in the doctor's healing activity that the patient obeys their physician. The doctor's instructions and requests affect specific actions of the patient and, in many cases, affect his entire lifestyle. Even in the case of complete impersonality, the doctor-patient interaction quickly develops to a personal level. An essential prerequisite for this position of trust is empathy. The patient's obedience is only realized if he has complete confidence in the person from whom he receives instructions, treatment plans, and advice.

2.2. The role of empathy in individually shaped interaction

Doctor-patient communication is a unique situation in which patients find themselves in an intimate situation with a stranger, their doctor. They often have to share sensitive information. They have to answer questions that they do not even talk about to others, often even family members. It allows the doctor to have tests that affect patients' intimate sphere. Therefore, it is paramount that this interaction is not schematic but individually designed. The physician must be able to communicate according to the psychological needs of the particular patient. It is why empathy is emphasized in a doctor-patient dialogue. "Empathy is essentially the key to understanding the patient's individual communication code system" (Buda 1986: 186). If the patient experiences an empathic, understanding doctor-patient interaction, their collaboration will be more effective, making therapy more effective. It is essential to have an

open, trusting atmosphere that a doctor can only create with their patient if they can create this attunement through empathic communication. It is crucial in situations where the doctor has to report bad news. In the absence of empathy, physicians have difficulty interacting, which affects the effectiveness of treatment. In applying empathy, the personality almost empathizes with the other person's situation, focusing on their emotional and conscious state with full attention. This attention should also focus on the patient's non-verbal communication, emphasizing what the patient is saying. For this reason, the development of communication, the development of communication sensitivity, and the enhancement of empathy are of paramount importance for physicians: Buda (1986).

3. Definition of empathy

When we talk about empathic communication, we need to define what empathy means for the doctor. Previous studies have sought to answer two questions. How do we know what the other person is thinking and feeling? What factors help someone respond sensitively and carefully to another person's suffering? According to many theories, the two questions are closely connected; other research has sought to answer only one or only the other question: Batson (2011). It is essential to determine what empathic skills can be applied in clinical practice. Based on a comprehensive review of the relevant literature, empathy in patient care has been defined as a predominantly cognitive (rather than affective or emotional) trait that involves understanding rather than feeling a patient's pain and suffering: Hojat et al. (2011); Hojat (2018).

3.1. The two-step process of empathy in clinical practice is:

Understanding and sensitively appreciating another person's situation or feelings.

Giving feedback to the patient in a supportive way: Silverman *et al*. (2013).

4. The role of the group in enhancing empathy

Simulated doctor-patient situations provide an opportunity for medical students to communicate with a patient in a medical case scenario. Group dynamics can increase participants 'empathic attunement in several ways. Students can experience the doctor-patient interaction not only as a doctor but also as a patient. Their own experience and empathy can help develop their medical communication skills. After each interaction, the feedback and view of the participants and external observers are essential. It is possible to review the recorded image and audio material of the dialogues, which is a great help to view and evaluate the situation played out and experienced as an external observer. Feedback from group participants helps to transform the usual patterns. The group effect provides an opportunity to develop self-knowledge and introspection skills. The physician-patient

interaction displayed in the simulation situation shows remarkable similarity to the scenarios played in the psycho-drama group: Buda, (1986). When breaking bad news, participants experience the same difficulties and individual emotional problems between the doctor and the patient in their role as in an actual situation. Emotional experience, similar to a psycho-drama group, helps the participants develop their communication and psychological skills, which allows them to form patient-centered conversations later, beyond their barriers. The focus shifts from the doctor experiencing difficulties to the patient's problem in the simulated situation. In simulated practice, the patient must respond as quickly and sensitively as in an actual case. On the other hand, discussing possible errors and difficulties helps the medical student to minimize these errors in clinical practice and to be able to handle and control difficult situations with much more confidence. These experiences in the group will help them in their later medical work.

5. The role of persuasive communication in medicine

The purpose of persuasion is to reach joint decision-making in therapy. During persuasion, the doctor tries to influence the patient to cooperate and change their mind. Communication effectiveness depends on the doctor's ability to help the patients understand and accept the diagnosis, the need for related therapeutic procedures, and whether the outgoing patient has memorized the medical instructions. Patient opposition to treatment may be due to fears, misconceptions, criticism, distrust, bad experience, or attitude. The steps of joint decision-making are well structured. The doctor informs the patient that there are several ways to solve the problem. He describes the benefits and risks of each option. A comprehension check is essential in this process. He should assess the patient's treatment preferences. Based on all this, he suggests treatment, and finally, they agree on the views of the doctor and the patient: Pilling (2011); Pilling (2018).

6. Empathic communication in healthcare

Active listening is the basis of empathic communication. Empathic communication has nonverbal and verbal signs. Verbal signs:

Repetition, which can help give back vital information to the patient. Paraphrase: rewording the patient's words. Sub-summary: a brief summary of a long train of thought. Elimination or decreasing of fear. Transform negative attitude into positive.

It helps joint decision-making if the doctor explains the course of treatment to the patient in detail, avoids complicated medical terms, gives positive confirmation of all the issues, clarifies misunderstandings, and answers questions.

Nonverbal signs: eye contact, posture, mirroring of any facial expressions of the patient, nodding, which can be a sign of attention, encouragement to continue, and agreement, adequate distance, slow and low pitch voice: Pilling (2018).

7. Method

Title of the twelve-week course: Empathy and assertive communication in clinical practice Participants: 4-5-6-year medical students and a dentist student – identifying with doctor roles in the simulated scenarios, a 5-year teacher's assistant medical student – identifying with different patient roles. Instructors of the course: Judit Szalai-Szolcsányi – psychologist and ESP, and medical communication instructor Kata Eklics – ESP and medical communication instructor.

7.1. The objective of the course:

Our pilot course aimed to improve senior medical students' empathy and assertive communication skills through simulation exercises. The course was designed for an in-person format; however, due to Covid-regulations, it was launched during the peak of online education. Therefore, the planned scenarios had to be reconstructed to match the online communication. The teacher assistant student – playing the patient's role – was trained to shift focus from the total body onto facial non-verbal communication prior to each session. Maintaining eye contact was hampered by different camera angles and looking at the screen simultaneously. Yet, when preparing the participants for the scenes, we emphasized the importance of talking to the camera when they wished to be listened to by their conversational partners or convinced them. After being exposed to a theoretical introduction to different types of empathy and assertive communication, the available linguistic tools, and non-verbal cues, the students were asked to play the role of a medical specialist who has to break bad news or inform the patient of a diagnosis of a current condition and/or treatment options. The diseases were chosen by the instructors after learning about the medical background of the participants (major: general medicine or dentistry, year of studies, and also gender roles when patient-doctor situation was planned). The cases were based on authentic scenarios collected by clinician colleagues and applying case presentation guidelines for medical students in Hungary.

Process of enhancing emphatic communication:

- teachers' online presentations: students were given a detailed theoretical background
- simulation case: role-playing between student and simulated patient
- after each scenario: feedback focusing on emphatic communication

- teacher evaluation: how frequently students could use verbal and non-verbal signs of empathic communication during scenarios

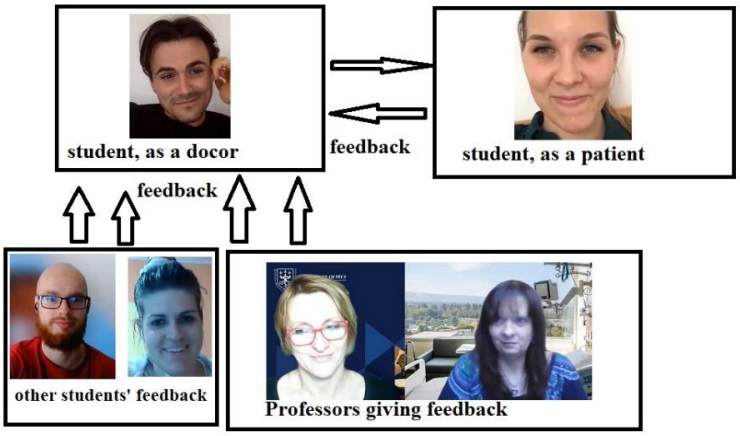

Figure 1. Feedback after the doctor-patient situation

7.2. The scenarios were as follows:

The cholecystitis procedure, when the doctor informs the patient of the necessary gallbladder surgery, but the patient wants to avoid operation. The broken tooth, when the dentist tells the patient of the need for extraction. The diagnosis of high cholesterol level and its medical therapy, when patient denies medical treatment. The hepatitis C infection, when student should break bad news of a fatal disease and tells its consequences. The pancreatitis, when a student breaks bad news and details a fatal outcome. The abscess in the oral cavity, when the doctor gives a bad diagnosis. The diagnosis of Wolff-Parkinson-White (WPW) syndrome (congenital heart disease with excessively rapid heartbeat) when the patient is against the operation. In the last case, the dentist informs a mother of the need for clinical investigations of her child, but the mother denies hospitalization.

8. Results

The simulated scenarios were assessed during the sessions, starting with self-reflection, followed by peer assessment, and finally commented on by the psychologist and the communication instructor. They were also video-recorded and later analyzed by the instructors. During analysis, we scored 0-5 scales on the frequency of communication signs used by medical students during scenarios. A value of 0 indicates that there was no detected the given verbal or non-verbal communication sign in the scenario. A value of 1 indicates that the given communication sign was rarely present. A value of 2 indicates that the given communication sign was sometimes noticed. A value of 3 indicates that the given

communication sign was often used during the dialogue. A value of 4 indicates that the given communication sign was very frequently used by the medical student, and a value of 5 indicates that the given communication sign was continuously used.

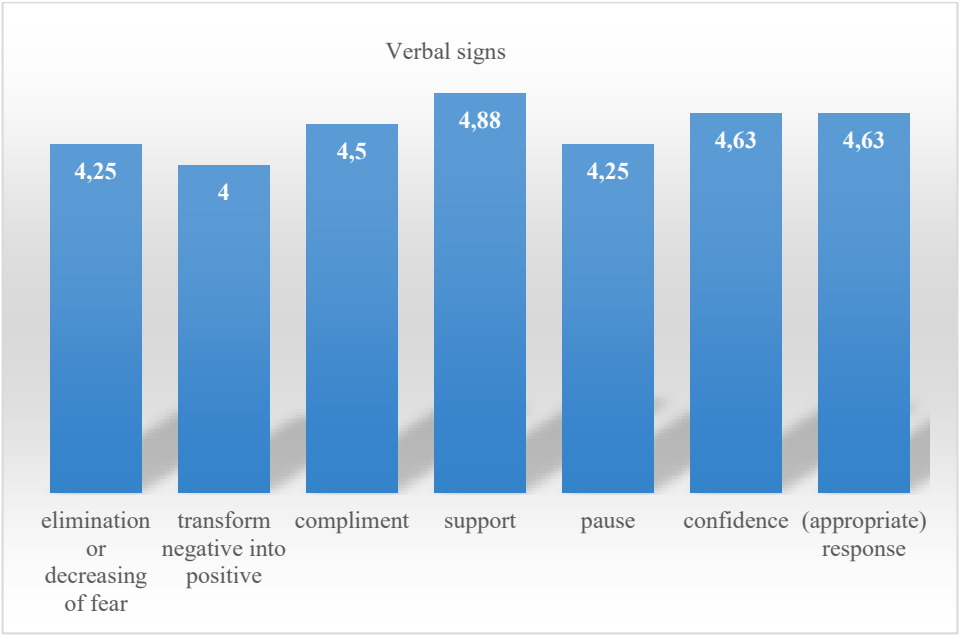

Figure 2. Mean scores for verbal signs

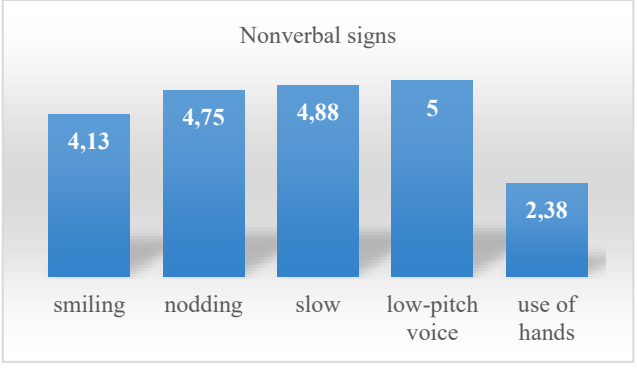

Figure 3. Mean scores for nonverbal signs

In the case of most situations, the verbal and nonverbal signs got 5 or 4 points. The patients with hepatitis C and pancreatitis gave only 3 points for "elimination or decreasing of fear", and only 2 points for "transform negative into positive".

Table 1. Descriptive Statistics of cases

	N	Minimum	Maximum	Mean	Std. Deviation
cholecystitis	12	4.00	5.00	**4.67**	.49237
broken tooth	12	4.00	5.00	**4.83**	.38925
high cholesterol	12	3.00	5.00	**4.58**	.66856
hepatitis C	12	.00	5.00	**3.75**	1.60255
pancreatitis	12	.00	5.00	**3.67**	1.61433
abscess in the oral cavity	12	4.00	5.00	**4.83**	.38925
WPW	12	3.00	5.00	**4.42**	.66856
child with asthma	12	.00	5.00	**4.08**	1.37895

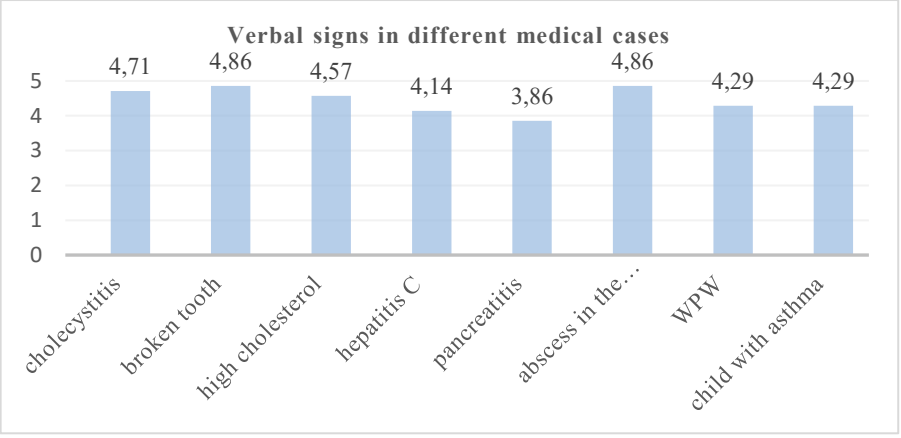

Figure 4. Mean scores for verbal signs in different medical cases

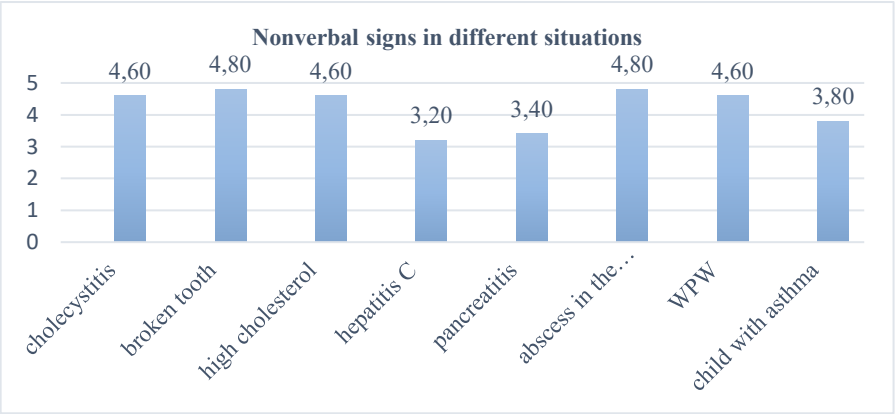

Figure 5. Mean scores for verbal signs in different medical cases

9. Conclusion

In our pilot study, we found that even in an extraordinary situation such as online doctor-patient communication, students could apply empathic communication well. During the persuasion, the doctor and the patient were able to reach a joint decision. After studying the theoretical background, students were given the structure and techniques to build a dialogue that helped them break the bad news and use persuasion. In the online platform, verbal tools of empathic communication were used more; but even nonverbal elements, including eye contact, smiling, and use of hands could appear. Although the use of hands was less present on the online platform, it appeared on the screen in some situations. We found a difference in whether the task was only to persuade the patient about the treatment or to break the bad news. In the latter case, it was difficult for the students to communicate the plan of successful therapy to the patient. Thus, the role of empathic communication in persuading was to achieve successful cooperation while breaking bad news, such as in the case of an incurable disease, to provide support, understanding, and assistance. During the analysis of the video material on the scenarios, we found that using both verbal and nonverbal tools, the students provided continuous feedback to the patient in the given case. Fears and misconceptions were reduced by providing an accurate, detailed description of the treatment. Positive affirmation, encouragement, and active listening as essential elements of empathic communication all appeared. Students acting as doctors did not assess the patient asking a lot of meaningless questions negatively. They reacted to questions with patience and supportive behavior. All the methods and techniques studied in the theoretical part of education were used correctly. Based on the patient's feedback, the persuasion was effective. The most frequently used adjectives were the *confident*, *trustworthy*, *calm* words to the doctor. Students' feedback suggests that with the techniques they have learned and their practice, they will be able to build a much more confident and structured dialogue in the future, in which they need to

convince the patient or break the bad news to them. We recognize that this study has several limitations, but during one semester, in 12 online seminars, we could perform no more situations. The main advantage of this technique is to give detailed feedback to students individually, which can enhance students' emphatic communication.

References

Batson, C. Daniel (2009). These Things Called Empathy: Eight Related but Distinct Phenomena. In Decety, J. – Ickes, W. (Eds.) (2011), *The Social Neurosciene of Empathy*, 3-15. Cambridge, Massachusetts: The MIT Press.

Buda, Béla (1986). *A közvetlen emberi kommunikáció szabályszerűségei*, 142-143, 181-187. Budapest, Hungary: Animula Kiadó.

Hojat, Mohammadreza et al. (2011). Physicians' Empathy and Clinical Outcomes for Diabetic Patients. In *Academic Medicine. Journal of the Association of American Medical Colleges.* 86(3), 359-364. doi: https://doi.org/10.1097/ACM.0b013e3182086fe1

Hojat, Mohammadreza. et al. (2018). The Jefferson Scale of Empathy: a nationwide study of measurement properties, underlying components, latent variable structure, and national norms in medical students. *Advances in Health Sciences Education: Theory and Practice,* 2018 Dec. 23/5, 899-920. doi: https://doi.org/10.1007/s10459-018-9839-9

Pilling, János (2011). *Medical Communication*,113-137. Budapet, Hungary: Medicina.

Pilling, János (2018). *Orvosi kommunikáció,* 88-96 Budapet, Hungary: Medicina.

Silverman, Jonathan – Kurtz, Suzanne – Draper, Juliet (2013). *Skills for Communicating with Patients,* 138, London, England: Radcliffe Publishing Ltd.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14572

Adapted model of flipped classroom in Veterinary Medical Pathology teaching: students' perception

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Abstract

The European Higher Education Area (EHEA) has restructured university faculty to reduce classroom time dedicated to theoretical teaching. For this reason, we have resorted to the inverted—or flipped—classroom, where students acquired complimentary instruction prior to classroom instruction. Our objective was to evaluate the usefulness of online tests to evaluate students' knowledge prior to theoretical classroom instruction, the degree of student satisfaction, and student performance.

During the last academic year, we implemented online tests requiring students to review information prior to in-person classroom instruction. We carried out an anonymous survey evaluating student perception related to the flipped classroom method and how it affected acquiring medical-veterinary knowledge and skills. We collected the final evaluation results in recent years.

Students took this assessment online, with mixed results, although the majority obtained high scores. The modified inverted class was favorably perceived by students and demonstrated a high degree of satisfaction with the knowledge and skills they acquired. For these reasons, we can affirm that students favorably accept the inverted classroom model.

Keywords: *flipped classroom; on line tests; veterinary; clinical subjects; motivation.*

1. Introduction

The European Higher Education Area (EHEA) is a project promoted by the majority of European countries to facilitate the mobility and employability of European citizens by aligning institutions of higher education between European Union (EU) countries. Historically, the process began with The Bologna Declaration (1999), which restructured the university system to promote coordination between the different countries.

In 2012, professors within the University of León Veterinary Faculty implemented a new study plan adapted to address the EHEA purpose. Medical Pathology (MP, similar Internal Medicine) curriculum for fourth-year students was subdivided into two semesters (I and II). The plan reduced the credits for theoretical masters classes so it was not possible to address all the Theoretical Program of Medical Pathology (MP II) in the limited time available. Therefore, we reorganized the program and considered alternatives before deciding on the inverted classroom (or flipped classroom), whereby students may acquire theoretical knowledge that will be reinforced with the practical classes, directly on animals, and laboratories.

The origin of the inverted classroom, or flipped classroom, dates back to the United States almost a decade. Professors Bergmann and Sams (2012) began recording their classes on video to support their students' learning experiences. In the flipped classroom, the cycle of knowledge acquisition and its application is reversed. Thus, students must acquire knowledge prior to in-person instructionclass while the teacher guides students to interact with both the teacher and with other students. It has the aim of clarifying and applying the knowledge obtained (López-Olvera & Prandi, 2019). The flipped classroom also represents a fundamental change in class time, which becomes a time dedicated to active learning. This pedagogical method assumes that students prepare and learn different concepts or skills prior to the class session (Cuello, 2020; McDonald & Smith, 2013).

While the flipped classroom is used in multiple teachings, ranging from secondary to university education, it has been used in health professions in recent years (Hew & Lo, 2018; Londgren et al., 2021; Moffett, 2014; Moffett & Mill, 2014). Recently, it was used to teach clinical subjects in Veterinary Medicine (Cuello, 2020; Dooley et al., 2018; López-Olvera & Prandi, 2019; Matthew et al., 2019; Uribe et al., 2020; Londgren et al., 2021).

Therefore, in our opinion, the basic idea inherent in this educational model would be to provide students with learning autonomy. In particular, to encourage students to work on theoretical concepts on their own, outside the classroom, using various learning resources provided by the instructor. Examples of such resources include informative text and specialized publications or videos (although not exclusively). Class time is used to resolve doubts related to the material provided, carry out practices, and open content-related dialogue (Berenguer-Albaladejo, 2016).

In this way, the MPII faculty provided informative material for students to visualize, read, process and study basic material prior to theoretical classroom instruction. Specifically, it was implemented to ensure students were familiar with the material provided. While in principle we tried to implement an exam at the onset of classes, we found that it was too difficult to carryout the tests within the classroom. A combination of large class size, 100 to 125 students, and limited classroom time led us to implement online tests to encourage prior learning with the intention of promoting the aforementioned attitudes.

For all these reasons, our objective was to assess the usefulness of a series of online tests prior to the theoretical masters classes, and to assess the degree of student satisfaction with this flipped learning method.

2. Methodology

To evaluate the first objective during the last six academic years (2014-15 to 2020-21), we used the Moodle platform to carryout a type of test that "encourages" the students of the MP II subject to study, or at least to read carefully, information provided by the instructors.

Periodically, and always at the beginning of each thematic block, we implemented a multiple choice exam (choice type) through the Moodle platform. The platform is an online system that remains open for 36-48 hours and limits the amount of time students have to take the exam to 10-12 minutes. This test randomly presents 20 questions with four options and only one correct answer. The scores obtained, together with other activities (clinical, tutorials and discussion groups), consist of 35% of the overall evaluation model. The opinions expressed both individually by the students and through their representatives, invite us to think that the approach was appropriate. For this reason, and with the intention of assessing the second objective, we considered it appropriate to carryout an anonymous survey —prior to the final written exam— where a series of items request the students´ opinion and degree of satisfaction with this teaching methodology and the repercussion of this flipped classroom model in their acquisition of medical-veterinary knowledge and skills. Students were asked to rate the following items on a Likert scale (1: poorly or a little, 2: regular, 3: acceptable, 4: good, 5: very good or a lot).

- Usefulness of online resources (notes, clinical cases, previous tests, etc.) in the acquisition of theoretical knowledge
- Would you recommend limiting the use of online tests?
- Degree of satisfaction with the teaching and methodology used
- Degree of satisfaction with the competences, knowledge and skills acquired during this subject

To better visualize the results obtained, we have grouped them as follows: 1+2: indicating an unfavorable evaluation or perception, 3: as acceptable, and 4+5: as a positive or very positive perception (Figure 1). Likewise, we have raised a series of questions where the students could identify both the didactic resource that they found most interesting and most innovative. The students could also freely express other opinions with comments. Finally, we took into account the results of the final evaluation of MPII (success rate), in the two options (June and July) as proposed by the Teaching Plan at the University of León. We differentiated between the students who passed the subject and those who did not. Results are expressed as a percentage of the students present and of the students enrolled (Figure 2).

3. Results and Discussion

Nearly all students completed the online evaluation test, which favours the first of the objectives. Specifically, the objective highlighted that students become familiar with classroom instruction before in-person classroom instruction. The learning serves as the basis for the teacher's explanations and furthers understanding of course-related pictures, videos, ultrasounds, as well as any interactions.

The students commented that they perform these online tests both individually and in groups. In our opinion as teachers, it is indifferent whether the students answer the questions individually or in groups, since our main objective is to introduce the students to the subject and expose them to the activities carried out in the classroom (Uribe et al., 2020). The grades obtained on these online tests show very different results that range between 4.0 and 10/10 points. Most of the students obtain scores between 8.5 and 9.5 points, which demonstrates that they review the material available, or at least discuss differing opinions among themselves within the limited time they have to take the test.

Survey results are shown in figure 1. Our data illustrate how this flipped classroom model is perceived positively by the majority of students with 75 to 79% of the students indicating the online resources provided were very useful. These data are in agreement with multiple authors (Hew & Lo, 2018; Londgren et al., 2021; Moffett & Mill, 2014).

Up to 84% of those surveyed do not agree with the possibility of discontinuing the use of online tests, and only between 3.6% and 6.6% are in favor of eliminating them. When asked about the degree of satisfaction with the teaching and the methodology used, only between 2.3 and 5% of the students are dissatisfied and up to 95% either consider it acceptable or are clearly in favor of it. Also up to 96% express a high degree of satisfaction with the skills, knowledge and abilities acquired during this subject, and only 4% disagree with it.

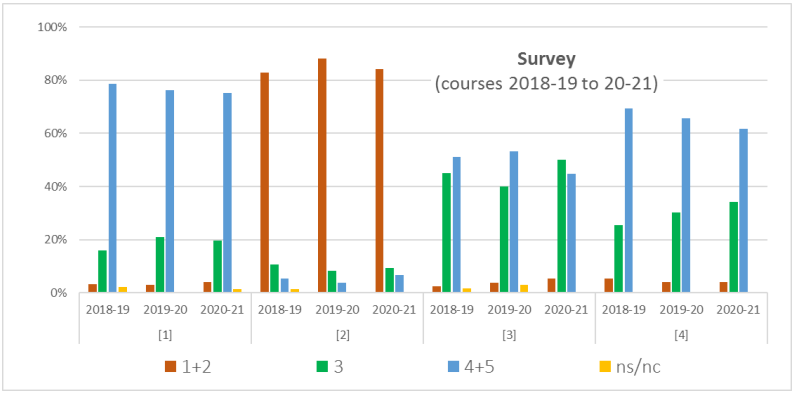

Figure 1. Results of some of the items in the survey carried out. Footnotes: the numbers indicated between [ ] refer to the following items: [1]: Usefulness of online resources (notes, clinical cases, previous tests, etc.) in the acquisition of theoretical knowledge; [2]: Would you recommend suppressing the use of online tests? [3]: Degree of satisfaction with the teaching and methodology used; [4]: Degree of satisfaction with the skills, knowledge and abilities acquired during this course.

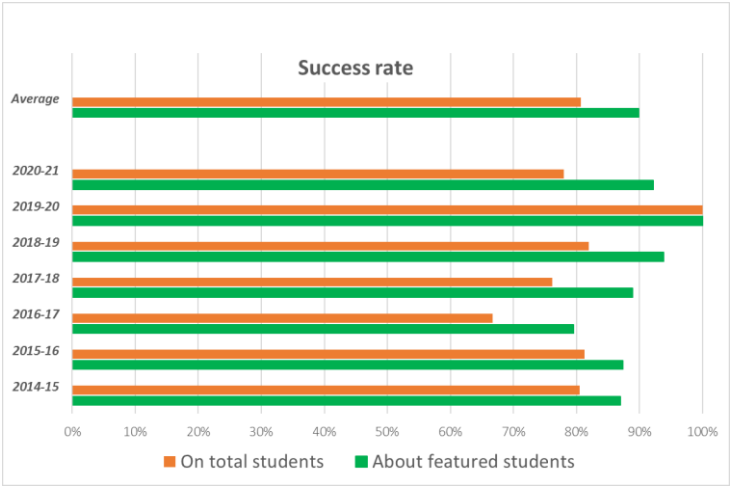

Figure 2. Results of the final evaluation of the subject Medical Pathology (II) in the different years that that this flipped classroom model has been used. Foot notes: The results are expressed based on the students who have taken the final test, although the grades obtained in the different activities carried out have been taken into account, as well as based on the students enrolled.

We agree with several authors that the flipped classroom is a pedagogical model that frees up the time of the presentation, which allows us, as teachers, to highlight the most important aspects, clarify the most complex concepts, individually help students with difficulties and encourage learning. Students' are commitment to their own learning instead of focusing on theoretical exposition (Olaizola, 2014). However it is possible that more content can be

covered in a simple and didactic lecture, compared to a workshop of similar time, focused on active learning (Moffett & Mill, 2014).

As Bergmann et al. (2012) indicated, the inverted class is not synonymous with the use of specific videos. For this reason, the teaching resource we used for our inverted class could vary (Gálvez & García, 2015). Since it can be used from the subject manual, different notes, videos, audios, or even scientific publications of specialized reviews or clinical cases, which are usually highly accepted by students. According to Uribe et al. (2020) it is essential that the teacher is resolute in not reteaching the material previously provided in the classroom, in order to shape the culture of the students in the operation of the new dynamic. In our case, the teaching staff reproduced different videos and graphical material that support and complement the previous students´ work and the comments, as well as classroom interactions between teachers and students. The previous line tests are also used as one of the activities developed to verify how well students understand the topics (Olaizola, 2014).

The flipped classroom approach has become increasingly popular within medical health instruction (Hew & Lo, 2018; Moffett, 2014; Moffett & Mill, 2014)), and while literature on the flipped classroom in veterinary science is scarce (Dooley et al., 2018; Londgren et al., 2021; Matthew et al., 2019; Moffett & Mill, 2014), the positive results in student satisfaction and involvement encourage the use of this methodology (Cuello, 2020; Dooley et al., 2018; Londgren et al., 2021; López-Olvera & Prandi, 2019; Matthew et al., 2019; Uribe et al., 2020).

There are hardly any reports evaluating the implementation of the flipped classroom in veterinary education (Dooley et al., 2018), and even fewer in clinical subjects (Londgren et al., 2021; Matthew et al., 2019) or even postgraduate (Moffett & Mill, 2014), so it is difficult to compare our results. Matthew et al. (2019) conducted a study focused on establishing baseline information on the use of the flipped classroom technique in veterinary education, but focused on the familiarity of the participants—along with the activities used—the perceived benefits and the barriers to implementation. Dooley et al. (2018) demonstrated that a transition to online learning resources in a flipped classroom format improved aspects of student academic performance, satisfaction, and engagement in a pre-clinical sciences course. The activity closest to our experience was carried out by Londgren et al. (2021) when they investigated the potential of the flipped classroom approach to prepare students for internships in a clinical skills laboratory.

Several students explicitly pointed out the performance of online tests as the most innovative didactic resource and just as interesting as other teaching resources used in this subject, such as practices carried out with sick animals, resolution of virtual or real clinical cases, visits to farms and group discussion of clinical. They agree with Londgren et al. (2021) that the

flipped classroom was an investment of time and resources, but in general, it was worth it in terms of results—especially if the students had done the previous homework.

Although the percentage of students who pass the subject in the final evaluation (success rate) varies in the different courses, it is around 90% of the students within the classroom and over 80% of the students enrolled (Figure 2). We must point out that in Course 2019-2020 (confinement due to the Covid-19 pandemic) 100% of the students presented passed the subject. There is consensus that students seem to prefer the flipped classroom approach over the traditional classroom approach (Dooley et al., 2018; Moffett & Mill, 2014), although this preference did not always translate into better academic performance. McLaughlin et al. (2014) found that cumulative final exam performance increased and overall grades increased from 80% to 82.5% when a flipped classroom approach was adopted in a first-year pharmacy foundation course (Moffett & Mill, 2014).

A significant beneficial effect was also found for the flipped classroom cohort, which achieved significantly higher scores on the written response section of the final exam, while this difference was not seen for the multiple choice section, which was identical for both cohorts (Dooley et al., 2018). However, and although students preferred flipped classroom teaching over traditional teaching, traditional classroom students outperformed flipped classroom students on multiple-choice items (Moffett & Mill, 2014). For this reason, and given that studies of the implementation of the flipped classroom have shown variable impacts on the academic performance of students, it is possible that some of the benefits of this design are not adequately evaluated with traditional methods (Dooley et al., 2018).

We consider that the best results in this aspect may be due to the fact that this methodology is perceived positively by the students, increasing their motivation towards the "active learning" experience of this subject. It is reinforced by the high attendance within non-mandatory theoretical classes. This is consistent with a study, in which students who participated in the flipped classroom rated the teaching staff better than those who participated in the traditional classroom course, although the teaching staff remained the same (Moffett & Mill, 2014).

4. Conclusion

As conclusion, the favorable student acceptance from surveys results, combined with marks obtained in the final evaluation, invite us to believe that adaptating the flipped classroom facilitates the learning process in Medical Pathology (Clinical Veterinary) and that it may directly transfer to other subjects in the Veterinary degree curricula.

References

Berenguer-Albaladejo, C. (2016). Acerca de la utilidad del aula invertida o flipped classroom. *XIV Jornadas de Redes de Investigación en Docencia Universitaria*, 1466.

Bergmann, J., Overmyer, J., & Wilie, B. (2012). *The flipped class: Myths versus reality*. The Daily Riff. http://www.thedailyriff.com/articles/ the-flipped-class-conversation-689.php.

Cuello, C. (2020). El aula invertida como herramienta para la docencia no presencial en Veterinaria. *CIVINEDU 2020*, 480.

Dooley, L. M., Frankland, S., Boller, E., & Tudor, E. (2018). Implementing the flipped classroom in a veterinary pre-clinical science course: Student engagement, performance, and satisfaction. *Journal of Veterinary Medical Education*, *45*(2), 195-203. https://doi.org/10.3138/jvme.1116-173r

Gálvez, A., & García, A. (2015). *Uso del vídeo docente para la clase invertida: Evaluación, ventajas e inconvenientes* (1.ª ed.). ACCI (Asoc. Cultural y Científica Iberoameric.).

Hew, K. F., & Lo, C. K. (2018). Flipped classroom improves student learning in health professions education: A meta-analysis. *BMC Medical Education*, *18*(1), 1-12. https://doi.org/10.1186/s12909-018-1144-z

Londgren, M. F., Baillie, S., Roberts, J. N., & Sonea, I. M. (2021). A survey to establish the extent of flipped classroom use prior to clinical skills laboratory teaching and determine potential benefits, challenges, and possibilities. *Journal of Veterinary Medical Education*, *48*(4), 463-469. https://doi.org/10.3138/jvme-2019-0137

López-Olvera, J. R., & Prandi, D. (2019). Nuevos métodos docentes para una nueva asignatura: Clase invertida y aprendizaje en grupos en Métodos Exploratorios del Grado de Veterinaria. *VetDoc. Revista de Docencia Veterinaria*, *3, Extraord.*, 58-59.

Matthew, S. M., Schoenfeld-Tacher, R. M., Danielson, J. A., & Warman, S. M. (2019). Flipped classroom use in veterinary education: A multinational survey of faculty experiences. *Journal of Veterinary Medical Education*, *46*(1), 97-107. https://doi.org/doi: 10.3138/jvme.0517-058r1

McDonald, K., & Smith, C. M. (2013). The flipped classroom for professional development: Part I. Benefits and strategies. *The Journal of Continuing Education in Nursing*, *44*(10), 437-438.

McLaughlin, J. E., Roth, M. T., Glatt, D. M., Gharkholonarehe, N., Davidson, C. A., Griffin, L. M., Esserman, D. A., & Mumper, R. J. (2014). The flipped classroom: A course redesign to foster learning and engagement in a health professions school. *Academic medicine*, *89*(2), 236-243.

Moffett, J. (2014). Twelve tips for "flipping" the classroom. *Medical Teacher*, *37*(4), 1-6. https://doi.org/10.3109/0142159X.2014.943710

Moffett, J., & Mill, A. C. (2014). Evaluation of the flipped classroom approach in a veterinary professional skills course. *Advances in Medical Education and Practice*, *5*, 415-425.

Olaizola, A. (2014). La clase invertida: Usar las TIC para "dar vuelta" a la clase. *Actas X Jornadas de Material Didáctico y Experiencias Innovadoras en Educación Superior*, 1-10.

Uribe, A. A., Jimenez, G. D., & Troncoso, M. F. (2020). Flipped Classroom: Una experiencia para fortalecer el aprendizaje en Medicina Veterinaria. *Educação e Pesquisa, São Paulo*, *46*(e214200), 1-16.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14251

An art-based approach to teaching English language speaking skills

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Abstract

Learning to speak in a foreign language can be a very challenging task for learners. This could be due to the way speaking is taught, the lack of motivation or limited opportunities to practice the foreign language. Visual art has been found to provide a creative and imaginative platform for communication that can stimulate learner involvement and motivation. This study attempted to measure the impact of an art-based approach on teaching English language speaking skills to intensive English language program students at Sultan Qaboos University in the Sultanate of Oman. The researchers used the one-group pretest and posttest research design. The themes of the art work were based around the 17 sustainable development goals. The results showed a significant improvement in students' speaking ability and overall language level. In addition, the learners were enthusiastically involved in the language learning process. The findings of the study assert the positive impact of visual art on speaking in particular and language proficiency in general.

Keywords: *English language teaching; Oman; speaking skills; using art to teach English.*

1. Introduction

Learning a foreign language has always been a big challenge. Many factors contribute to the complexity of the task such as limited exposure, the absence of a clear goal for learning the language, limited number of classroom hours, etc. This often results in low motivation which in turn leads to low achievement. Numerous studies have been written about the low proficiency levels among learners in Oman (Al-Issa, 2020; Al-Mahrooqi, 2012; Al-Mahrooqi & Denman 2018). Some of the reasons behind this low achievement is the use of conventional methods of teaching (Al Muhaimeed, 2013; Teemant, 2010). Recent research has tried to find creative and innovative approaches to make foreign language learning experience more interesting and effective. Art has been long used as a vehicle for learning other subjects (Lastra, 2017). This wide spread use is due to the fact that art is a neutral vehicle for learning as it provides students with content to create, analyze and talk about. Art conveys what it means to be a human being, challenges the intellect and provides rich experiences in analysis, exploration, reflection, observation, imagination, experimentation, and communication (De Jesus, 2016). In addition, art has been found effective in developing children's motivation in learning, developing their knowledge through multicultural art, developing their attitudes to the art, and developing art language (Al-Amri et al.2016, p.59). McMahon, Klopper, and Power (2014:2) argue that "learning through art enhances students' social, emotional and academic outcomes, as well as their knowledge and understanding", aspects which reflect the whole learner approach to education. Art gives learners the opportunity to contemplate and express their emotions and values (Gibson, 2003). In language education, art has the potential to engage student learning in a meaningful and enjoyable way (Werff, 2003), thus enhancing their English proficiency (Farokhi & Hashemi, 2012) as well as increasing their motivational level (Ekoç, 2020). Motivation is key in the language learning process especially in contexts where the target language is learned as a foreign language. In such contexts art provides the learners with a meaningful and enjoyable content for using the language to communicate their views using the target linguistic forms (Werff, 2003). However, art involves hard work, persistence and perseverance (Farokhi & Hashemi, 2012). Students need to have a clear purpose and guidance. There are also certain skills students need to acquire such as noticing, analysis and interpretation.

This research study attempted to investigate the use of visual art as a potentially engaging subject for improving learners' speaking skills based on the premise that art provides a creative and imaginative platform for communication. For many students, speaking remains a challenging task. This is especially true for low level learners who often lack the linguistic competence and possibly also motivation to speak the foreign language. Looking at a picture, singing a song, or even getting involved in a dance sequence, all provide new learning opportunities and challenges to students (Lloyd, 2017, p. 6). According to Chi (2017, p. iv), "arts serve as a stimulus, refresher, guider and facilitator in English language learning".

Different approaches have been proposed for teaching speaking skills. These range from direct approaches that draw students' attention to conversational rules and linguistic features of the language, to indirect approaches that are based on the students' acquiring conversational competence through meaningful tasks. The latter have gained more popularity recently influenced by the calls for developing learners' communicative competence. In the process of introducing a creative activity in the form of art, students engage with the activity because of the self-enjoyment and satisfaction that art brings to them and not for getting a physical reward (Ben-Chetrit, 2014). This intersects with the modern approaches to language teaching which emphasize that learners best acquire language by interacting with the social and physical world around them. As Žemberová (2014) states, "integrating the arts and language learning in the classroom not only increases the students' understanding of art but also allows them the opportunity to look at, listen to, talk about, share and create art. It can also enhance and develop their foreign language vocabulary and language skills" (p.243). Thulasivanthana (2020) conducted an experimental study on "participants [who] were randomly assigned to control and experimental groups, each consisting of eleven students." (p. 53) in order to examine the usefulness of integrating visual arts into English language teaching. The students in the experimental group outperformed students in the control group in the four English skills (listening, reading, writing and speaking). The students in the experimental group reported that incorporating visual arts into English learning helped them recall the lessons they learned and increased their motivation to learn the English language. The findings of this study "assert that the use of visual arts in the English language classrooms attracts learners' interests, offers a meaningful context for the learners, and stimulates the students to become more enthusiastically involved in the language learning process" (Thulasivanthana, 2020, p. 54).

2. Methodology

2.1. Context and Participants

The study aimed at examining the effect of teaching the English language through art on students' speaking skills. The research targeted students who were studying intensive English courses in the foundation program at the Center for Preparatory Studies (CPS) at Sultan Qaboos University in the Sultanate of Oman in Fall 2021. It was applied to the students in level one (FPEL0120), specifically in the listening and speaking course. This is the lowest proficiency level. Students received 18 hours of English instructions per week (6 hours writing skills, 6 hours reading skills, 6 hours listening and speaking skills). There was one experimental group (21 students) that was taught listening and speaking using art, and one control group (20 students) which followed the traditional course materials. Two out of the six hours assigned for the listening and speaking skills were dedicated to cover the art-based materials for the experimental group. The groups were taught by two different teachers.

2.2. Procedure and Instruments

The study employed the one-group pretest-posttest design in measuring the impact of the art-based approach on students' speaking skills. The experimental group was taught speaking using art. The course material was based on the 17 sustainable development goals (SDGs) agreed upon by 193 world nations and announced by the UNESCO in 2015. These 17 themes address the global challenges that humanity faces. These were chosen for their universality and potential interest among university students. Students were guided to work in pairs and choose a sustainable development goal which they thought was important to raise people's awareness about and relate it to the Omani context to create an art work. Instruction followed a working model developed by the research team which consisted of four stages: Explore, Develop, Express and Share (EDES). In the *Explore* stage, the students learned about the 17 UN SDGs and understood their meanings and impact. In the next stage *Develop*, they proposed a plan of action to tackle one of the themes which they thought could affect their local community. In the *Express* stage, students had to decide on a type of art work they thought was best to use to express their thoughts/suggestions about the chosen theme. The implementation started at the beginning of the fall semester 2021 and lasted for eight weeks.

A speaking pre-test and a post-test were developed by the research team and administered to the experimental group in weeks one and eight. The test consisted of an art work the students had to describe orally using some guiding questions. The researchers used two comparable versions of the test for pre and post testing. The students' answers were independently recorded and marked by a third teacher based on an assessment rubric that contained criteria related to fluency and accuracy. The total mark was out of 20.

3. Results and Discussion

The results show a positive impact of art on students' speaking ability in the experimental group. The pre and post test results indicated that the students' improved in both aspects of speaking. The average score of the pre-test was 9.2 (Standard deviation =1.1) and increased to 14.8 (Standard deviation = 1.5) in the post-test. The paired samples t-test showed a statistically significant improvement. The criteria related to fluency improved from 5.80 to 8.83 (out of 12), while those related to accuracy improved from 3.42 to 5.97 (out of 8). The degree of improvement was very similar in both. In order to get an insight about the impact of the art-based approach on students' overall language level, the researchers looked into the total course marks (out of 100) for the experimental group and compared them with those of students following the traditional approach. The results showed that the students in the experimental group significantly outperformed their counterparts in the other group, according to the t-test, as shown in Table 1.

Table 1: T-test results for art-based and traditional teaching classes

Section	N	M	SD	T	Significant	Cohen's d
Art-based teaching group	21	82.30	5.93	1.90	.033	5.07
Traditional teaching group	20	79.30	3.97			

The results suggest that art has the potential to enhance the language of description and comparison because it allows learners the opportunity to explore and express their thoughts and opinions. This finding supports the claim that art can be very effective for struggling students (Rabkin and Redmond, 2006). Expressing ideas and feelings through art is of immense value as a way to respect, explore and share the traditions of different cultures. The findings of this study corroborate those by Ekoç (2020) who found that the works of art motivated students, helped improve their critical thinking and improved their appreciation of art.

Gains in the experimental group went well beyond test scores. The art-integrated lessons energized the class teacher who was very enthusiastic about her lessons and about learning more about the SDGs in order to sustain students' interest and accommodate their questions. The teacher became a resource for students' art works and accepted a new leadership role in developing supplementary materials and supporting and directing students' work. This was a true indicator of her passion about the approach. In addition, the participating teacher, the director of the Center for Preparatory Studies and other teachers who attended the students' art exhibition expressed fascination with the art works. The students produced art works around their chosen SDG's and linked them to the Omani context. It was clear from the magnificent art works they produced and the presentations they gave that they had understood what the SDG's meant and what actions were needed to realize them. Such meaningful language use transcends mechanical reproduction of the target language that conventional speaking exercises tend to promote. This is moving away from teaching speaking through practicing language patterns to communicative language use. As stated earlier, the development of CPS' students' expression and creativity are key program objectives. We believe that this art-based approach helped realize those objectives.

4. Conclusion

Learning how to speak fluently and accurately in another language can be a big challenge. The task is exacerbated in situations where the target language is learned as a foreign language. In such contexts, motivation is key in the learning process. Therefore, educators need to think of creative ways to engage students in the language. The findings of this study clearly show that visual art has the potential to engaged students and enhance their speaking. Art provides learners with a meaningful and enjoyable opportunity to use the language to communicate their views using the linguistic forms.

Acknowledgements

We thank the Deanship of Research at Sultan Qaboos University for funding this research study. We are also grateful to the Center for Preparatory Studies for allowing us to conduct the experiment. We sincerely thank Ms. Munira Al-Wahaibi and her students for their active involvement, and Ms. Claire Noonan for her valuable contribution to the development of the teaching materials.

References

Al-Amri, M. Al-Radaideh, B., Al-Yahyai, F., Almamari, B. & Alhajri, S. (2016). Artists and their artworks as a model for improving the quality of teaching in art education. *British Journal of Arts and Social Sciences*, *21* (1), 59-71.

Al-Issa, A. S. M. (2020). The language planning situation in the Sultanate of Oman. *Current Issues in Language Planning*, 21(4), 347–414. https://doi.org/10.1080/14664208.2020.1764729

Al-Mahrooqi, R. (2012). A student perspective on low English proficiency in Oman. *International Education Studies*, *5*(6), 263-271.

Al-Mahrooqi, R., & Denman, C. (2018). English language proficiency and communicative competence in Oman: Implications for employability and sustainable development. In *English Education in Oman* (pp. 181-193). Springer, Singapore.

Al Muhaimeed, S. (2013). Task-based language teaching vs. traditional way of English language teaching in Saudi intermediate schools: a comparative study. (Unpublished doctoral Dissertation). Kent State University.

Ben-Chetrit, L. (2014) The effect of high school arts classes on exit exam scores in measurement and geometry. Unpublished EdD thesis. Minneapolis: Walden University.

Chi, C. (2017). Integrating the arts into English learning: a case study of EFL learners in a Canadian university (thesis). Electronic Theses and Dissertations.

De Jesus, O. (2016). Integrating the Arts to Facilitate Second Language Learning. *Journal for Research and Education*, Special Issue #5, September, 1-4.

Ekoç, A. (2020). Teaching speaking with works of art in a preparatory class at university. *Innovation in Language Learning and Teaching*. DOI: 10.1080/17501229.2020.1824232

Farokhi, M. & Hashemi, M. (2012). The impact/s of using art in English language learning classes. *Procedia - Social and Behavioral Sciences*, *31*, 923 – 926. doi:10.1016/j.sbspro.2011.12.170

Gibson, R. (2003). Learning to be an Art Educator: Student Teachers' Attitudes to Art and Art Education. *International Journal of Art & Design Education*. 22 (1), 111-120.

Lastra, C. (2017). The benefits of arts education in second language acquisition and in pedagogy. (A Master's thesis). Faculty of Humboldt State University. Arcata, California.

Lloyd, K. (2017). Benefits of art education: a review of the literature. *Scholarship and Engagement in Education, 1*(1), 1–21.

McMahon, A., Klopper, C., and Power, B., (2014). Excellence in arts based education – one school's story. *International Journal of Education & the Arts*, *15*(5), 1-22.

Rabkin N, Redmond R. (2006). The arts make a difference. *The Journal of Arts Management, Law and Society*, *36*(1), 25-32.

Teemant, A. (2010). ESL student perspectives on university classroom testing practices. *Journal of the Scholarship of Teaching and Learning*, *10*(3), 89-105.

Thulasivanthana, U. (2020). Incorporating visual arts into English language teaching. *Shanlax International Journal of English, 8*(4), 52–56. https://doi.org/10.34293/english.v8i4.3320

Werff, J. (2003). Using pictures from magazines. *The Internet TESL Journal, IX*, 7.

Žemberová, I. (2014). Art in Foreign Language Education. *Journal of Language and Cultural Education*, *2*(3), 240-253.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14563

Integrating virtual simulation (MyDispense) for teaching Pharmacy curriculum

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Abstract

MyDispense, a web-based pharmacy simulation program, allows students to assume the role of a pharmacist to evaluate, verify, and dispense a prescription in a virtual pharmacy setting. The aim of this study was to create MyDispense simulation activities to teach Pharmacy curriculum within a therapeutic unit and measure its effects on student perception and learning. Clinical Practitioners reviewed existing case-based teaching material and incorporated new elements to the cases, to simulate the identification, resolution and documentation of medication related problems. A secondary review was conducted and cases were built onto the MyDispense web-based platform. Cases were designed with a primary focus of teaching contraception and diabetes patient-centred management and counselling. In addition, a complex case was designed to include real-life complexities such as prioritisation of tasks, conflict resolution and patient-centred care to better simulate an authentic experience. Virtual simulations such as MyDispense, offer an authentic teaching tool for Pharmacy curriculum.

Keywords: *MyDispense; simulation; pharmacy; curriculum.*

1. Introduction

Pharmacists play a vital role in the evaluation of primary care conditions, and the suitability of therapeutic options in complex conditions encountered in clinical settings (Pharmaceutical Society of Australia, 2010). One of the challenges of pharmacy programs worldwide is the need to link theoretical training with the mastery of practical skills (Mak *et al.,* 2021). For future pharmacists, these skills include safe provision of medications and medical devices. In line with this, students enrolled in the Bachelor of Pharmacy (Hons)/Master's degree at Monash University's Faculty of Pharmacy and Pharmaceutical Sciences, are introduced to applied therapeutic-focused 'Comprehensive Care' units from their second year. Often, students at this stage have had limited to no exposure to pharmacy practice. The Comprehensive Care units integrate multiple disciplines such as physiology, chemistry, therapeutics and professional practice. The complex integration of these disciplines is applied through case-based learning to promote problem solving and critical thinking, communication and empathy.

MyDispense is a virtual simulation tool that Monash University's Faculty of Pharmacy and Pharmaceutical Sciences developed to help students master the skills they need as a pharmacist-in-training (Costelloe, 2017). The web-based Pharmacy dispensing program provides a virtual environment in which it is safe for students to make mistakes without the potentially life-threatening consequences of a real-world dispensing error. This is akin to a pilot practising their skills using a flight simulator or an astronaut using a space flight simulator. Students can practise tasks as many times as they need and receive instant, tailored feedback on these attempts. As a consequence of the Global pandemic, face-to-face case-based activities in the "Comprehensive Care" therapeutic units were replaced with virtual case-based MyDispense activities. MyDispense provided an active and constructive educational environment based on challenges and learning objectives that promote deeper learning, emphasising understanding and the application of knowledge students have learnt. Furthermore, whilst there has been some research conducted on the use of MyDispense to integrated virtual pharmacy scenarios (Shin *et al*., 2018; Ferrone *et al*., 2017), there has been little research into more of a scaffolded approach to the use of MyDispense from simple primary care cases, to developing into more complex cases in a clinical setting to enhance problem solving and critical thinking skills.

2. Aim

The aim of this study was to create and implement MyDispense virtual simulation activities to teach Pharmacy case-based therapeutic curriculum and measure its effects on student perception and learning.

3. Method

MyDispense activities were incorporated into two therapeutic units taught within the 2nd year pharmacy curriculum of the Bachelor of Pharmacy (Hons)/Master's degree: Comprehensive Care Endocrinology and Renal (PHR2042) and Comprehensive Care Cardiovascular (PHR2142). PHR2042 spans the treatment and management of endocrine diseases and disorders/conditions such as thyroid disease, diabetes, as well as chronic kidney disease and contraception and is required for all second year Pharmacy students. PHR2142 specifically covers cardiovascular diseases and disorders such as hypertension, heart failure, atherosclerosis and thromboembolic disorders. The 'Contraception' topic within PHR2042 was identified for incorporation of MyDispense activities. Clinical Practitioners reviewed existing case-based teaching material and incorporated new elements to the cases, to simulate the identification, resolution and documentation of medication related problems. A secondary review was conducted and cases were built onto the MyDispense web-based platform. Elements such as information from other sources such as MyHealth records, prescriber information gathering and dispensing history were incorporated into the MyDispense activities. For PHR2142, a MyDispense activity was constructed to represent a complex case which contained multiple comorbidities, multiple information sources and multiple medication related issues. Distractors such as phone calls and interprofessional queries were used to mimic real-life environments. The developed simulation cases were founded on four key underlying principles which offered students: 1) a realistic pharmacy environment to learn and practice a variety of skills; 2) the opportunity to practice exercises multiple times without the risk of causing harm to a patient; 3) individualised learning opportunities and immediate feedback; and 4) flexibility in terms of when and where learning can take place.

For students, each MyDispense case exercise started with a brief description of patient history and the instruction to critically evaluate each medication from both a new prescription or a refill request by the patient. The simulation activity required gathering and summarizing relevant information, including patient dispensing history on the pharmacy computer, correspondence from the doctor and laboratory test results attached to the case. During the virtual encounter, students were required to interview the patient and search existing pharmacy patient records to acquire all necessary information to fully evaluate a given prescription. Students then had to submit a final answer by writing a professional note within the online patient profile in the program regarding medications in the prescriptions they would fill and/or would not refill, along with their rationale. If they had a medication they would not fill, they needed to recommend an alternative medication, if necessary, and provide justification for their selection. Students could access the answer key and feedback only after their answers were submitted. This was coupled with a class discussion with their facilitators

Following completion of the MyDispense activities, students were invited to participate in an online survey using the Qualtrics (Qualtrics, Provo, UT) platform. Survey responses were collated and de-identified. The survey consisted of 20 items. Of these, three items were about the general evaluation of the MyDispense tool, five items determining the most useful features of the MyDispense tool and eight items measuring student perceptions on the quality of the MyDispense activities embedded within PHR2042 and PHR2142. Student perceptions were measured using a 5-level Likert-type scale (1=strongly disagree; 3=Satisfactory; 5=Strongly agree. Descriptive statistics was used to determine frequency distribution and percentage distributions. This project was approved by the Monash University Human Research and Ethics Committee (Project ID: #26899).

4. Results

A total of 38 out of 174 students enrolled in PHR2042 and PHR2142 participated in the study (response rate: 22%). More than 90% of the students felt that the MyDispense simulation activities were well organised and made the learning process more engaging (Table 1). All students felt that the MyDispense software created an environment that was realistic to a pharmacy setting.

Table 1. General evaluation of the MyDispense tool.

Item	Class response (N=38) n (%)				
	Strongly disagree	**Dgree**	**Neutral**	**Agree**	**Strongly agree**
The MyDispense activities were well organized.	0.0 (0.0)	0.0 (0.0)	3 (7.9)	16 (42.1)	19 (50.0)
The MyDispense activities made the learning process more engaging.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	1 (2.6)	37 (97.4)
The MyDispense interface/environment was realistic.	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	4 (10.5)	34 (89.5)

As seen in Figure 1, students deemed the two most useful features of MyDispense were its ability to provide immediate feedback and to be accessed at any time and place for practice purposes. More than 50% of students felt that MyDispense allowed them to practice their history taking skills. More than 45% of students felt that MyDispense provided a safe environment to practice and 40% of students were in agreement that MyDispense allows for them to identify and obtain patient specific information.

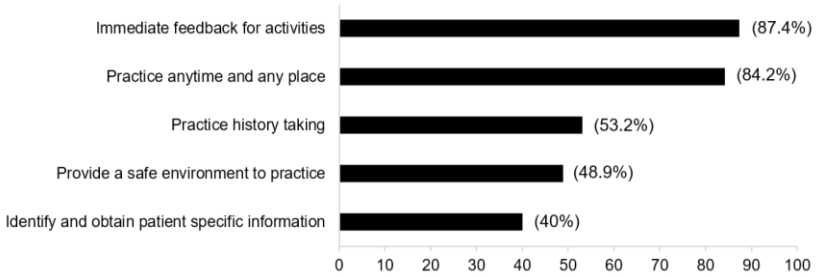

Figure 1. Students' perceptions of the most useful features of MyDispense.

Overwhelmingly, 84% of students felt the case-based MyDispense virtual simulation activities were of excellent quality (Table 2). Within the context of the PHR2042 therapeutic units, more than 94% of students felt that MyDispense helped them to better understand and practise the steps involved in history taking. In PHR2142, the MyDispense activity was constructed to represent a complex case which contained multiple comorbidities, multiple information sources and multiple medication related issues. More than 70% of students felt that using MyDispense in PHR2142 helped them better understand and practise collaborative decision making and prioritisation. More than 60% of students strongly agreed felt that the MyDispense activities in PHR2042 sufficiently prepared them for the critical thinking skills required for the complex scenario in the MyDispense activity in PHR2142 and furthermore, more than 40% of students strongly agreed that it sufficiently prepared them to apply their knowledge of management of a complex range of ailments in the complex scenario PHR2142. The complex case scenario developed in PHR2142 also incorporated distractors such as phone calls and interprofessional queries were used to mimic real-life environments. Encouragingly, more than 90% of students felt that the MyDispense activity in PHR2142 simulated real-life complexities such as prioritisation of tasks, conflict resolution and necessity of patient-centred care to better simulate an authentic experience.

Table 2. Students' Perception of the usefulness of MyDispense in Therapeutic units.

Item	Class response (N=38) n (%)				
	Strongly disagree	**Dgree**	**Neutral**	**Aisagree**	**Strongly agree**
In PHR2042, using MyDispense helped me better understand and practise the steps involved in history taking.	0 (0.0)	0 (0.0)	0 (0.0)	2 (5.3)	36 (94.7)
In PHR2142 (Workshop 5C: Complex patient), using MyDispense helped me better understand and practice collaborative decision making and prioritisation.	0 (0.0)	0 (0.0)	5 (13.2)	28 (73.6)	5 (13.2)
MyDispense is a stimulating learning environment.	0 (0.0)	0 (0.0)	0 (0.0)	9 (23.7)	29 (76.3)
MyDispense helped me learn from mistakes I made	0 (0.0)	0 (0.0)	0 (0.0)	5 (13.2)	33 (86.8)
The MyDispense workshop and assessment activities were consistent with the learning.	0 (0.0)	0 (0.0)	5 (13.2)	25 (65.8)	8 (21.0)
The MyDispense workshop activities in PHR2042 (Workshop 2C: Contraception management & Workshop 3B: Injectables) sufficiently prepared me for the critical thinking skills required for the complex scenario MyDispense activity in PHR2142 (Workshop 5C: Complex patient).	0 (0.0)	0 (0.0)	0 (0.0)	13 (34.2)	25 (65.8)
The MyDispense workshop activities in PHR2042 (Workshop 2C: Contraception management & Workshop 3B: Injectables) sufficiently prepared me to apply my knowledge of management of a complex range of ailments in the complex scenario MyDispense activity in PHR2142 (Workshop 5C: Complex patient).	0 (0.0)	0 (0.0)	2 (5.3)	18 (47.4)	18 (47.4)

The MyDispense workshop activity in PHR2142 (Workshop 5C: Complex patient) simulated real-life complexities such as prioritisation of tasks, conflict resolution and necessity of patient centred care to better simulate an authentic experience.	0 (0.0)	0 (0.0)	0 (0.0)	3 (7.9)	35 (92.1)

5. Discussion

In this preliminary study, we utilised a case-based virtual simulation tool, MyDispense to seek students' perception of the online tool and to ascertain the benefits of using MyDispense to teach pharmacy curriculum in 2nd year 'Comprehensive Care' therapeutic units. Problem solving and critical thinking are an essential part of the Comprehensive Care stream, whereby one of the core learning outcomes of the unit is to evaluate a patient's condition and provide patient-specific care after clinical review. MyDispense offers active experiential learning to enhance the attainment of higher order learning outcomes and supports students to become fluent in the Five Rs of dispensing: Right drug, Right route, Right time, Right dose, Right patient in a safe, low stakes environment, thereby supporting students' successful transition from university to the clinical setting (Grissinger, 2010).

During the MyDispense simulation activities, students observe virtual representations of patients, prescriptions, medicines on shelves, dispensary and ancillary labels and note-taking tools. There are also web links to legally required pharmacy references. By allowing ongoing access to the virtual simulated pharmacy scenarios, students are able to practice processes they must undertake when providing patient care, reflecting on how to improve their interaction and errors which may have occurred (McDowell *et al.*, 2016). Accordingly, all students surveyed perceived that the MyDispense program created an environment that was comparable to a pharmacy setting.

The use of a simulated environment changes the teaching method from direct instruction, or didactic teaching, to that of 'productive failure', and, as a result of feedback, are able to learn from their mistakes in a safe environment (Kapur, 2008; Moreno, 2004). Feedback to students is immediate, thus students have a real-time opportunity to reflect on the case and learn from their mistakes and errors of judgment. Students deemed one of the most useful features of MyDispense was the ability to provide immediate feedback and to be accessed at any time and place for practice purposes.

The MyDispense simulation allows a full spectrum of challenges to be presented, from simple to highly complex. These can be one-dimensional focusing on a single technical element or can be blended to help students practise technical procedures, cognitive skills and personal

skills in conjunction with each other. By adding complexity in line with the knowledge students are gaining in their broader pharmacy education, lies the opportunity of scaffolding the skills of the student from novice level to mastery. In this preliminary study, the MyDispense cases in the 'Endocrinology and Renal' therapeutic unit (PHR2042) were comparatively simpler than the complex case in the 'Cardiovascular' (PHR2142) unit where students were challenged with a complex problem, involving patients with multiple comorbidities, and a range of distractors. The majority (>70%) of students reported that using MyDispense in PHR2142 supported their understanding of collaborative decision making and prioritisation of tasks. A significant number of students (>60%) strongly agreed that the MyDispense activities in PHR2042 sufficiently prepared them for the critical thinking skills required to decipher the complex scenario in PHR2142.

6. Future directions

Virtual simulation is useful to promote student learning and the MyDispense tool allowed curriculum to be shifted to online learning during the global pandemic. The combination of virtual and real-world practical training will better prepare students for pharmacy placements at various points during their degree and for their internship. The outcomes of this preliminary study will inform curriculum development in the effectiveness of utilising virtual simulated pharmacy scenarios in therapeutic units. This may also identify new approaches which can be applied to other units such as professional pharmacy practice units, as it also has the capacity to be a virtual practice platform for the Objective Structured Clinical Examinations (OSCEs), incorporating professional practice with legal and ethical scenarios.

References

Costelloe, Marian. (2017). MyDispense: Lessons from Global Collaboration in Developing a Pharmacy Educational Simulation Tool. INNOVATIONS in pharmacy. 8. 10.24926/21550417.1356.

Ferrone, M., Kebodeaux, C., Fitzgerald, J., & Holle, L. (2017). Implementation of a virtual dispensing simulator to support US pharmacy education. *Currents in pharmacy teaching & learning*, *9*(4), 511–520. https://doi.org/10.1016/j.cptl.2017.03.018

Grissinger M. (2010). The Five Rights: A Destination Without a Map. *Pharmacy and Therapeutics*, *35*(10), 542.

Kapur, M. (2008). Productive Failure. *Cognition and Instruction*, 26(3), 379–425. http://www.jstor.org/stable/27739887

Mak, V., Fitzgerald, J., Holle, L., Vordenberg, S. E., & Kebodeaux, C. (2021). Meeting pharmacy educational outcomes through effective use of the virtual simulation MyDispense. *Currents in pharmacy teaching & learning*, *13*(7), 739–742. https://doi.org/10.1016/j.cptl.2021.03.003

McDowell, J., Styles, K., Sewell, K., Trinder, P., Marriott, J., Maher, S., & Naidu, S. (2016). A Simulated Learning Environment for Teaching Medicine Dispensing Skills. *American journal of pharmaceutical education*, *80*(1), 11. https://doi.org/10.5688/ajpe80111.

Moreno, R. (2004). Decreasing Cognitive Load for Novice Students: Effects of Explanatory versus Corrective Feedback in Discovery-Based Multimedia. *Instructional Science, 32*, 99-113.

Pharmaceutical Society of Australia. National Competency Standards Framework for Pharmacists in Australia: Pharmaceutical Society of Australia; 2010.

Shin, J., Tabatabai, D., Boscardin, C., Ferrone, M., & Brock, T. (2018). Integration of a Community Pharmacy Simulation Program into a Therapeutics Course. *American journal of pharmaceutical education*, *82*(1), 6189. https://doi.org/10.5688/ajpe6189

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14602

Rethinking Hybrid Teaching: The Hybrid Rhombus Model as an Approach to Understanding Hybrid Settings

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Abstract
After extended periods of remote-only teaching at university, lecturers tried to come back to lecture halls. Due to restrictions not all students could participate on-site. Therefore, hybrid teaching models proliferated. To reflect the transformative effects on teaching practice, we conducted focus groups with lecturers and found that didactic models aimed at capturing dynamics of the in-situ learning experience do not provide sufficient understanding of the bifurcated nature of hybrid teaching. The hybrid rhombus model is an approach to conceptual understanding of the newly developed situation of teaching in a hybrid way. This paper gives a brief description of the model description and the empirical background, to contribute to the debate of hybrid teaching in relation to digital or on-site teaching.

Keywords: *digital teaching; hybrid teaching; COVID teaching; hybrid model;*

1. Introduction

After COVID pandemic countermeasures had constrained university operations at large, partially relaxed mandates of physical distancing allowed for some on-site presence and popularized hybrid attendance models in education that comprise synchronous teaching of students present on site and attending remotely (Reinmann 2021). As a didactics center for digital teaching and learning that is part of the University of Vienna, we set out to research the hybrid situation and how it transforms teaching practice, both to learn how teachers are best supported during this crisis and to explore the overall potential that hybrid models hold for university level teaching. With this paper, we want to briefly characterize and argue for the *Hybrid Rhombus* as a model to further derive successful conditions of hybrid teaching and contribute to ongoing discussion of the transformative effect pandemic measures had on teaching practice.

1.1. Related Work

1.1.1 Hybrid Teaching

Gabi Reinmann (2021) remarked that the term of "hybrid teaching" is used diversely within the university context. We adopt the concept of "synchronous hybrid teaching", as an interaction of teachers and two groups of students learning simultaneously (synchronous) in a session. One group is present in the lecture hall together with the teacher - the on-site group - whereas the other group participates in a virtual environment - the remote group.

As Raes et al. (2020) remarked, research into synchronous hybrid learning is still in its infancy and research gaps exist e.g. at the relation of student learning experiences and pedagogical scenarios. Hybrid settings come with different pedagogical, organizational and technological challenges and benefits (Raes et al., 2020). We will focus on the two most relevant aspects, that are crucial for the introduction of the *Hybrid Rhombus*: The intention of the University to establish synchronous hybrid teaching as well as some characteristics regarding communication and interaction in a hybrid classroom.

The organizational benefits for students are often mentioned (Raes, 2022). Students can choose whether to attend the course remote or on-site, which leads to a greater flexibility for the learners to schedule their semester (Hastie et al., 2010). From an institutional point of view, the effective use of classroom space is another reason to introduce a synchronous hybrid teaching concept (Lakhal, 2017). That was especially relevant for the University in times of COVID, since it was possible to reduce the numbers of students who shared one classroom.

A disadvantage in terms of communication is, that the two groups (on-site and remote) experience the class differently/ in different ways (Szeto 2014). Huang (2017) stated, that in

comparison with the on-site group, the remote group might feel excluded from the class. Even more when they have to struggle with technical problems. From a teaching point of view, it is crucial to create an environment in which both groups are able to make similar learning experiences (Raes 2022).

1.2.2 Extending the Didactic Triangle

The didactic triangle (see e.g. Bönsch 2006, p. 149) is a fundamental theoretical model used frequently to classify and incorporate innovation and advances in the field of didactics. Goodchild and Sriraman (2012) argued for extending the didactic triangle in light of technological advance in the classroom, e.g. offering additional flexibility in teaching procedure, but demanding increased attention by the lecturer. Lampiselkä et al. (2019) used the didactic triangle as a taxonomy to identify focus areas in science education research.

2. Research Interest and Methodology

Based on our inner-institutional purpose of supporting teachers and students, shaping and evaluating available technological tools and obtaining a rich picture of teaching practice as decision input for university upper management levels, we set out to capture the transformative effect of hybrid teaching practice, guided by the research question: *"How do novel hybrid teaching paradigms relate to teaching practice?"*.

2.1. Focus Groups

We conducted three online focus group sessions that took place after a semester of physically distanced (i.e. digital and hybrid) teaching had just concluded and experiences were fresh in the participant's memories. The sessions had a duration of 45 minutes and were organized after a semi-structured discussion guide covering six mayor topics: personal experiences with implementing hybrid teaching, successful and unsuccessful teaching techniques, essential requirements for a successful hybrid teaching setting, changes for their own next hybrid teaching setting to ensure it is (even) more successful and advice for colleagues – always considering different levels such as didactical, technical, organizational elements in hybrid teaching.

2.2. Participants

We recruited 12 employees of the University of Vienna who had employed hybrid teaching in the prior semester, specifically between October and end of November 2020, when governmental pandemic measures allowed for partial on site student presence. All participants are experienced, authoritative lecturers and researchers who collectively represent a diverse area of academic fields and related teaching paradigms (natural sciences, humanities and cultural studies). Furthermore, several participants hold additional faculty

management roles (vice dean, director of study program) that bring them into regular contact with other teachers and their students within their respective faculties.

2.3. Analysis

Each focus group session was conducted by a moderator and observed by an additional member of the researchteam who took extensive notes of discussion progress and verbatim quotes. After the sessions, moderators were asked to also add interesting participant contributions to the notes. Following the analytical method of Thematic Analysis (Braun & Clark, 2006), the resulting dataset was annotated in several consecutive iterations. This resulted in a thematical overview of practical experiences and reflections, which, upon further discussion among the researchers, led to the didactical model at hand.

3. Results

First and second hand experiences with synchronous hybrid teaching were consistently described as challenging, bordering overwhelming. Participants reported unfamiliarity with then-new streaming technology that in turn was observed to work unreliably with existing audiovisual lecture hall equipment. On organizational and didactic levels, transposing explicit (e.g. conveying content) and tacit (e.g. keeping in touch with students on their progress) elements of teaching practice into an in-part digital realm caused unanticipated but crucial-to-success tasks and responsibilities to emerge.

In preparation of synchronous hybrid course meetings, specific and detailed, additional planning efforts are necessary to organize, communicate with and monitor the progress of on- and off-site cohorts.The act of holding a synchronous hybrid lecture itself comes with additional work as well: participants reported unexpected amounts of cognitive load that can be categorized as either (1) technological monitoring and support of participants of either cohort or (2) additional didactic efforts, resulting in feelings of stress that stem from keeping track of students and their learning experience in either cohort, as well as relational or attentional strain w.r.t. the task of moderating student participation in either cohort simultaneously, which was reported as specifically challenging.

In the subsequent analysis of these results, we formulated possible ways of mitigating these challenges, i.e. familiarization with and pre-check of technological equipment (also with students w.r.t. the technical requirements of their respective cohort) or team-teaching structures (participants reported successes with tasking on-site students with off-site cohort chat moderation).We found that on a theoretical level, didactic models aimed at capturing dynamics of the in-situ learning experience do not provide sufficient understanding of the bifurcated nature of hybrid teaching. Departing from the didactic triangle, this led us to

extending the triadic interactive structure into the off-site realm, resulting in the *Hybrid Rhombus* (see Fig. 1 for a schematic overview).

3.1. The Hybrid Rhombus Model

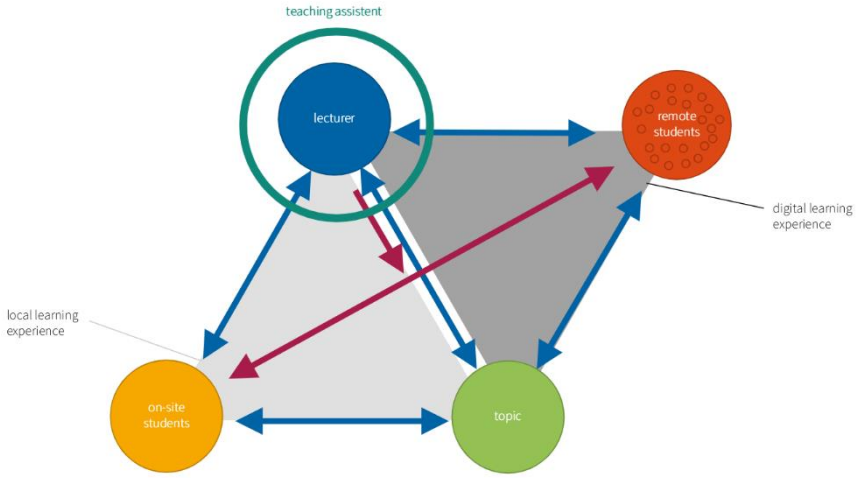

Figure 1. Hybrid Rhombus.

The didactic triangle shapes interactional dynamics of teaching/learning processes as a triad between lecturer, student(s) and the topic at hand. We suggest that, in settings of hybrid teaching that incorporate remote and on-site cohorts into the same in-situ session, differences in teaching and learning experiences among remote and on-site cohorts are substantial:

We differentiate students, who attend the lecture in the hall ("on-site students") and students, who attend digitally via videoconferencing tool ("remote students"). Since remote and on-site students experience topic and lecturer in different media and communication modalities, they approach both the subject and the learning process from literally different perspectives. The cohort's learning experiences are differently paced, following different levels of immediacy and social immersion related to physical presence and digitally mediated attendance.

While both cohorts can follow the session live, establishing reasonable rapport with all students at the same time is however difficult for the lecturer, given the differences in pacing, immersion and communication; conceptually, we suggest this should be understood as a form of bi-directional attention that comes with twice the cognitive and relational effort.

Here it should be added that, the remote students do not act like the on-site students, because every one of them should rather be seen as isolated or individualized with a technical barrier to interact with others: if a remote student has a technical issue, they can not follow the class,

need to contact the lecturer and the whole room is affected by it. Therefore, the teaching is interrupted. On the other hand, if an on-site student has a problem, they could ask their seatmate and these two could deal with the problem and teaching is not affected. While we deal with two "groups", a new way of exchange occurs in the communication between on-site students and remote students (red arrow), that is not easily comparable to other interactions; e.g. due to technical restrictions and GDPR practice, remote students do not see the on-site students.

4. Discussion

The hybrid rhombus formalizes structures that emerged in the prior empirical work, and especially makes visible how interaction and communication is inhibited by the technical barrier. Therefore, on the teaching side, planning and rethinking interaction and communication is key to success. While teaching and presenting content, a second person (teaching assistant or student) should moderate the chat or prepare forms of interaction, comparable e.g. to how Cain et al. (2016) relied on technological and pedagogical qualified assistants as "Technical Navigators" ("TechNavs").

The empirical work hinted at overburdening on two levels: On the didactic level we see a major challenge for practitioners in shaping how and when to interact with any or both cohorts and ensuring sufficient communicative rapport between them; generally with balancing their attention between teaching and moderating. On the technical level, participants reported additional efforts for operating the equipment and dealing with technical problems of remotely connected students. Particularly in the relations of teacher to on-site, the hybrid rhombus implies the increased effort in relationship maintenance (the need to overlook and interact with two groups) and minimizing of disturbance (e.g. technical, difficulties following the lectures,...)..

Notably, the hybrid setting is not a new way of teaching in itself. If we think about streaming, hybrid teaching has been practiced for some years. What is really novel is the use of backward channels, e.g. chat, audio/video and the need of lecturers to design the lesson as they do on-site. This backward channel changes the interaction between teacher and students completely. The remote learning group can raise questions via chat or audio/video for a better understanding. This additional communication feature allows them to address and discuss individual questions with either the teacher, the whole class or with their colleagues (Wang, Huang 2018). Here we can isolate and discuss an example: In traditional teaching, a lecture is characterized by a high amount of frontal lecturing. There, lecturers tend to ask questions for various reasons. Transferred into a hybrid setting, asking a question implies (1) the possibility and channel to answer. E.g. the on-site students can answer by raising their hand, the remote group could use chat, audio, video or raising their hand digitally. (2) the possibility

to follow the students answer. E.g. the on-site student can hear the answer, because they are in the same room. The remote student can just hear it, if the on-site student talks to a microphone. Therefore, a microphone has to be handed to the on-site student or the teacher has to paraphrase the answer, taking up additional time.

With this paper, we want to contribute to the reflective, scientific discussion of hybrid teaching practice in the wake of pandemic-related lockdowns, by utilizing the Didactic Triangle as a fundamental and very common pedagogical structure model. Future work will also explore the value of other, e.g. student-centered approaches like flipped classroom (Bergmann & Sams, 2012; Bishop & Verleger 2013), or active learning concepts (Prince 2004). Furthermore, this study is based on the perspective of experienced lecturers and thus incorporates the own perspective of students only indirectly. In a next step we plan to also involve students directly on their experiences with hybrid teaching.

5. Conclusion

The hybrid rhombus illustrates the hybrid situation and introduces a model for rethinking and redesigning hybrid lectures. The model shows core issues. The idea is still at a developing stage and further research is indicated, as described in the prior section.

While taking a deep dive into the model of hybrid rhombus we are aware that hybrid teaching is not just a remote approach and easily digitized teaching. The model can sensitize and support further thinking of bringing on-site and digital teaching together.

To carry out the didactic approach and provide the technical and spatial basics we will redesign a lecture hall, which should fit the basic needs for performing teaching in a hybrid setting. Therefore, we came to the compromise of the following assumptions: This lecture hall should be used for teaching on-site, digital (overcoming remote) and hybrid. The focus of this room is the interactions between lecturer and students in different group sizes and not frontal lectures. Besides that, the room should be flexible and therefore afford lecturers and students the possibility to reshape it to suit their needs.

Acknowledgments

We like to thank the participants of the focus groups for sharing their experiences. Hence, we like to thank Johanna Strauss for proofreading and language editing.

References

Bönsch, M. (2006). Allgemeine Didaktik : Ein Handbuch zur Wissenschaft vom Unterricht. Stuttgart: Kohlhammer.

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. International society for technology in education.

Bishop, J., & Verleger, M. A. (2013). The flipped classroom: A survey of the research. In *2013 ASEE Annual Conference & Exposition* (pp. 23-1200).

Bloom, B. S. (1956). *Taxonomy of Educational Objectives*. New York: David McKay.

Braun, V. & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology. 3. 77-101. 10.1191/1478088706qp063oa.

Cain, W., Bell, J., & Cheng, C. (2016, July). Implementing robotic telepresence in a synchronous hybrid course. In *2016 IEEE 16th International Conference on Advanced Learning Technologies (ICALT)* (pp. 171-175). IEEE.

Domenech, J., Blazquez, D., de la Poza, E., & Muñoz-Miquel, A. (2015). Exploring the impact of cumulative testing on academic performance of undergraduate students in Spain. *Educational Assessment, Evaluation and Accountability*, 27(2), 153-169. doi: 10.1007/s11092-014-9208-z.

Goodchild, S. & Sriraman, B. (2012). Revisiting the didactic triangle: From the particular to the general. ZDM. 44. 10.1007/s11858-012-0449-3.

Hastie, M., Hung, I. C., Chen, N. S., & Kinshuk. (2010). A blended synchronous learning model for educational international collaboration. *Innovations in Education and teaching International*, *47*(1), 9-24.

Huang, Y., Zhao, C., Shu, F., & Huang, J. (2017). Investigating and analyzing teaching effect of blended synchronous classroom. In *2017 International Conference of Educational Innovation through Technology (EITT)* (pp. 134-135). IEEE.

Lakhal, S., Bateman, D., & Bédard, J. (2017). Blended Synchronous Delivery Mode in Graduate Programs: A Literature Review and Its Implementation in the Master Teacher Program. *Collected Essays on Learning and Teaching*, *10*, 47-60.

Lampiselkä J., Kaasinen A., Kinnunen P. & Malmi L. (2019). Didactic Focus Areas in Science Education Research. *Education Sciences*. 9(4):294. https://doi.org/10.3390/educsci9040294

Morgan, D. L. (1988). Focus group as qualitative research. Newbury Park, CA: Sage Publications Inc.

Niebuhr, O. (2021). Advancing higher-education practice by analyzing and training students' vocal charisma: Evidence from a Danish field study. *7th International Conference on Higher Education Advances (HEAd'21)*, 743-751. doi: 10.4995/HEAd21.2021.12827

Peterßen, W. (1992). Lehrbuch allgemeine Didaktik (3., überarb. und erw. Aufl.. ed., EGS-Texte). München: Ehrenwirth.

Prince, M. (2004). Does active learning work? A review of the research. *Journal of engineering education*, *93*(3), 223-231.

Raes, A., Detienne, L., Windey, I., & Depaepe, F. (2020). A systematic literature review on synchronous hybrid learning: Gaps identified. *Learning Environments Research*, *23*(3), 269-290.

Raes, A. (2022). Exploring Student and Teacher Experiences in Hybrid Learning Environments: Does Presence Matter?. *Postdigital Science and Education*, *4*(1), 138-159.

Reinmann, G. (2021). Hybride Lehre – Ein Begriff und seine Zukunft für Forschung und Praxis. *Impact Free*, *35*.

Szeto, E. (2014). A comparison of online/face-to-face students' and instructor's experiences: Examining blended synchronous learning effects. *Procedia-Social and Behavioral Sciences*, *116*, 4250-4254.

Van Vugt, M., Hogan, R., & Kaiser, R. B. (2008). Leadership, followership, and evolution: Some lessons from the past. *American Psychologist*, 63(3), 182-196. doi: 10.1037/0003-066X.63.3.182.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14490

Combining subject-specific and subject-independent competencies in teaching Linguistics

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Abstract
In recent decades, the concept of key competencies has become increasingly relevant in education, prompting universities to revise their curricula to make more room for subject-independent skills and knowledge. We argue that the best way to incorporate key competencies into the curriculum is teaching them through different subjects. In favour of this notion we present the case study of our course 'Introduction to Linguistics' at the University of Tartu (Estonia), which successfully combines subject-specific and subject-independent knowledge through a coursework which let the students write their own linguistic autobiography, combining their own unique experience with an academic framework. In the process, the students mastered the linguistic concepts covered in lectures, while also practicing academic writing and application of academic methods.

Keywords: *Key competencies; linguistics; process writing; peer feedback.*

1. Introduction

One of the main challenges of modern education is incorporating into curricula the so-called 'key competencies' (Erstad & Voogt, 2018), which the European Commission framework document defines as "knowledge, skills and competencies that can be transferred to real-life situations" (EC EECEA, Eurydice 2012). Those universal key competencies are crucial for the students to successfully and sustainably cope in the modern age of rapid change and abundant information (EC EECEA, Eurydice 2012).

However, the increased focus on key competencies should not come with the price of neglecting subject-specific knowledge, which still is the core of university education (Young, 2008). One way to find balance between the universal and the specific is teaching subject-independent knowledge (i.e. key competencies) through subject-specific knowledge (EC EECEA, Eurydice 2012). That is what our course 'Introduction to Linguistics' aims to achieve.

2. Course Organization

The course 'Introduction to Linguistics' at the University of Tartu is a 3 ECTS introductory course covering the main branches, concepts and functions of linguistics. The course is mandatory in the 1st semester for undergraduate students of Linguistics, Literature, Semiotics, Foreign Languages and Literature and Educational Sciences. All in all, approximately 200-250 students take the course every year. Given the nature the student body (the wide spectrum of their majors and the fact that it's one of the first courses that they're taking at the university), we have set two aims for the course:

1. The subject-specific aim: To give the students a broad overview of modern linguistics that would later help them in their specific field of study.
2. The subject-independent aim: To introduce the students to academic writing, working with academic sources and analysing data with academic means.

With the combination of these two aims in mind, we have developed the coursework of this subject: each student writes their own linguistic autobiography, a 1800-2200 word paper where they describe and analyse their own language-related experiences according to a framework of materials and terminology covered in the lectures. Influenced by student-centred-learning (SCL) principles (Lee & Hannafin, 2016), the linguistic autobiography assignment seeks to turn learning more personal, to value each student's unique experiences and to encourage them to build on those experiences to create an original and personal paper.

The subject-specific aim of this coursework is in accordance with the revised Bloom taxonomy which ranks *creating* as the highest level of cognitive learning (Forehand, 2005): in order to create the original body of text that is the linguistic autobiography, they first have

to pass the lower steps of the pyramid, i.e. master the course material fully so that they can use and integrate it freely in their own text. This idea also follows the constructionist theory of learning, which emphasises the importance of students actively producing and "constructing" something new upon the knowledge gained in classes (Lee & Hannafin, 2016).

The subject-independent aim of this coursework is inspired by the disciplinary literacy concept coined by Elizabeth Birr Moje (2011). Disciplinary literacy encompasses reading, understanding, synthesising and creating academic texts of one's field of study. Moje argues that it's important for the students to understand where the knowledge presented in the class comes from and how it has been acquired in order to learn to produce these kinds of texts themselves (Moje, 2011). That includes "teaching young people how to access, interpret, challenge, and reconstruct the texts of the disciplines" (Moje, 2011). Through the coursework we guide and encourage the students to work with different academic sources to interpret and compare the data and observances from their own life, thus validating and sometimes also criticising the sources.

In order to walk the students through this process, they receive a task with guiding questions, a list of up-to-date relevant sources and a list of linguistic terms (see an example below) for each subtopic that they have to write about. In each subtopic the students must use at least two academic sources and at least two terms which have to have an explanation (in footnotes) based on the textbook or other relevant source.

The text is divided into four sections, following the basic topics in linguistics and covered in lectures (see Figure 1):

1. Psycholinguistics and the languages of the world (keywords: *language acquisition and learning, first words, language environment and contact, mono- and bilingualism, areal and genealogical classification of languages, language endangerment*).
2. Semantics and pragmatics (keywords: *the nature and the shift of meaning, a linguistic analysis of a text or conversation*)
3. Language typology (keywords: *phonetics, phonology, morphology, syntax, describing a language from morphosyntactic aspects, phonetic analysis of written language, comparing languages through grammatical categories*)
4. Sociolinguistics and Onomastics (keywords: *language variation, dialects, working with informants, structure and etymology of names*)

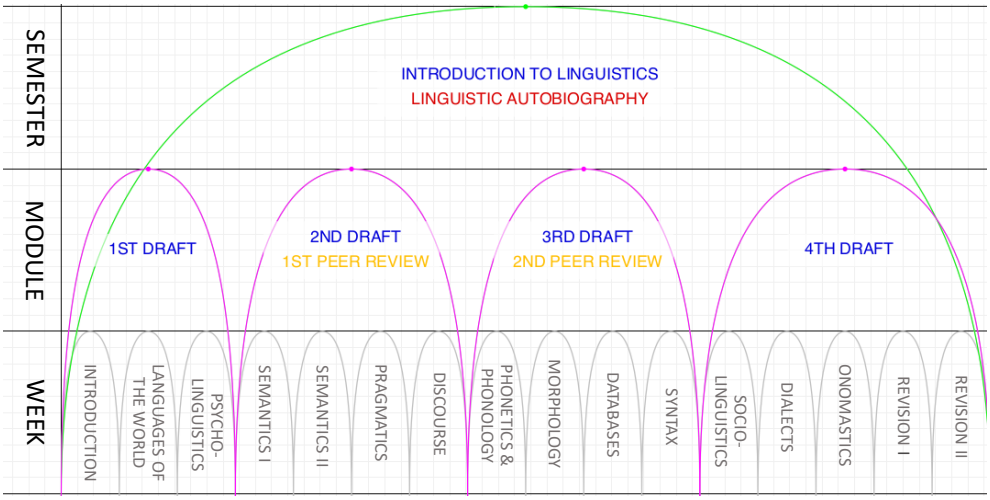

Figure 1. Course outline as a learning arch. Created in LearningArches by Kaospilot

In order to facilitate the process of learning, we use process writing, where students submit their drafts four times, adding one part each time according to the topics listed above and also resubmitting their previous text with corrections each time. After submitting each draft, the students receive feedback: in the 1st and 4th stage from their instructor, in the 2nd and 3rd stage from their peers in 3-5 member writing groups (about the benefits of process writing and peer-review see Guilford, 2001; Lundstrom & Baker, 2009; Leijen, 2016). After receiving feedback on the 4th draft, the students make their last amendments and submit the final version of the work for assessment.

Example 1. The guidelines given to the students for the 1st draft's 1st subtopic

> *Can you ask your parents which were your first words? Can you explain, why these particular words? When did they appear? What about longer utterances? Give concrete examples!*
>
> *[...]*[1]
>
> *In which kind of a linguistic environment (i.e. monolingual, bilingual) have you acquired your first language(s)? Do you consider yourself bilingual? Explain! Do you remember or can you find out what was your first contact with a foreign language? Describe it!*

[1] The opportunity to write about siblings, younger relatives or other acquaintances was also in the task in case the student doesn't have any recollection or materials from their childhood. In case student prefers not to write on his/her own experiences, use of CHILDES corpus (https://childes.talkbank.org/) was permitted instead.

As can be seen from the example, the tasks were written in an easy and accessible language, using the Socratic method inspired questions to prompt students to contemplate, re-evaluate, and generalise their life experiences and associate and compare them with theories that they learned about in the lectures and the sources provided to them. The task was also accompanied by 14 possible sources from textbooks to research articles (e.g. Ambridge *et al.*, 2013) and 16 terms (e.g. *bubbling, overgeneralisation, reference, reduplication*). All of this functions as conceptual scaffolds, meant to guide students in "linking and organizing knowledge related to a topic" (Lee & Hannafin, 2016).

Example 2. The respective section from a student's work

> *From the morphological traits that characterise child language (Tragel 2020), reduplication (e.g. auh-auh 'woof-woof', adaa-adaa 'bye-bye') was present in my speech, and from the phonological traits (Garmann et al. 2020) reduction (e.g. at 'auto' (Estonian for 'car')).*
>
> *As can be seen from this excerpt, the student has described her childhood language use referring to the lectures (Tragel 2020) and to an academic paper (Garmann et al. 2020), proving that they understand the theory and can apply it to real life by relating it with empirical data from their own experience.*

3. Evaluation and Outcomes

The final submitted papers will be assessed by instructors following a standardised point matrix that has been developed and updated throughout the three years that the linguistic autobiography task has been used. There are separate categories for every subchapter, where the content, the sources, the terms and (where applicable) the examples are graded on a scale varying from 4-point to 1-point (depending on the size and importance of this particular part in relation to the whole text). In addition to the topic-centred categories, there are also general categories that evaluate the work as a whole with regard to language, formatting, structure etc. All in all, it is possible to receive 74 points for the paper, with 19 points for general categories and 55 points for topics. In order to motivate students to work consistently throughout the semester and submit their drafts on time, they receive 5 points for each draft published before on time (losing one point for each day of delay) and 3 points for both of the peer review seminars where they give both oral and written feedback. The total amount of points is thus 74 + 4x5 + 2x3 = 100.

For meaningful learning purposes, we value the feedback by students at the end of the course about how difficult and how interesting the course was for them. The majority of students admitted that the course was relatively difficult. With SCL it was to be expected, because students were required to participate actively throughout the whole course instead of just

attending the lectures (Lee & Hannafin, 2016). The main hardships mentioned by students were time management, proper academic writing and working with academic papers. However, it's noteworthy that a similar percentage of students claimed the course to be interesting for them, thus meaning that the high percentage of students considering the course to be difficult may not be a problem, but rather sign that the course was challenging but rewarding. The written feedback reveals that students realise and value both of the two main aspects of the course: the subject-specific as well as subject-independent.

Example 3. Some excerpts from this feedback (answers to the question "What do you value the most from everything you learned in this course?"):

The ability to associate theory and practice.

This course made me think of language from such a different perspective than I ever could have imagined. I liked that even when I'm not going to become a philologist or linguist, it broadened my horizons and made me realise things from a different perspective.

Writing my own linguistic autobiography taught me to describe my own experiences and observances with academic methods.

4. Summary

Thus it can be said that the linguistic autobiography coursework was a success. It was naturally challenging for many students, given how most of them had little to none previous experience with academic writing and working with academic sources. However, this proves all the more the importance of this course for their academic path – which many students themselves also embraced in their feedback. We are also introducing the format of linguistic autobiography to high school students through a series of articles in a local popular science magazine Oma Keel (Teiva & Tragel, 2021, 2022). In order to make the study resources available to a wider public (and also enable the students to access them after the course ends) we have created a MediaWiki-based linguistics wiki environment that can be accessed at wiki.ilonatragel.ut.ee (in Estonian only).

In a wider sense, our course proves that it is in fact possible to successfully unite subject-specific and subject-independent learning, educating the students on their chosen field of study while also developing their key competencies. It's not only the students that gain from this sort of compound teaching, but also universities: in a world where universities tend more and more towards cost-effectiveness, it is even more crucial to maximise the benefit of every course.

References

Ambridge, B. P. (2013). The retreat from overgeneralization in child language acquisition: Word learning, morphology, and verb argument structure. Wiley Interdisciplinary Reviews: Cognitive Science, 4(1), 47-62. 10.1002/wcs.1207

Erstad, O., & Voogt, J. (2018). The Twenty-First Century Curriculum: Issues and Challenges. In K. G. Voogt J. (Ed.), *Second Handbook of Information Technology in Primary and Secondary Education.* Cham: Springer, 19-36. doi: 10.1007/978-3-319-71054-9_1

EC EECEA, Eurydice = European Commission, European Education and Culture Executive Agency, Eurydice. (2012). Key competencies: a developing concept in general compulsory education. Eurydice. doi: EC-32-12-295-EN-N

Forehand, M. (2005). Bloom's Taxonomy: Original and Revised. M. Orey (Ed.), *Emerging perspectives on learning, teaching, and technology.* Retrieved online from: http://www.d41.org/cms/lib/IL01904672/Centricity/Domain/422/BloomsTaxonomy.pdf

Guilford, W. H. (2001). Teaching Peer Review and the Process of Scientific Writing. *Advances in Physiology Education*, 23(3), 167-175. doi: 10.1152/advances.2001.25.3.167

Lee, E., & Hannafin, M. J. (2016). A design framework for enhancing engagement in student-centered learning: own it, learn it, and share it. *Education Tech Research Dev*, 64, 707-734. doi: 10.1007/s11423-015-9422-5

Leijen, D. A. (2016). Advancing writing research: an investigation of the effects of web-based peer review on second language writing (Doctoral dissertation). Tartu: University of Tartu.

Lundstrom, K., & Baker, W. (2009). To give is better than to receive: The benefits of peer review to the reviewer's own writing. *Journal of Second Language Writing*, 18, 47-62. doi: 10.1016/j.jslw.2008.06.002

Moje, E. B. (2011). Foregrounding the Disciplines in Secondary Literacy Teaching and Learning: A Call for Change. *Journal of Adolescent & Adult Literacy*, 96-107. doi: 10.1598/JAAL.52.2.1

Teiva, N. K. & Tragel, I. (2021). Keeleteaduslik elulugu 1. Teadlik ja teaduslik pilk oma keeleelule. [Linguistic autobiography 1. Academic perspective on everyday language.] *Oma Keel*, 2, 66-71

Teiva, N. K. & Tragel, I. (to appear 2022). Keeleteaduslik elulugu 2. Kust sa pärit oled? [Where are you from?] *Oma Keel*, 1.

Young, M. F. (2008). Bringing Knowledge Back In. From social constructivism to social realism in the sociology of education. London, New York: Routledge.

8th International Conference on Higher Education Advances (HEAd'22)
Universitat Politècnica de València, València, 2022
DOI: http://dx.doi.org/10.4995/HEAd22.2022.14616

A case of an assessment module in Distance Education at the University of Pretoria

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Abstract

The purpose of the study was to investigate the teaching and learning experiences of students and tutors in an assessment Distance Education module. The study looked at the students' and tutors' experiences of the pedagogy (like the contact sessions) the technology used (the Blackbaoard LMS) and the content and assessment of the module. The methodology followed was a descriptive qualitative case study, using semi-structured interviews and online questionnaires. Responses were obtained from the academic supporter, three tutors and 22 students. The learning management system, Blackboard, is easy to use and user-friendly. Students make use of the discussion board to communicate with each other and lecturers. They also find the contact sessions organised on Blackboard Collaborate useful and use the recordings of the sessions if they cannot attend virtually. They experience the assessment module as very relevant to their teaching practice and believe the content to be well planned.

Keywords: *Assessment; Blackboard; content; Distance Education; pedagogy; technology.*

1. Introduction

For a number of years, the University of Pretoria has been offering a variety of distance education programmes. Currently, the Unit for Distance Education (DE) in the Faculty of Education specialises in the Bed Hons in Computer Integrated Education, Learning Support, Education Management, Law and Policy, and the undergraduate Advanced Diploma in School Leadership and Management (SLM) and Advanced Diploma in Visual Impairment Studies. The API733 (an assessment module) is part of the graduate qualifications of all these specialisations. The role players in all modules are the DE administration, the academic supporter, tutors, lecturers and the students.

2. Background

All the content is digital and uploaded on the Blackboard Learning Management system using a common template for all modules. There is no dispatch of printed material to students. Content is derived from varied resources instead of one textbook. Large classes are split into groups of 50 students or less and a tutor is appointed to oversee teaching and learning activities. Formerly face-to-face contact sessions were used in about six different venues across the country. Contact sessions play an important role in the pedagogy at UDE. During contact sessions, the academic staff gives lectures, facilitate activities and offer study support. Issues that came up during the marking process are discussed. Students have an opportunity to interact with the lectures and their fellow students. Since the start of Covid-19 these contact sessions ave been online, facilitated in Blackboard Collaborate. There are two mandatory orientation sessions for tutors twice a year and at least three contact sessions for students before assignments. Each module also conducts in-between contact sessions as needed. Discussion boards are used for academic discussions. All assessments are conducted online and no students physically sit any written exams.

3. Rationale of the research

The purpose of this study was to thoroughly investigate the teaching and learning experiences of all role players in a distance education assessment module at the University of Pretoria. The reason for this was mainly to determine if the use of technology, pedagogy and content of this module can be improved.

4. Research question

What are the teaching and learning experiences of the different role players in the API733 module in the DE programme of the University of Pretoria?

5. Theoretical framework: Technological Pedagogical and Content Knowledge framework (TPACK)

The TPACK model is based on Shulman's (1986) explanation of Pedagogical Content Knowledge (PCK). Shulman's model explains how educators' PCK work together to produce effective learning and teaching (Shulman, 1986). TPACK extended these two main elements to create three main elements for effective teaching and learning: content, pedagogy and technology (Graham, 2011; Koehler & Mishra, 2009).

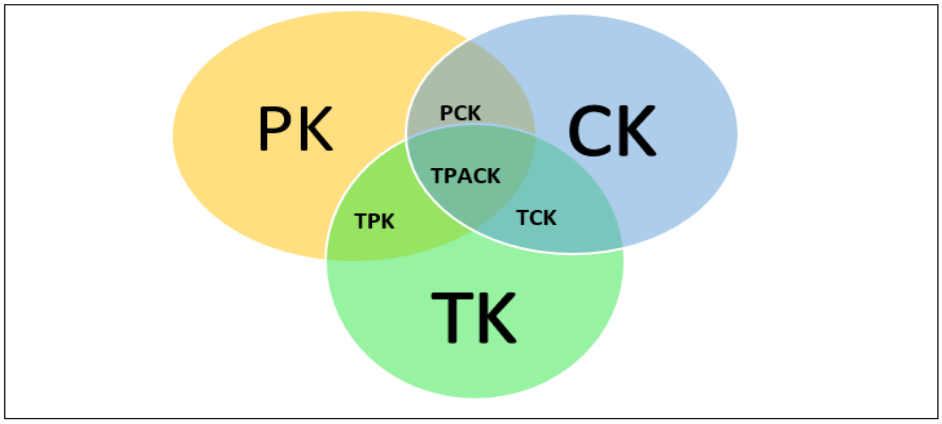

Figure 1. The TPACK model (Mishra & Koehler, 2006).

This study will use an adaptation and extension of the TPACK framework by concentrating on:

- The content of a distance education (DE) assessment module
- The role players in this module, namely the lecturer, academic supporter, tutors and students;
- The pedagogy used by the lecturer, academic supporter and tutors in the assessment module;
- The technology used by the tutors and students, namely the affordances of Blackboard.

6. Methodology

6.1. Methodological paradigm

Qualitative research involves collecting and analysing how "humans arrange themselves in their settings" and "how inhabitants of these settings make sense of their surroundings" (Maree, 2020). During the proposed study, a qualitative methodology was used to acquire new knowledge. The study undertook a qualitative approach because it dealt with words and

meanings to understand the participant's ideas, beliefs, opinions and experiences. The data was analysed to gain insights into the students, tutors and academic supporter's views of an assessment module. The benefit of the ideas and experiences is the potential improvement of the content, pedagogy and use of technology in a DE assessment module.

6.2. Research design

Case study research is a method that allows the in-depth analysis of a complex phenomenon in a real-life situation or problem (Coimbra & Martins, 2013). A descriptive case study was conducted during this investigation. Descriptive case studies often attempt to describe a particular situation or case that happened in real-life in a lot of detail. It usually includes a description of the people or groups that are involved in a given situation, as well as additional facts of the situation/case at hand that enables readers to understand the problem and the causes better (Adolphus, 2020).

6.3. Sampling

Maree (2020) defines convenience sampling as a method used by researchers to select samples for research data because they are quickly and conveniently available, but it does not necessarily result in a representative sample. The sampling for this study was convenient, because all the participants are available on Blackboard; signed up for a specific module of the lecturer in question. Maree (2020) describes purposive sampling as a method used to select samples with a specific objective in mind. All participants had something to do with a specific online assessment module, namely the academic supporter, tutors and the students registered for the module. A semi-structured interview was held with the academic supporter and three tutors. Twenty-two students filled in a Google Form survey.

6.4. Data collection strategies

Kabir (2016) describes data collection as the systematic process of gathering information from relevant sources to answer research questions, test hypotheses and achieve the research project's objectives. There are various methods for data collection. In this research study I used semi-structured interviews and a Google Forms survey.

Nieuwenhuis (2020) defines semi-structured interviews as a line of open-ended, probing questions that the researcher develops before the interview. He explains that the researcher asks a list of open-ended questions and further probes and clarifies without getting side-tracked by trivial aspects. I also used a survey that is defined as a research tool that collects "information from a sample of individuals through their responses to a question" (Check, 2011). This is due to wanting to use a wide range of responses to a specific question to reach a conclusion. The self-created survey also allowed me to get the experiences and answers for these questions without needing to interview every participant in my research. The research

collection tool that I used was Google Forms, which allowed me to provide the survey online, therefore allowing me to provide the forms without the need to give physical copies of the surveys and it allowed me to see the responses online.

6.5. Data analysis

According to Maree (2020), content analysis is the most commonly accepted data analysis strategy for descriptive qualitative studies. A broad definition of content analysis is any systematic method used to interpret specified aspects of messages objectively. It is a valuable technique that allows the researcher to discover and describe people, places, actions, places, context and events.

Thematic analysis is a data analysis method for identifying, scrutinising, organising and reporting themes (patterns) 'emerging' in the data (Braun & Clarke, 2006). Braun and Clarke (2006) argue that thematic analysis is a valuable method for analysing the perspectives of different research participants, identifying similarities and differences, and generating insights that the researcher did not anticipate.

7. Results and findings

7.1. About Blackboard

The University of Pretoria Balckbaord version is called ClickUp. Lecturers have a variety of course documents to provide to students. Such documents include the syllabus, handouts, projects and assignments. By providing these documents in a central location, students learn quickly to go to Blackboard to get everything they need. Most tutors and students find the Blackboard LMS easy to use and user friendly. It can be difficult to navigate for new students, especially those who are not tech savvy. The utilization of the LMS depends solely on the efficiency of the user. It is much simpler to use with sufficient and efficient training.

Blackboard has many features that help academics to stay organized and help students engage with content. Tools such as announcements help to communicate with students quickly, whilst the grade center provides grades in electronic format. Students prefer to see grades immediately. This electronic access reduces the number of enquiries - phone calls and emails - from students wanting to know a grade on a specific assignment or their overall grade in the course. The discussion board helps students to engage with content and becomes a community of practice. The integration of Turnitin into the LMS helps lecturers and students guard against plagiarism. Blackboard Collaborate is the tool that is used to conduct online classes and meetings. It is easy to use and content can be shared via pdfs and PowerPoints. Participants can assume different roles, like participant, guest or moderator. Even groups over 250 can be accommodated on the platform.

Some suggestions for improvement from students are that the university should come up with strategies to increase student participation, for example a merit / reward system in the form of marks. ClickUp pages could be presented as an online study guide. It is irritating to download documents and store them offline. There should be links to hypertext on ClickUp pages. There should be a main page for each module with sub-pages listed in the left margin for each unit and text inside those sub-pages, instead of links to pdfs, Word docs, etcetera. There should be a downloadable pdf of documents at the top of the page for those who want to work offline. Some students also complain that messages that you start on the Discussion board are discarded if you go out of ClickUp. Provision should be made for Drafts.

7.2. Pedagogy and contact sessions

Students have a lecturer, academic supporter and tutor that run the module. The academic supporter is mainly in charge to conduct the contact sessions. In API733 contact sessions are done in the beginning of the module and before every assignment. In between students can use the discussion board or emails that are answered as soon as possible. According to students, instruction and training on the setting of assessment can be improved. Students have to do more discussions that count for marks. They must be able to defend their position. Owing to Covid-19 there are limitations that cannot be overruled, like network challenges and limited data.

According to tutors and students physical contact sessions were great. It allowed for more students to participate and seek understanding before handing in assessments. Currently, fewer students participate because of the digital approach being used. Contact sessions should be compulsory to attend and done on a monthly basis. In the past it was mostly based on content. Students prefer that videos should be used. It is good that contact sessions are recorded. Contact sessions should be conducted at an earlier date in advance of the assignment date. Many students experience network challenges. Some students prefer to communicate with tutors through emails.

7.3. API733 module

Certain opinions feel that this module is one of the most imperative modules in the education fraternity. According to tutors and students it should be offered across specialisations. It offers students a critical insight and understanding of assessment and how to properly conduct it. Every educator needs this knowledge. Development of activities using Bloom's taxonomy, learning about principles and purposes of assessment are appreciated. One student said: "It is very relevant to my teaching practice. With the little development I received as a young teacher, I learnt a lot about assessment that is applicable to my work. It improved me as a teacher".

This module can be improved through sparking meaningful discussions and encouraging students to ask open-ended questions. Content on blended learning can be added. It can be added on how to deal with assessment of learners with barriers, and how to revise content before a learner is assessed. Many students do not know how to create online assessments. Marks should be added for discussions and research related activities. The module can focus more on setting quality assessments. There is too much focus on digital educational games without providing support to actually use these in class. More than 80% of schools do not have computer systems for learners and games are not incorporated in daily classwork. Monitoring and moderation is not covered as well as systemic assessment.

8. Conclusion

In this study the technology, pedagogy and content of an assessment module in Distance Education at the University of Pretoria were investigated. The main findings are that the Blackboard LMS is easy to use and useful. The pedagoy is mainly handled through contact sessions, discussions and putting up content on the LMS. The content of the module is seen as very important in the arsenal of teachers. The suggestions of the students as discussed above will be used to improve the module.

References

Adolphus, M. (2021). *How to undertake case study research*. Emerald Publishing. https://www.emeraldgrouppublishing.com/how-to/research-methods/undertake-case-study-research

Braun, V. & Clarke, V., 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77-101.

Check, J. (2011). Research methods in education. *Sage publications*, 159-185.

Coimbra, M., & Martins, A. (2013). Case Studying Educational Research: A Way of Looking at Reality. *American Journal of Educational Research*, *1*(9), 391-395.

Graham, C. R. (2011). Theoretical considerations for understanding technological pedagogical content knowledge (TPACK). *Computers & Education*, *57*(3), 1953-1960. https://doi.org/https://doi.org/10.1016/j.compedu.2011.04.010

Kabir, S. (2016). *Methods of Data Collection*. Retrieved from: https://www.researchgate.net/publication/325846997

Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary issues in technology and teacher education*, *9*(1), 60-70.

Maree, K., 2020. *First steps in research*. 3rd ed. Van Schaik Publishers.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers college record*, *108*(6), 1017-1054.

Nieuwenhuis, J. (2020). Qualitative research designs and data-gathering techniques. In J. Creswell, L. Ebersöhn, R. Ferreira, N. Ivankova, J. Jansen & J. Nieuwenhuis et al., *First steps in research* (3rd ed., pp. 108-112). Van Schaik Publisher.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational researcher*, *15*(2), 4-14. https://doi.org/https://doi.org/10.3102/0013189x015002004