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An inter-disciplinary simulation model for authentic learning

This paper proposes an inter-disciplinary simulation model for authentic learning that bridges the gap between short group-based simulations within the classroom and longer individual placements in professional working contexts. Dissemination of the model is expected to widen the use of authentic learning approaches in higher education.

The model is based on an inter-disciplinary project in which UK higher education students acted as professional developers to produce prototype educational games for academic clients from other subject areas. Perceptions about the project were obtained from interviews with project participants. The stakeholders believed the inter-disciplinary simulation to be a motivating learning experience, whilst identifying possible improvements.

To evaluate whether the authenticity of the student-client relationship could be improved, the interview data were compared to four themes for authentic learning described by Rule (2006). The data supported Rule's themes, whilst highlighting the added value gained from meta-awareness of the simulation as a learning opportunity.

Keywords: authentic learning, simulation model, role-play, inter-disciplinary, problem-based learning, meta-awareness.

An inter-disciplinary simulation model for authentic learning

Introduction

This paper describes an inter-disciplinary learning initiative within Higher Education (HE). It considers how a simulated client-developer relationship provided a valuable learning experience for students, academic staff and educational developers. It also considers a match between the participants' experiences and theories about authentic learning and reports on how the project has since been modified to heighten authenticity.

The initiative was facilitated by the Creative Development Team (CDT), part of the Learning and Teaching Institute (LTI) at Sheffield Hallam University. CDT are educational developers with a focus on academic innovation, and in this project took a liaison role to support a new model for authentic learning.

Authentic learning has been valued within HE contexts since the 1980s (Rule, 2006), but as there are still gaps between pedagogic theory and teaching practices (Herrington, 2006), and between university learning experiences and the real-world application of learning (Stein, Isaacs, & Andrews 2004), it is useful to share successes in fostering authentic learning. Rule carried out a qualitative analysis of literature on authentic learning and proposed four themes of importance to authentic learning. These are: real-world problems; open-ended inquiry; social discourse; and self-directed learning (Rule, 2006).

In the inter-disciplinary simulation model presented here, students on one course were asked to work with academic staff from other subject areas, on problems of genuine interest for those academic staff. The students acted as professionals in their own subject area (in this case, computer graphics) and the academic staff acted as clients for the students. As such the approach is a combination of simulation and problem-based learning. In the typology

described by Lean, Moizer, Towler and Abbey (2006) the model fits into the category of interactive role play.

Within the literature on authenticity, some papers are particularly relevant to this initiative, for example, Radinsky *et al.* (1998) explore differences between simulation and participation models of authenticity, whilst Maxwell, Mergendoller, and Bellisimo (2004) argue that a combination of simulation and problem-based learning can enhance active-learning strategies. Various authors (Newmann & Wehlage, 1993; Reeves, Herrington & Oliver, 2002) have attempted to summarise the characteristics of authentic learning. However, the review carried out by Rule provides a usefully broad framework in which to assess the authenticity of our model, and is revisited in the methodology below.

Ideas about student employability were a driving force in deciding to design an authentic and simulated learning experience. Harvey and Locke's employability report recommended that UK HE should continue to embed employability to enhance the curriculum by 'revising course structures, curricula content and teaching methods' (Harvey & Locke, 2002, p. 44). Various institutions already involve employers in designing, delivering and assessing courses (Cox & King, 2006), role-based simulations of work experience are widespread (see for example Hughes (1992), and Van Ments (1999)) and often include interaction with professional experts (for example, Arias-Aranda (2007) and ChanLin and Chan (2007)). Others (Wheeler, 2006; Vincent & Shepherd, 1998) describe role playing experiences that can last many weeks. However, the model described in this case study aimed to exploit a niche between classroom based simulations involving group-work and individual student placements in the workplace.

The effectiveness of simulation and role-play approaches to learning have been explored elsewhere (DeNeve & Heppner, 1997; Feinstein, Mann, & Corsun, 2002). In addition, others have explored the factors affecting the believability of simulations (Herrington, Oliver &

Reeves, 2003; Mark, 1999) and that meta-reflection and interventions should be used to fully elicit the value of the learning experience (De Freitas, 2006; Wheeler, 2006). Whilst these examples demonstrate some discussion of the issues of immersion in and meta-awareness of simulations, they are elaborated further in this paper.

An initiative was therefore designed to provide authentic learning opportunities for students and an open evaluation project was established with the aim of learning from unanticipated benefits and difficulties arising within the initiative.

The Simulation Design

Groups of final year undergraduate students studying computing visualisation were each asked to create a prototype for a digital game. Students acted as professional developer companies to produce prototype educational games for academic clients from other subject areas.

The stated aims of the initiative were to explore:

- The appropriateness of using digital games in higher education
- The benefits and challenges of managing a cross-faculty learning experience
- The ways in which a simulated client-developer relationship could provide a valuable learning experience.

In this paper we report only on the third of these themes.

The initiative was envisaged as an exciting opportunity for computing students to experience professional dimensions of their discipline through a highly interactive simulation. The lines of communication in the simulation are shown in Figure 1.

FIGURE 1 about here.

The opportunity for the project was identified in a conversation between CDT and the course tutors for the 3rd year of the computer graphics course. The initial action of the educational developers in functioning as a liaison group was to publicise the opportunity to academic staff. Through a series of conversations, five academic staff from various subject areas (education, criminal justice, computing, biomechanics, and property management) were invited to play the role of clients who were commissioning game prototypes. During the simulation the course tutors did not have a simulated role, but acted as learning facilitators. They initiated the simulation on behalf of the students by asking them to form small groups to play the role of developer companies.

Hence staff participants and student participants attended separate briefing events for the project. The primary focus at each introductory event was not about the simulation methodology, but about the academic benefits for each participant. The project designers believed that the authenticity of the relationships would not require any artificial interference in that all stakeholders would enter into the initiative with a clear purpose of how working together would be mutually beneficial.

Although the term 'game' was not defined by the liaison group for either the client group or for the student developer companies, clients discussed and developed outline briefs with the liaison group to describe an educational requirement that they believed could be addressed by a digital game. The brief documents were then passed on by the liaison group to the course tutors, and the student groups each selected a client from the descriptions in the brief documents.

Academic clients and student developer companies worked over 12 weeks to design an appropriate game and develop a prototype with minimal intervention from the liaison group. The course tutors provided support for skill development as required for each student developer group. Assessment of the student work was based on a mid-project review of the

students' planning and design methodologies, the final prototype presentations, and end-of-project reports.

Evaluation Methodology

The initiative was evaluated through a qualitative action research methodology in which reactions from all stakeholder groups were captured and then compared to a theoretical framework about authentic learning:

Given the complexity of this inter-disciplinary initiative, and the new elements it introduced into the teaching and learning context for participants, it was appropriate to carry out an open evaluation to capture a rich pool of qualitative data from which to identify unanticipated difficulties and opportunities arising during its implementation. Kemmis and McTaggart point out that while action research is generally thought of as involving a 'spiral' of self-contained self-reflective cycles of planning, acting and reflecting (Kemmis and McTaggart, 2000, p. 595), in reality, it is more likely to be 'fluid, open and responsive'. Macdonald argues that 'Evaluation is all about being a professional, reflective practitioner, curious about the impact of our efforts to improve the quality of student learning' (Macdonald, 2006, p. 12). This embodies the spirit in which the evaluation was carried out.

Many approaches to evaluation have been recognised. The ones which seem most appropriate for this context are formative evaluation perspectives such as *evaluation for development*, and *evaluation for learning about process* (Chelimsky, 1997; Lewis, 2001). These authors highlight various methods, mainly qualitative, as appropriate methods for these evaluation approaches, for example: case studies, research synthesis, stakeholder evaluation, self-evaluation; descriptive monitoring and 'feedback from assessment into new action' (Chelimsky, 1997, p. 102; Lewis, 2001, p. 392).

Data collection was undertaken by the three liaison group members in the form of post-simulation interviews with participants. Semi-structured interviews of approximately 30 minutes were carried out with students, academics, and course tutors to capture their experience of the project. The design of the interviews addressed a number of themes of interest to the evaluation, such as the appropriateness of using digital games in higher education, and the value of experiencing the client-developer relationship as part of the learning process; the interview design also aimed to uncover unanticipated aspects of participation through a series of broad question areas. Interviews with the students, for example, considered: project choice; client-developer relationships; communication; group working; the product; and the use of games in education. A randomised sample of 10 students were contacted from the cohort of 23 students; those who attended for interview represented all 6 student groups. All 6 academic clients and the course tutor were also interviewed.

The liaison group were also involved in key project events (project initiation, client-developer meetings, student presentation events, etc.). In their role of liaison group, the authors met regularly to reflect on the progress of the project, consider the need for intervention and to note possible improvements for future iterations. The informed perceptions of the authors therefore guided the interpretation of the formal interview data.

The initial results implied that the project was successful on many levels: the client-developer relationships were mostly very successful in terms of fostering a challenging and engaging learning experience for the students; the course tutor saw the simulation as an effective assessment opportunity and was keen to run the simulation again in the following year; and several academic clients told us that the initiative helped them to reconsider the key learning outcomes in their own courses and to consider new approaches to teaching and learning.

These findings are *not* the focus of this paper. On consideration of the initial findings, much of the value of the initiative as a learning opportunity appeared to stem from the 'authenticity' of the process. It seemed useful to explore the following evaluation questions: To what extent does the simulation model exemplify an authentic learning opportunity, and how can the authenticity of the student-client relationship be improved? The published literature about authentic learning offered additional insights into the success of the simulation, and possible improvements to it. In particular, Rule's four themes for authenticity in learning provided a theoretical framework through which to analyse the authenticity of the student learning experiences within the simulation and to draw out the wider significance of the research findings.

In the analysis below, the authenticity of the simulation was compared to Rule's theoretical framework for authentic learning which is summarised here:

1. 'real-world problems that engage learners in the work of professionals....beyond the classroom;
2. 'open-ended inquiry, thinking skills, and metacognition are addressed;'
3. 'discourse among a community of learners; and'
4. 'student empowerment through choice.'

Rule, 2006, pp. 1-2

The interview data were re-examined in terms of their relationship to authenticity and categorised according to their relevance to the four themes of the framework. Although much of the interview data related to other aspects of the initiative, many comments were relevant to Rule's theoretical framework and are reported on here. For example, the following extract, in which a student is talking about the relationship with their academic client, illustrates how the students experienced the positive impact of effective communication skills.

> At first we didn't know the subject very well, but as we went along, and we understood the kinds of things we needed to develop, it made it easier to communicate with him. So he was helpful as well. (student participant)

Analysis of the Simulation

The analysis is presented in three parts: factors which contributed to the authenticity of the simulation, those that reduced its authenticity, and additional findings which did not fit within Rule's framework. The analysis is illustrated by representative quotes from student participants, academic staff and the course tutor.

Factors contributing to the authenticity of the simulation

1. Real-world problems

Many dimensions of the experience contributed to the real-worldness of the experience. These are described below:

In acting as professional developers, students experienced the need for negotiation skills to arrive at a shared agreement of the scope of their 'games':

> It did feel kind of realistic as we had to change our ideas. We'd never had that kind of communication with an external client before. (student)

> We did go through a lot of meetings. A compromise had to be made by the client. The idea that we came up with everyone was quite happy with. (student)

> We tried to draw a line: the client really wanted it to be a finished application so that's what she was pushing us to do. But we had to say 'Right that's it, we've got the documentation to do, so that's your lot, sorry!' (student)

The students were motivated to prove and extend their technical skills to solve the challenges presented:

> I think working with a client and the way it was like a real working, you know, real job in a way, I think it inspires you a bit and it makes you want to do better at it. (student)

> One of the best things about it was that it didn't feel like a usual university assignment. It felt more professional and you were keen to get on with it... very valuable. (student)

The academic clients were external to the computing visualisation course and could relate to the students as independent professionals, with a genuine requirement for the games:

> I thought the three I dealt with were very good because they divided their roles up. They had one who was the back-end developer, one who was the front-end developer and one who was the project manager, minute taker and librarian... and I did feel like a Client, especially because they kept me informed. (academic staff)

> I think it was completely real. I think it is real because what you're saying is, to them, they are the consultants/consulting group and they're doing this to get their degree and that's the same as doing it to get paid for doing it. So... as far as the students are concerned that's real. The great thing about this was that the project ideas were coming from the lecturers [Clients]. They wanted this to be done, so for them it was real as well. So in that sense I think it was real. (course tutor)

Finally, the authenticity of the role-playing by students influenced how academic staff might interact with students in the future:

> It was valuable in terms of the [initiative], of working with students in new ways, and seeing them as experts. (academic staff)

> It helped build my notion of students as crime prevention consultants, with some module that I'm developing... that they can go and act as consultants for the replica companies. (academic staff in the subject area of criminology)

2. Open-ended enquiry

In terms of open-ended enquiry, in constructing the game prototypes, students were developing skills through creative investigation of the best methods for constructing their prototypes:

> I had an hour a week with them, [and they had an hour a week on Flash skills], but in the main they didn't need that... the learning was centred around the projects they were doing. (course tutor)

In addition, students needed to abstract from the complex subject areas presented to them by their clients, a distillation of the key processes for the game context. They had to decide how much of the complexity was required within the working prototype and what might be included in future developments:

> The scenario that unfolded was one based upon something we use with postgraduates, where they can deal with a very complex situation; I think the thing that we begin to work towards was breaking those components down so they are more understandable for say first or second year students... but without losing the cohesion of the whole big-picture problems. (academic staff)

> I think it did fit with what [our client] was expecting. The main thing was to get an actual role play fitted in, and the rest of it was open for us to decide how we wanted it to go. (student)

> We only produced a tiny amount of the full idea in the prototype. The actual design is very big and all documented (student)

3. Social discourse

There were opportunities for rich communication in various facets of the project:

The students communicated with course tutors to ask for help with technical skills or dealing with absent academic clients, or to seek reassurance about the assessment criteria:

> Quite a bit of tutor input. He was suggesting how to sit down and brainstorm at the beginning and helped us with some of the coding. And we had help with some of the coding from another tutor on a different module. (student)

The developer groups also had to communicate with their client, by both listening and articulating ideas, in informal meetings, formal presentations, via email and through a written design specification:

> At first we didn't know the subject very well, but as we went along, and we understood the kinds of things we needed to develop it made it easier to communicate with him. So he was helpful as well. (student)

> I think the relationship was very good and it worked very well, they liked the idea of working for a client, I think they were quite motivated by that, I think we had some very positive meetings... the whole process I think was very good, they seemed to get a lot out of the communications we had, either face-to-face, by email or sending documents for review, there was a lot of interaction that led to focusing in on the scope of the project. (academic staff)

Within developer groups there was a need to negotiate the professional project roles, as well as to execute the game development. Clearly this presented challenges initially:

> The group had a good spread of skills. We didn't get on that well to begin with. The communication was difficult to begin with as none of [the] ideas were clear. (student)

4. Choice

The simulation promoted, and depended on, student autonomous behaviours as they directed their own action within a generous learning context:

Developer groups had control over which clients to work with:

> I think the project worked really well, especially because we were given a choice of projects so we could just pick one as thinking of an idea is the hardest part. (student)

> We tried to pick the one that would be the easiest to do in the actual game. It was the 'disruptive students' game we did, which we weren't sure about initially, but the tutor said we'd have a good client, who'd give plenty of feedback. (student)

They could also negotiate the genre of game solution they selected:

> It was an open framework / not a fully sorted, closed idea (student)

> Room for creativity, more options for us to make decisions and come up with ideas. (student)

In addition, the students could negotiate which skills and roles they wanted to develop, how much help they sought from tutors as skill deficits emerged, and how they balanced the tight requirements of a game prototype with all their ideas and their other student commitments:

> They were learning without really realising they were learning I think. You know what I mean? There wasn't a sort of didactic sort of 'This is what you're being taught' [approach]. They were learning to solve the problems that they were coming up against. And doing that in their own time. I think when you get that you know it's going right and I really enjoyed that. (course tutor)

Lack of authenticity in the simulation

All the factors mentioned above contributed to the success of the initiative. However there were also problems, and Rule's framework was particularly useful in analysing the causes of the problems and how these could be addressed. It seemed that most of the problems were related to weaknesses in the 'real worldness' of the simulation:

Firstly, as this was the first time the simulation had been run, clients weren't clear about their role as clients rather than as academic staff, or were simply unavailable at critical times:

> The first meeting with the client wasn't very organised, as they didn't know what to do in their role, and we didn't know either. Might have been useful to have a facilitator initially. But later on things got more organised. (student)

> It was a student-tutor relationship [rather than a client-developer relationship] (student)

> I think some rules of engagement for tutors [academic staff] would be good (academic staff)

Secondly, the intended end-users for the games (i.e. students of the academic clients) were not present in the simulation. In reality a developer should have access to the client's end-user group:

> Quite a lot of students said they'd like to have been able to get access to [end-user] students. (course tutor)

> They [the end-user students] are more important because they are the ones who are going to be using the system. You could get quite a lot of feedback from them. What they wanted to see and what kinds of things they are interested in. So it would have been a good idea to have had that kind of information. (student)

Meta-awareness of authenticity - an additional factor which did not fit Rule's model

There was a need for students and academic staff to balance their in-role behaviours with meta-awareness of the simulation as a learning opportunity:

The students were, by definition, learning on the job and the academic clients needed to be generous when the students made mistakes or behaved in a non-professional way:

> She was fine, she respected the fact that we are not a real life company but we're there for the learning aspect. (student)

Students had to ensure they could meet the external requirements of assignment submission as well as the requirements of their clients within the simulation:

> We went to our tutor and asked if it was a problem that it wouldn't be a game, and he said as long as it has elements that you can't do it on a DVD player (e.g. drag and drop elements) then it would be OK. (student)

Lastly, some of the motivation for engagement in the project is external to the simulation, as the students weren't driven by financial rewards, but by accreditation:

> OK, their life didn't depend upon it in terms of money but they did depend upon [the project] in terms of their performance for their degree. (course tutor)

Changes to the simulation

The problems identified as weaknesses in the 'real-worldness' of the simulation were due to our inexperience as simulation facilitators. The simulation was run again the following year with the following improvements: To improve role clarity, clients were provided with a detailed briefing describing the requirements of their role. To strengthen the authenticity around the commissioning of games, the academic clients were asked to provide focus groups composed of representative end-user students (see Figure 2). To maintain appropriate equity in the simulated relationships, the academic clients were briefed to behave as clients, and never as tutors. Finally, to introduce a driver beyond the student assessment, a prize of a development budget was awarded to the prototype with the best chance of being completed as a working game.

FIGURE 2 about here.

Summary and Conclusions

The model for authentic learning

The strength of this model is in bridging the gap between short group-based simulations within the classroom and longer individual placements in professional working contexts. The model combines elements of group and problem-based learning via simulated role-play in a low risk, but supportive environment.

The use of Rule's framework was useful for analysing the strengths and weaknesses of the simulation model. The framework was largely validated by this case study, even when the real-world problems were simulated rather than genuine. However, the use of the simulated roles in this extended simulation model merits careful attention. We would argue that the benefits of an extended simulation are heightened when all players have a belief and confidence in playing their roles, and also some meta-awareness of the learning opportunity offered by the simulation. These points are explored below:

Immersion and meta-awareness

As noted in the introduction, it is important that an educational simulation is believable by the students. In this case it was important that the students should interact with their clients with the confidence and authority that they would have in the real world as consultants or developers, and that the academic clients should not attempt to tutor the students. If some measure of equity was not established between the student developers and the academic client there was a danger that the learning experience could be undermined.

It was relatively easy for the academic clients to stay in role because their need was real and they had no responsibility to tutor these unknown students. However, the pretence was much harder for the students playing the developers as they were by definition, learning on the job, and likely to make mistakes or behave in a non-professional way. Academic clients had to be generous in ignoring this. Even though confidence grew through the 12 week initiative, the student participants needed to remember to act in role in order to help them suspend reality and benefit from the otherwise authentic interaction.

Participants also need to retain meta-awareness of the educational context of the simulation in order to elicit the value of the learning opportunity for the students. In the context of this model, meta-awareness allows the forgiveness of unprofessional mistakes, and

allows the simulation to be consciously suspended when ongoing learning synthesis is being processed by the students, or when tutor intervention is necessary. If students are encouraged to be aware of switching in and out of role each time they engaged with the project, such meta-awareness may also contribute to greater confidence in playing their roles within the simulation. Hence in the educational context, participants should balance immersion within simulations with some meta-awareness of their roles as learners and learning facilitators.

Transferability

How transferable is the model to other contexts? Given that the academic clients were from a wide range of subject areas (Real Estate, Biomechanics, Criminology, Teacher Education, and Computer Science), it seems likely that the approach of designing a digital game could be applicable to many additional subject areas. The approach need not be limited to game design however. Transferability is more likely to be limited by the type of service that a student group could genuinely offer diverse academic clients. However, the model should be applicable to any subject areas in which students can provide professional or semi-professional services to students or staff from other disciplines. The level of support required for students must be judged according to the capacities and competencies of each cohort.

One of the obvious questions in considering the transferability of this model to other contexts is whether the 'liaison' role is really necessary. However, as one of the course tutors said, '*How would I do it [without the liaison group]? I would have to email everybody and ask if you've got some nice projects you'd like to run. I might get one or two answers if I'm lucky...*' In this case study the educational development liaison group was able to tap into an existing network of academic staff contacts to identify possible participants. It is possible that this brokering role could be handled by an electronic system if such inter-disciplinary initiatives become more common.

Conclusions

Rule's themes for authentic learning provided an effective framework for analysing the experience of stakeholders participating in the inter-disciplinary simulation model described here. The stakeholder opinions showed a good fit to Rule's framework, and we conclude that the simulation model was effective in providing students with an opportunity to develop the professional aspects of their subject area. In addition to the themes from Rule, two findings are important: it is valuable for participants to retain some awareness of simulation as a learning opportunity, and also to have sufficient confidence in playing their role. If these conditions are met, the extended nature of this simulation model effectively bridges the gap between short group-based simulations within the classroom and longer individual placements in professional working contexts. We hope that others can adopt this inter-disciplinary model of facilitating relationships between students and academic clients as a way to create authentic learning experiences for students.

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