Toward a digital future of curriculum, pedagogy & assessment

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Toward a digital future of curriculum, pedagogy & assessment

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ABOUT THE BERA BLOG

The BERA Blog was established to provide research-informed content on key educational issues in an accessible manner. Its aim is to produce and promote articles that attract policymakers, parents, teachers, educational leaders, members of school communities, politicians and anyone who is interested in education today. It also welcomes the submission of research-informed articles from across this community.

The blog is edited by a small team comprising academic representatives chosen by BERA's Academic Publications Committee and the BERA office. All content is approved for publication by one or more of this team. However, the views of the authors are their own, and the views expressed on the blog (and in this collection) are not the official views of BERA.

The blog is currently curated by the editorial team of Gerry Czerniawski, Alison Fox, Denise Mifsud, Rowena Passy, Barbara Skinner and Kathryn Spicksley.

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ABOUT BERA BITES

The BERA Bites series presents selected articles from the BERA Blog on key topics in education, presented in an easily printable and digestible format to serve as teaching and learning resources for students and professionals in education.

Each collection features an introduction by editors with expertise in the field, and each article includes questions for discussion, composed by the authors, prompting readers to further explore the ideas and arguments put forward in the original articles.

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ABOUT THIS ISSUE

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MARY RICHARDSON, RICHARD POUNTNEY & WEIPENG YANG
IOE, UCL'S FACULTY OF EDUCATION & SOCIETY, SHEFFIELD HALLAM UNIVERSITY & THE EDUCATION UNIVERSITY OF HONG KONG

In the last three decades, digital technologies have become an integral part of our lives, societies and education systems worldwide. Hence it is essential that educators can teach and incorporate technologies in their teaching practices (Yadav & Lachney, 2022). By doing so, we can 'future-proof' the upcoming generations who will learn with the aid of constantly evolving technologies, need to understand the impact of technologies on society, and must use technologies to showcase creativity and innovation in all aspects of life. The Covid-19 pandemic and subsequent lockdowns since early 2020 have accelerated the incorporation of technology in education. Web-mediated education has been introduced to replace or supplement traditional offline modes of teaching and learning. The willingness to adopt and experiment with digital technologies in education, including online learning software, video conferencing tools, virtual tutoring, and learning apps, continues to grow.

We have chosen the following blog posts for this edition of BERA Bites because they provide valuable insights into curriculum, pedagogy and assessment, and suggest further lines of inquiry for research and practice. The authors address important issues impacting education and offer ideas for developing a shared vision for the digital future of education.

Martin Weller presents a compelling argument highlighting the often ignored issue of accessibility and genuinely equitable access to resources, particularly those fast evolving online. Access to the resource does not indicate that the content is accessible to all learners and he calls for more research in this area.

In the second article of this collection, **Ken Kahn** explores how artificial intelligence (AI) programming can engage children in learning and advocates for hands-on learning to foster creativity and advance technology for public good.

Ausma Bernotaite's blog post raises the challenge of transitioning from physical classrooms to digital learning spaces and suggests a resource from Griffith University to help teachers rethink their teaching philosophies for this paradigm shift.

Can learning be predicted with the assistance of technology? **Jennifer K. Olsen, Kshitij Sharma, Nikol Rummel and Vincent Aleven** explore the potential of multimodal data for understanding collaborative learning and evaluating the benefits of different data streams in temporal analysis.

Technology integration in education is not one-size-fits-all. **Emma Derbyshire** highlights the negative impact of online teaching during the pandemic on children with

special educational needs, including dyslexia, and calls for more research on improving virtual teaching to make it more inclusive for neurodiverse learners.

Nathan Garrett's research examines the effect of system-controlled pauses in video for segmenting teaching, but finds that this strategy does not benefit students. Instead he suggests that staff should focus on finding easily navigable videos for online teaching.

The authors address important issues impacting education and offer ideas for developing a shared vision for the digital future of education.

Neil Selwyn and Jesper Aagaard emphasise the importance of rethinking the role of technology in education and engaging with ethical and moral issues related to technology use in classrooms. Education has a significant role to play in shaping global views of technology despite not having all the answers.

Laura Outhwaite, Anthea Gulliford and Nicola Pitchford's research shows that high-quality maths apps can improve early learning experiences and achievement outcomes, particularly for young children with English as an additional language. The study conducted in Brazil with 61 children suggests best practices for using apps in different languages.

Tom Lowrie and Kevin Larkin propose experience, represent, apply (ERA) as a heuristic to integrate STEM learning into play-based environments and foster authentic connections between digital and non-digital experiences. This approach contributes to a deeper understanding of the use of digital technology beyond passive learning.

Thorkild Hanghøj's blog post addresses the issue of student participation in class, particularly for 'at-risk' students who may not be engaged in their learning. He suggests using complex video games as a means to support these learners, as shown in a Danish school with 190 students where game use increased class participation in a few weeks.

Richard Pountney's blog post explores the concept of open educational resources (OER) and its potential in promoting open educational practices. The post examines the challenges and opportunities of using OER in higher education and teacher education, where the potential of OER to encourage openness in the curriculum and promote co-construction of knowledge remains largely unfulfilled. The post highlights the importance of digital literacy for openness and the need for practices to evolve in ways that are linked directly to classrooms and schools as the site of production.

In her blog post on the future of the artificially intelligent examination, **Mary Richardson** presents a discussion of how AI is perceived in educational settings and considers a continuous tension between embracing the new and fear of 'a rise of machines'. She discusses how there is already much AI content at play behind the scenes in large-scale educational assessment, and given the value it has to mitigate against much of the drudgery of marking, there is indeed a fascinating future unfolding.

The impact of digital learning on student achievement has been a topic of much discussion. In the final blog post, **Weipeng Yang** shares an intervention study that compared the effects of robot programming and block play on preschool children's learning outcomes, including sequencing ability, self-regulation and computational thinking. Yang argues, based on research, that digital learning may be more effective than traditional learning activities in promoting children's development. This supports the idea of incorporating technology in early childhood curricula.

This BERA Bites collection offers a wide range of views, pedagogies and resources related to digital futures in curriculum, pedagogy and assessment. While new technologies develop rapidly, not all proposed educational tools are useful for educators. The BERA Curriculum, Assessment and Pedagogy special interest group is dedicated to exploring research in these domains and welcomes suggestions for blog posts, articles and events related to our interests.

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A NOTE FROM THE BERA BLOG EDITORS

While you read these blog posts, you might also think about your own contexts or research. Perhaps you would like to contribute a post to the BERA Blog, or perhaps when you are next at a conference or professional development event you might come across someone who you could encourage to write for us (see bera.ac.uk/submission-policy for details on how to submit). Please consider interesting methodological aspects, issues and approaches that would be worth reporting more widely, as well as the content of studies. As the BERA Blog team and our colleagues develop these resources we welcome feedback that can help us improve their quality and accessibility.

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Open educational resources offer promise for more equitable teaching and learning

MARTIN WELLER
THE OPEN UNIVERSITY

The past year and the pivot to online learning has highlighted and exacerbated inequities in education systems around the world[1]. It is more apparent than ever that our schools must do better at meeting the needs of all learners, regardless of their circumstances.

One tool for meeting the unique needs of each student is open educational resources (OER). OER are educational materials that are free for educators and learners to use, customise and share. OER carry open licences – such as a creative commons licence – which enable educators to adjust the content to students' learning levels and include content that is relevant to students' cultures, backgrounds and environments. In this way, OER hold promise for helping educators engage students with content that is more comprehensible and relevant than that found in traditional, commercial curricular materials.

Recent studies have indicated that the use of OER in the classroom can have positive impacts on students' learning. For example, one recent study found that K-12 educators in the US who use OER gave these materials higher marks on 9 out of 10 dimensions of 'deeper learning' – such as collaboration and extending knowledge to novel tasks – as compared to their counterparts using traditional curricula (Seaman & Seaman, 2020). Another study found that US secondary students who used open textbooks scored 0.65 points higher on end-of-year standardised science tests than students using traditional textbooks when controlling for the effects of 10 student and teacher covariates (Jared Robinson et al., 2014). A Taiwanese study on using OER videos with English as a foreign language students found that OER were beneficial to the students' use of communicative strategies and preparation for multicultural encounters (Lin & Wang, 2018).

Research has also shown that OER benefit the educators who incorporate them into their curricula. A Mexican study on using OER to teach English found that teachers spent less time searching and selecting materials that suit their needs and that the Moodle repository design was viable for accessing and searching the materials (Garcia & Idalia, 2020). While more extensive and larger-scale research is required, the evidence so far is encouraging and merits attention.

1 Original blog post, published 26 August 2021: https://www.bera.ac.uk/blog/open-educational-resources-offer-promise-for-more-equitable-teaching-and-learning

One area of research that deserves particular attention is the impact of OER on language learning. Currently, the majority of available OER are in English followed by a few other widely spoken languages. OER can be a powerful tool to support English learners. For example, a Colombian study found that pairing OER for learning English with the topics studied in class was helpful to the teachers and students, especially with the webpages being designed for independent study and practice (Cera et al., 2019). Although English dominates, OER development in other languages is increasing, and it offers a route for the development of resources in minority languages which are not always well served by commercial publishers. Some OER have been developed and translated in different languages[2] (such as Welsh[3]) and research has been conducted on OER in multiple languages (such as Portuguese[4]). Regardless of whether OER are available in a given language, the customisable nature of OER offers educators the flexibility to tailor course material to meet the needs of students who may be learning in a language other than their native tongue. The text complexity level of the resources can be adjusted to reflect the language proficiency level of the students.

Regardless of whether open educational resources are available in a given language, the customisable nature of OER offers educators the flexibility to tailor course material to meet the needs of students who may be learning in a language other than their native tongue.

The potential of OER goes beyond just school-based learning, as these resources can be used in a wide range of settings. For example, OER have been used in the UK to create a programme that increases asylum seekers and refugees' access to justice (Charitonos et al., 2020). As more research goes into using OER for learning outside of schools, it's likely that more groups will leverage OER to promote equity in various fields.

2 https://oloer.opened.ca/

3 https://www.open.edu/openlearn/openlearn-cymru-wales/openlearn-cymru

4 https://www.pimentacultural.com/

Open educational resources offer great promise for better serving all learners, including non-native language learners, but there is a need for more extensive research on the impact of OER use on students learning in non-native languages. In addition, there's a need for more research conducted outside of North America and on OER applications that are not school based. All learners deserve high-quality materials that meet them where they are in their learning journey, and OER can help educators provide these types of customised, equitable materials. OER present an exciting opportunity for increased equity in education; it's now up to us to more thoroughly examine the impacts that these resources can have in supporting the success of all students.

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QUESTIONS FOR DISCUSSION

1. What factors will promote the use of OER by teachers?
2. How important is it for teachers to be able to tailor OER for their use with students?
3. How might students participate in the development of OER?

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The reawakening of the old idea of children doing AI programming

KEN KAHN
UNIVERSITY OF OXFORD

In the recently published *British Journal of Educational Technology* article, 'Constructionism and AI: A history and possible futures', Niall Winters and I examine the 50-year history of efforts to support the creation of artificial intelligence (AI) applications by children (Kahn & Winters, 2021)[1]. Seymour Papert and colleagues promoted this idea in the 1970s and beyond (Papert & Solomon, 1971). Others led complementary efforts to introduce logic programming languages and tools to children in the 1980s (see Yazdani, 1984). These efforts were motivated by the belief that children will not only learn about an exciting and powerful technology but perhaps acquire new ways of thinking about their own thinking and learning.

Although a long hiatus followed with very little much happening, since 2017 there have been several developments, likely triggered by recent successes of deep machine learning. Unlike the previous efforts that were focused on symbolic AI, the focus was now on machine learning using neural networks. Several groups, including Dale Lane at IBM[2], the European

1 Original blog post, published 22 June 2021: https://www.bera.ac.uk/blog/the-reawakening-of-the-old-idea-of-children-doing-ai-programming

2 https://machinelearningforkids.co.uk/

eCraft2Learn research project[3], and Stefania Druga at the MIT Media Lab[4], have integrated deep learning with block-based languages such as Snap! and Scratch. Deep machine learning is behind the recent AI successes in object recognition, speech understanding, language translation, world-class game playing, deep fakes, medical diagnosis and robotics. Today, we can add new motivation for helping children to create AI applications: they may acquire a hands-on understanding of the potential and dangers of a technology that is rapidly changing the world.

Deep machine learning is behind the recent AI successes in object recognition, speech understanding, language translation, world-class game playing, deep fakes, medical diagnosis and robotics.

Consider, for instance, the task of classifying images. Children today can train a machine-learning model to classify images into a few categories and then integrate their model into their programs. If they are building a rock, paper, scissors game, for example, they can provide a few dozen images of hands in different configurations for training. Or perhaps they are interested in butterflies (or birds or flowers, and so forth) and want to build an app that can assist identification. Or maybe they want to make an app that greets them and their friends after recognising them. Their app may perform well until they try it with someone else's hand or images of butterflies or friends taken with different lighting, angles or cameras. Such an experience may result in a deeper appreciation of the current controversies such as the one around facial recognition software.

Given age-appropriate programming tools and resources, children can be very creative in how they incorporate AI into their projects. Children have been creating simple computer games for decades, but today they can design ones that respond to gestures and speech. Children can build miniature versions of digital voice assistants such as Alexa, Siri or Cortana that respond appropriately to questions about a topic such as the weather. Technology that they daily rely upon no longer seems like a magical black box when they discover how to create something similar.

3 https://ecraft2learn.github.io/ai/
4 http://cognimates.me/home/

Many children, as they begin to understand the potential of this technology, discuss how it could be used to help people.

Many children, as they begin to understand the potential of this technology, discuss how it could be used to help people. They talk about how a farmer might use it to be warned when their crops are not healthy or are competing with weeds. Or how a doctor might use it to help interpret an X-ray. Or how one can build something that will raise an alert if an elderly person falls in their home. And they can do far more than imagine such uses; they can begin to work towards them.

This blog post is based on the article 'Constructionism and AI: A history and possible futures' by Ken Kahn and Niall Winters, published in the *British Journal of Educational Technology* on an open access basis.

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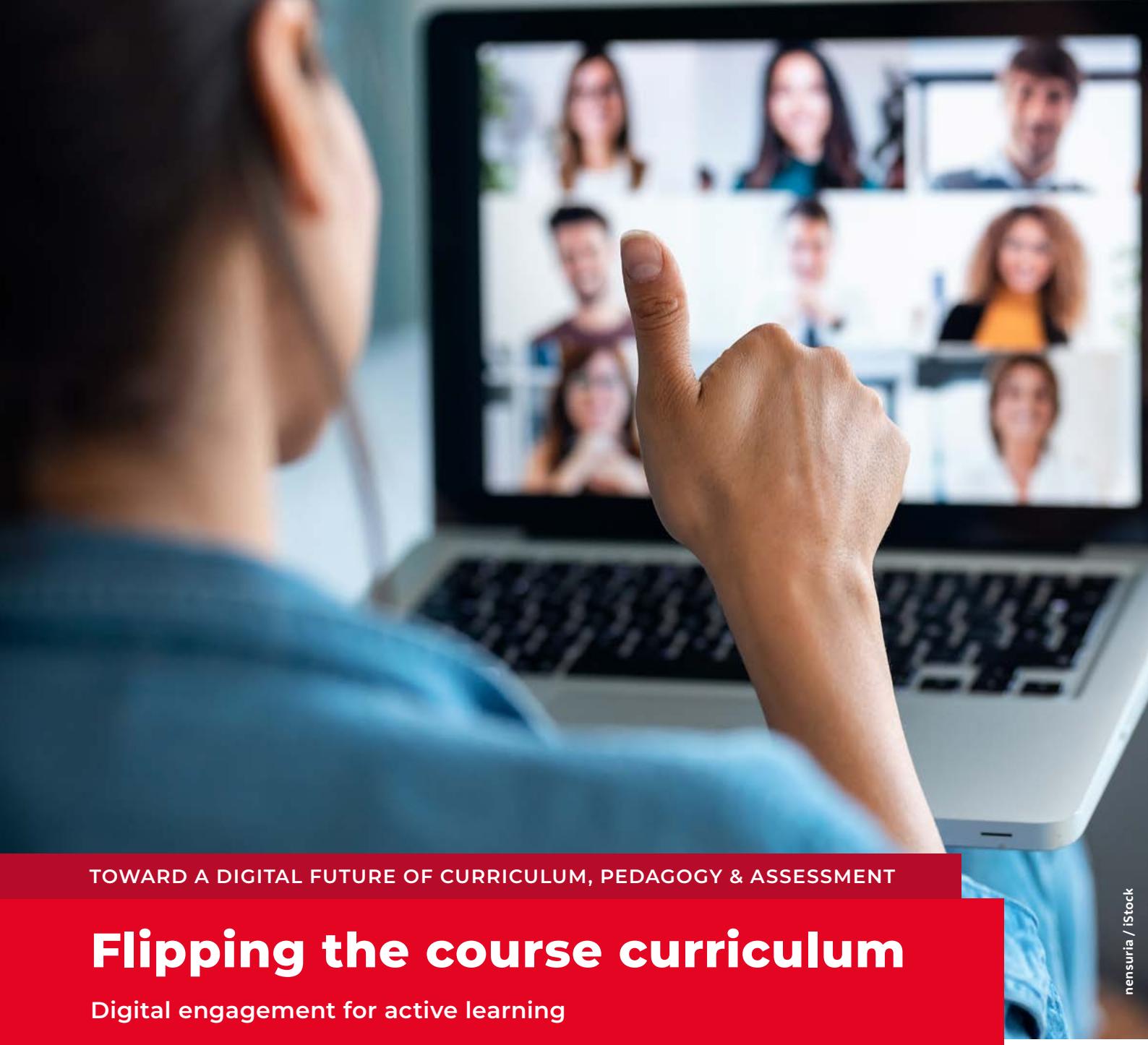
QUESTIONS FOR DISCUSSION

1. What are the main considerations for promoting AI as part of learning experiences among children?
2. AI can be used as a tool for enriching children's learning experiences and promoting their creativity; what effect does the culture of the student (and the cultural biases of many AI tools) have on this?
3. Is AI literacy education for all? Why or why not?



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Flipping the course curriculum

Digital engagement for active learning

AUSMA BERNOTAITE
GRIFFITH UNIVERSITY

Digital engagement has steadily become an important part of an educator's pedagogic repertoire since universities started offering courses online in the early 2000s[1]. In light of the Covid-19 pandemic, the need to be acquainted with tools for online engagement is now particularly pronounced and the universities that have not yet incorporated practices of blended learning are pulling the short straw. As universities were forced to start delivering content online unexpectedly, plummeting student attendance and dropout rates have highlighted the pressing need for the provision of engaging digital classrooms. Online learning can be a challenging experience for students who are used to in-class teaching. Understanding the principles of online teaching and learning can give a head-start to educators moulding their new digital teaching styles and philosophies.

1 Original blog post, published 5 November 2020: https://www.bera.ac.uk/blog/flipping-the-course-curriculum-digital-engagement-for-active-learning

What may be the biggest (and most exciting) challenge of digital classrooms is that switching from in-class teaching to a digital classroom requires a paradigm shift. The core principles of retention, persistence and knowledge acquisition remain pertinent to the learning process, but technology-assisted teaching and learning offers unique benefits. Säljö (2010) suggests that technologies do not simply assist learning, but that they in fact transform the nature of learning. Successfully applied approaches of blended learning have been found to engage the higher-order thinking skills of students (Becker et al., 2015). Indeed, education scientist Redmond (2011) observed instructors as they moved from teaching in a physical classroom to blended and then to fully online classrooms, and concluded that – if provided sufficient time and training resources – educators embraced the paradigm shift in the ways that they designed, delivered and supported online teaching and learning.

The core principles of retention, persistence and knowledge acquisition remain pertinent to the learning process, but technology-assisted teaching and learning offers unique benefits.

Institutions that already offer courses online have been more equipped to support their educators in bringing their teaching and learning online. Some institutions that have largely relied on face-to-face teaching and learning approaches may have found it more challenging to respond to the Covid-19 pandemic without prior preparation. The key research-based principles of engagement in the context of learning are emotional, cognitive, behavioural, social and collaborative (Redmond et al., 2018). The authors highlight that these five interrelated elements can be treated as a curriculum design tool for instructors. The good news is that these five principles of student engagement are the same for all types of classrooms – physical, blended and fully digital. The element that is different is the tools of engagement used to include those five principles. Active learning design tools for online environments, such as the Active Learning Design Tool (Griffith University, 2020), are essential tools for the design of engaging online content. The foundation of successful online teaching is in designing digital course content with engagement principles in mind and using active learning tools – that is, to prioritise student engagement over learning tools.

Digital engagement requires a paradigm shift in a way of developing new competencies to allow educators to develop parallel online teaching philosophies. Although the need to become a 'master of all trades' – proficient both at in-class as well as online engagement – may seem daunting, digital learning is now part of the skill set required to ensure student success, and it is not likely to go away. Institutions must ensure that teaching and learning support teams are ready to accompany their educators departing on the exploration of their own digital teaching styles. In times of uncertainty, teaching is indeed all about supported continuous learning after all.

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QUESTIONS FOR DISCUSSION

1. How does the shift to online learning affect the teacher–learner relationship?
2. How can the social and collaborative benefits of engagement be maximised online?
3. What tools and strategies can teachers use to develop their online learning resources?

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Only time will tell

Using temporal multimodal analysis to predict learning




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By analysing the learning process, one can understand how student behaviours are related to learning outcomes[1]. When assessing the learning process, researchers have shown multimodal learning analytics to provide better predictions than single data streams in individual learning due to each unimodal measure providing different information (Cukurova et al., 2019; Giannakos et al., 2019). Moreover, by including temporal aspects of the data, in which data points are collected across multiple time points (such as for each 10-second window), rather than only counts or averages, one can understand the correlations and impacts around the change in behaviours (Csanadi et al., 2018), which may lead to better predictions. In our recent article, 'Temporal analysis of multimodal data to predict collaborative learning outcomes', published in the *British Journal of Educational Technology* (Olsen et al., 2020), we investigate how multimodal data can aid in understanding the temporal inter-relationship of variables explaining learning from the collaborative process. The work expands our understanding of the use of multimodal learning analytics for collaborative learning beyond what unimodal data can provide and systematically assesses the benefits of different data streams in a temporal analysis.

A SYSTEMATIC COMPARISON OF DATA STREAMS

Multimodal data does not refer to a specific combination of data. Rather, multimodal data refers to any combination of multiple types of data. For example, multimodal data may consist of audio, gaze and log data, or EEG and dialogue data all being collected from the same participant. On the other hand, if only one of these streams is collected, such as audio, this is unimodal data, even if multiple measures are used, such as tempo or energy from audio. Consequently, what the combination of data includes in terms of which and how many data streams are collected can impact how beneficial the use of multimodal data may be. We analysed multimodal data collected from 25 9–11-year-old dyads as they collaborated using a fractions intelligent tutoring system, which is a system that provides step-by-step and adaptive instructional support to students. Using data streams that spanned time scales (Newell, 1990) – in other words, measured interactions at a biological, cognitive or social level – we investigated how different

1 Original blog post, published 30 October 2020: https://www.bera.ac.uk/blog/only-time-will-tell-using-temporal-multimodal-analysis-to-predict-learning

combinations of data streams impacted the prediction of learning gains and post-test scores. Specifically, we assessed the relation of gaze, tutor log, audio (speech at the signal level) and dialogue (speech at the content level) data.

EXPANDING DATA IN TIME AND TYPE

When we remove the temporal aspect of the process data by just using counts or averages for the different measures, we found few relations between the process data and learning gains. However, through our temporal analysis, in which we analysed each of the measures in 120-second windows, it is clear that these relationships do exist and may just be masked when we used counts and averages. We saw that addressing the temporal aspect of the data provides more information, although not equally. The variables that are measured at a smaller time scale, such as the gaze and audio measures, provided a more accurate prediction of learning gains than the measures at a higher time scale, such as the log data.

The variables that are measured at a smaller time scale, such as the gaze and audio measures, provided a more accurate prediction of learning gains than the measures at a higher time scale, such as the log data.

As with the expansion of the analysis across time by considering the temporal aspects, we also found benefits of expanding the data across type through a multimodal analysis, supporting previous research (Vrzakova et al., 2020). However, this is not without a caveat. It is not enough to just have multimodal data, as some of our combinations actually had a less accurate prediction of learning gains than the unimodal data. What data is combined matters. We saw that combining the data streams of different time scales is beneficial to predict learning gains. One explanation for the benefit of the different time scales may be that they provide information on different dimensions. It may be less about the combination of multimodal data that is a benefit in itself, and more about what unique information each data stream brings – with the time scales being one dimension to consider.

This blog post is based on the article 'Temporal analysis of multimodal data to predict collaborative learning outcomes' by Jennifer Olsen, Kshitij Sharma, Nikol Rummel and Vincent Aleven, published in the *British Journal of Educational Technology*.

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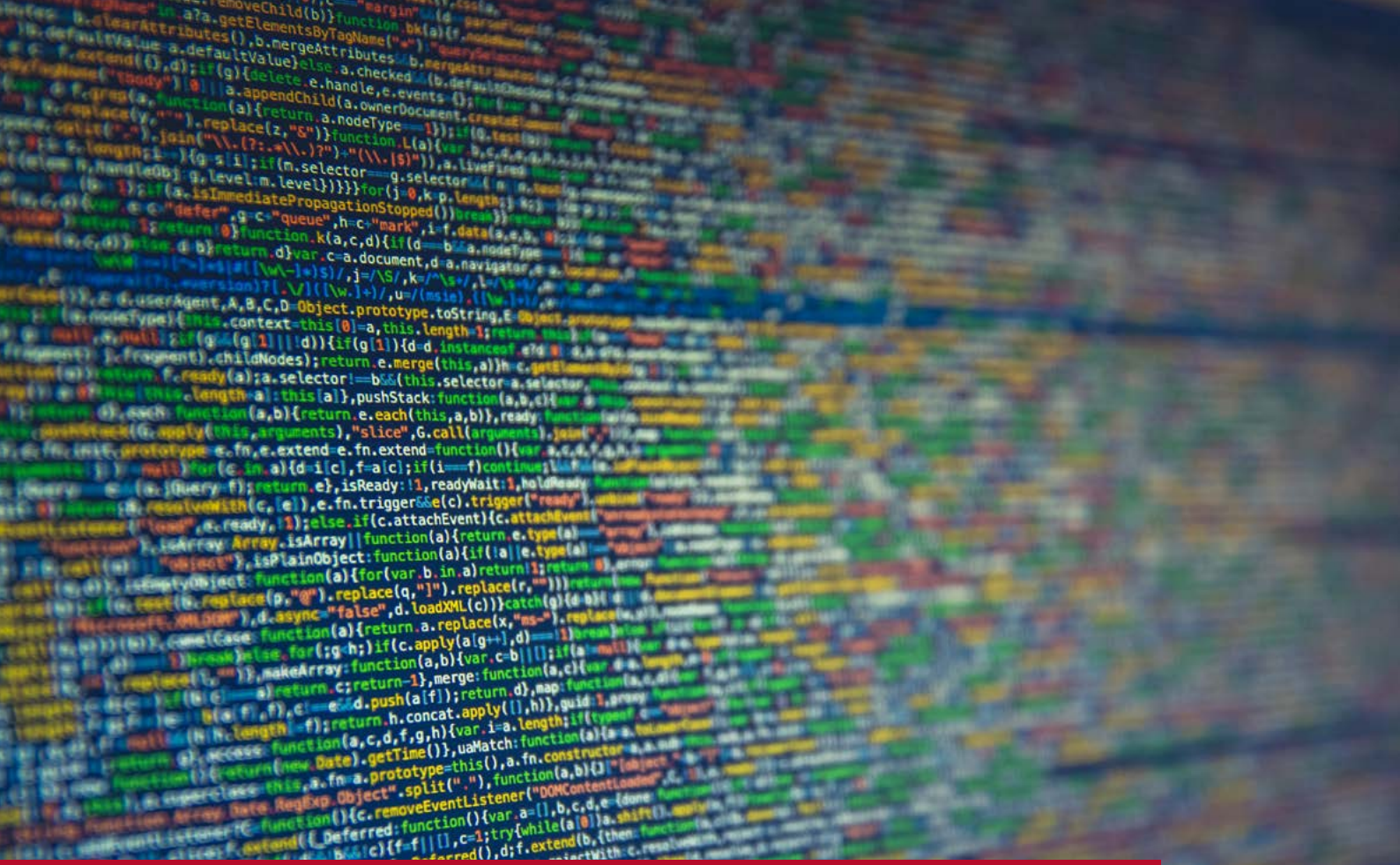
QUESTIONS FOR DISCUSSION

1. Is multimodal learning analytics always better at predicting learning outcomes than unimodal analysis?
2. How can temporal analysis be achieved for multimodal data in the learning process?
3. Is temporal multimodal analysis suitable for a range of dataset sizes and how may the dataset size impact the analysis?



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Virtual teaching for children with dyslexia

The realities & disturbing absence of research

EMMA DERBYSHIRE
HEADTEACHER

I am writing this post from both a parental and scientific perspective[1]. Firstly, from a parental stance, Covid-19 has undoubtedly driven us into situations that could never have been pre-empted. As any parent who has a dyslexic child will have discovered, even in a typical school-based teaching environment the concept of neurodiversity is still relatively new and finding its way into the classroom (BDA, 2020; Armstrong, 2012).

Now, parents have been lurched into teaching at home, and with this has come the rise of 'virtual teaching'.

Educators are doing their very best to maintain engagement with their pupils by using available virtual technologies. However, given the fast pace of change, have we considered the efficacy of such methods for children with special educational needs (SEN) such as dyslexia? The answer, by and large, is no, not yet.

Dyslexia affects an estimated 5-to-10 per cent of the population globally (Knight, 2018), so it is important to have a broad understanding of what it is and how it affects students. The British Dyslexia Association has adopted the Rose (2009) definition of dyslexia (these tend to be variable), which defines dyslexia as:

1 Original blog post, published 26 June 2020: https://www.bera.ac.uk/blog/virtual-teaching-for-children-with-dyslexia-the-realities-and-disturbing-absence-of-research

> ***'a learning difficulty that primarily affects the skills involved in accurate and fluent word reading and spelling. Characteristic features of dyslexia are difficulties in phonological awareness, verbal memory and verbal processing speed. Dyslexia occurs across the range of intellectual abilities. It is best thought of as a continuum, not a distinct category, and there are no clear cut-off points...'***
>
> Rose, 2009

Dyslexia is typically underdiagnosed in school children, and recent research has referred to these 'the lost children' (Barbiero, 2019).

As a scientist, when home-schooling my daughter I observed that virtual calls and the content shared through these tended to be:

- difficult to see/read
- used mixed fonts
- asked questions with little thinking time
- were of a prompt pace
- relied heavily on short-term working memory (dyslexics tend to score lower than peers on memory working tasks) (Gray et al., 2019)
- tended not to repeat information.

When these were delivered I began to see my daughter's confidence and self-esteem being eroded, and her anxiety returning. So, she began to disengage.

'Virtual teaching' is presently being delivered to children with dyslexia/SENs without any underpinning science or research.

This led me to search the 'evidence-base' behind virtual teaching for children with SEN, including dyslexia, and I found that it was largely absent. There is some evidence available in relation to the customisation of websites for those with dyslexia to improve their usability (Kous & Polančič, 2019). Recommended adjustments include modifications to font size, font type, reducing the amount of information on screen, using more graphic elements and modifying contrast between the background and text. I also liaised with various related organisations, and this observation was further confirmed: 'virtual teaching' is presently being delivered to children with dyslexia/SENs without any underpinning science or research.

A further survey of 2,600 teachers from England and Wales mainly related dyslexia to behavioural descriptions (79.5 per cent), followed by cognitive (39.3 per cent) and biological descriptors (9 per cent), with 71.8 per cent mentioning that dyslexia was not adequately covered in initial teacher training courses (Knight, 2018). So clearly there is an ongoing need to raise dyslexia awareness per se, with this becoming even more relevant given that modes of teaching delivery are rapidly evolving.

It is hoped that this blog post has been both thought provoking and insightful. Thank you for reading.

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QUESTIONS FOR DISCUSSION

1. Should the inclusive education movement also be promoted in the context of virtual teaching and learning?
2. What should be done to customise virtual learning experiences for children with SEN, including dyslexia?
3. Does technology exacerbate injustice in the education system? Why or why not?

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Does breaking up a video into parts improve learning?

NATHAN GARRETT
WOODBURY UNIVERSITY

With Covid-19 pushing video deeper into our pandemic-affected classrooms, studying multimedia design has taken on a new urgency[1]. My recent article in the *British Journal of Educational Technology* (Garrett, 2020) measures the effect of adding system-controlled pauses to a video. This 'segmentation' technique breaks a video into sections, with the goal of not overloading students.

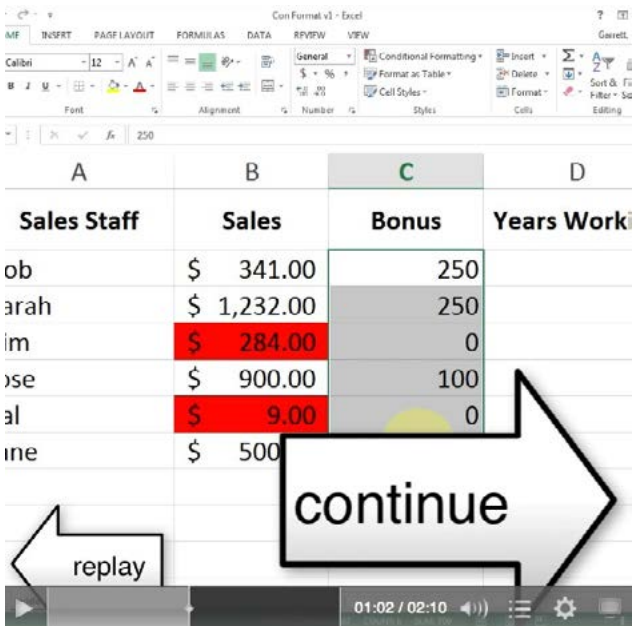
My project used segmentation to improve a Microsoft Excel conditional formatting video. Using videos to teach software has shown inconsistent outcomes (van der Meij & van der Meij, 2015). As instruction moves out of a lab to an online format, understanding why videos work (or not) becomes more critical.

The experiment compared three different teaching methods: text with accompanying screenshots, normal video and an auto-paused video. Each method had identical content, giving a high-level overview of the task, a step-by-step tutorial and an 'on your own' application task. The experiment was run in two phases over several years, with a total of 71 successful performance measurements (and between 9 and 19 participants per condition). The segmented video automatically stopped at the end of each step, showing 'continue' and 'replay' buttons, as well as a 'scrubber' bar on the bottom (see figure 1).

Oddly, the results showed that segmentation was not associated with either a reduction in student effort or an improvement in performance. Student effort was measured with a validated cognitive load scale (Leppink et al., 2014). Student performance was measured by time required to complete the 'on your own' application task.

One possible explanation was that the task was not sufficiently challenging for the students. So in response, I increased the video speed by 40 per cent, and re-ran the experiment as Phase 2. The increased speed made it almost impossible for viewers to stay with the step-by-step process. I hypothesised that the increased stress on users would show segmentation's benefit.

Figure 1
Segmented video screen



1 Original blog post, published 26 October 2020: https://www.bera.ac.uk/blog/does-breaking-up-a-video-into-parts-improve-learning

Table 1
Success measures by experimental condition

	Condition	Number of successful cognitive load measurements	Avg. intrinsic cognitive load (std. dev.)	Avg. extrinsic cognitive load (std. dev.)	Avg. seconds to complete application task (std. dev.)
Phase 1	Captioned screenshots	16	2.0 (1.5)	2.0 (1.2)	88 (60)
	Segmented	19	2.3 (1.7)	2.2 (1.3)	108 (100)
	Video	16	2.1 (0.8)	1.6 (1.2)	118 (112)
Phase 2	Segmented 140% speed	9	3.8 (2.4)	2.5 (1.3)	189 (172)
	Video 140% speed	11	2.4 (1.0)	2.0 (0.9)	161 (171)
	Total	71	2.4 (1.6)	2.0 (1.2)	130 (129)

But again, the experiment showed opposite results (see table 1). The increased speed of the video meant that students using the non-segmented video were forced to use the pause/play control, as well as use the scrubber to replay parts of the video. However, they were still more successful with this method than they were with the segmented video, which automatically paused after each step. Students were still able to be successful with the experiment, not even complaining about the speed of the task. Instead, any frustrations expressed during the experiment tended to be inwardly focused, as they blamed themselves for not being able to stay with the fast-paced video.

The results cast doubt on the benefits of segmentation for software instruction. Students showed more skill with navigating videos than I had expected, even in the presence of a fast-talking instructor. Additionally, this project shows the importance of a realistic baseline condition. Many of the previous studies on segmentation compared system-controlled pauses against videos with no (or very limited) user control (Rey et al., 2019).

Overall, this study shows that adding system-controlled pauses to software videos is a poor use of faculty time. Instead, instructors should focus on ensuring that videos are easy to navigate.

This blog post is based on the article 'Segmentation's failure to improve software video tutorials' by Nathan Garrett, published in the *British Journal of Educational Technology*.

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QUESTIONS FOR DISCUSSION

1. How can we improve consistency of teaching using video within our practice?
2. Why do students blame themselves for not being able to 'keep up'?
3. How can educators harness student competence in online learning environments to promote confidence when faced with challenges?

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Rethinking the 'digital' curriculum

What else should we be aiming for?


NEIL SELWYN & JESPER AAGAARD
MONASH UNIVERSITY & AARHUS UNIVERSITY

After years of excitement and enthusiasm about all things digital, recent times have seen us collectively becoming more sceptical about the relationship between technology and society[1]. We are now in an era of growing suspicion toward 'big tech' firms like Google and Facebook, concern over issues such as online misinformation, and increasing acknowledgement of the unintended consequences of technology use. As a result, there is now a newfound readiness to question, analyse and, not least, criticise the digital technologies that we produce and consume.

As always, societal shifts like these raise questions about the role of education, and what part schools can play in helping young people cultivate the required skills and competences. Of course, most countries have long had national curricular expectations for the teaching of 'computing' (England)[2] and 'digital technologies' (Australia)[3] that contain some commitment to helping students make sense of digital aspects of society. Yet as with any topic that is not considered to be 'core' curriculum, these elements tend to quickly become marginalised in the everyday realities of educational policymaking and school practice.

> **What do young people need to know if they are going to be genuinely digitally empowered? We need to start talking seriously about the undiscussed but crucial 'big issues' if school curricula are to have lasting impacts on the digital societies of the 2020s.**

1 Original blog post, published 20 May 2020: https://www.bera.ac.uk/blog/rethinking-the-digital-curriculum-what-else-should-we-be-aiming-for

2 https://www.gov.uk/government/publications/national-curriculum-in-england-computing-programmes-of-study

3 https://www.australiancurriculum.edu.au/f-10-curriculum/technologies/digital-technologies/

As the 2020s begin, it seems to now be a priority for school systems to finally get to grips with not simply teaching students to use digital technologies but also to critically navigate the challenges of the digital age. So, if schools are to develop robust forms of critical digital awareness over the coming years, what needs to be done? Of course, we need to be mindful of the usual stumbling blocks to school reforms and curriculum changes. Teachers need to be properly trained and there needs to be sufficient time and resources set aside to classes.

Above all, however, is the need to focus on the issue of content. What do young people need to know if they are going to be genuinely digitally empowered? In this sense, we need to start talking seriously about the 'big issues' that are not yet being talked about, but are nevertheless crucial if any school curriculum is to have a lasting impact on how the digital societies of the 2020s turn out.

There are a number of new critical curriculum areas to begin considering. For example, students need to be supported to make sense of their place in what has been popularised recently as 'surveillance capitalism' (Zuboff, 2018). Every technology user faces the prospect of having their personal data collected and then sold on to third parties such as advertisers, data brokers and other beneficiaries of the so-called 'data economy'. Developing awareness of this in schools will give students the opportunity to make informed choices over what they do with digital technology.

Schools are ideal places for students to develop critical awareness of the multinational big tech companies that are beginning to shape their lives more than governments.

Also of importance is developing a clear understanding of the morals and ethics of technology production and the machinations of the IT industry. All young people need to make informed choices over which companies' products they choose to consume. At the same time, those students hoping to go into employment within the IT sector need to be asking critical questions of their employer's practices – from the ethics of their supply chains and covert work on military and defence contracts, to the significant gender discriminations that remain in this sector's employment practices. Schools are ideal places for students to develop critical awareness of the multinational big tech companies that are beginning to shape their lives more than governments.

Schools are also key places to support thinking about the societal realities of AI-driven systems and technology. This includes addressing tough questions concerning how much control we want to give to automated decision-making, and the human qualities that need to be protected and extended in a world of intelligent machines.

Yet, the perhaps biggest issue that needs to be tackled is how our society-wide dependence on digital technologies is contributing to the ongoing climate crisis. The ways in which digital technologies are produced, consumed and discarded constitute a growing environmental problem. If the escalating use of digital technologies in society is ultimately unsustainable, then schools are good places to begin contemplating how digital technologies might be developed and deployed in ways that are better suited for a resource-constrained planet.

These are all huge issues for anyone to grapple with, let alone understand. Yet, this is precisely the kind of 'big picture' thinking that needs to be driving efforts to reform school curricula over the next few years. Of course, schools cannot provide a 'quick fix' to any of the digital issues that will undoubtedly continue to blight our societies, culture and politics as the 2020s progress. Nevertheless, moves toward new critical forms of digital education would be a great first step. The hard work starts now!

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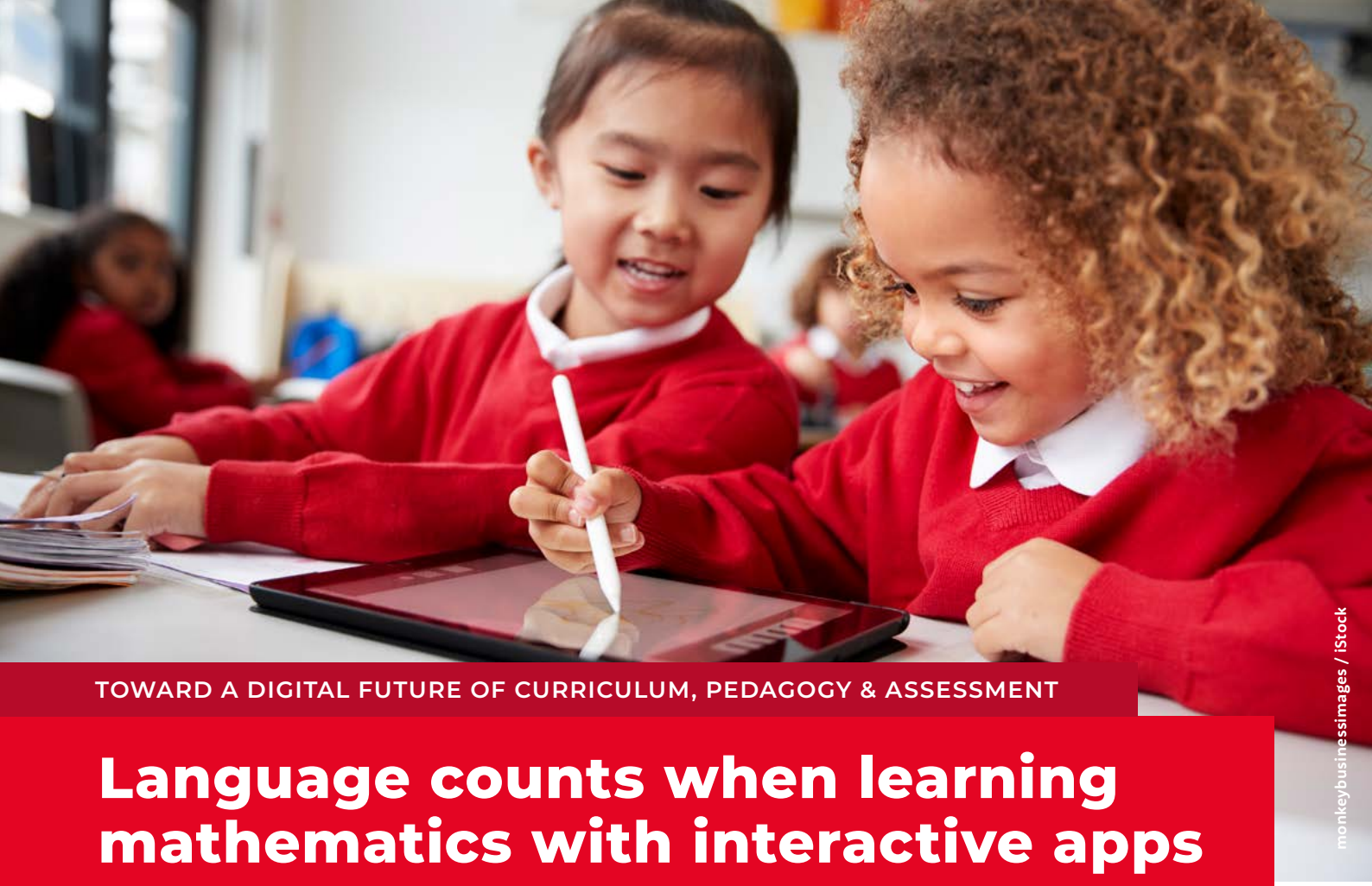
QUESTIONS FOR DISCUSSION

1. Are digitally related skills and understandings best delivered as a separate curriculum area or as a cross-curricular issue (that is, embedded into all curriculum areas)?
2. Which curriculum areas are most suited to engaging students in more critically minded discussions and understandings of the digital age?
3. How can schools be encouraged to adopt more environmentally sustainable approaches toward digital technology use?



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Language counts when learning mathematics with interactive apps



LAURA OUTHWAITE[1], ANTHEA GULLIFORD[2] & NICOLA PITCHFORD[2]
[1]IOE, UCL'S FACULTY OF EDUCATION & SOCIETY &
[2]UNIVERSITY OF NOTTINGHAM

Educational maths apps are increasingly popular in young children's early learning experiences[1]. When available in multiple languages, maths apps can offer the opportunity for learning in the child's first or preferred language. High-quality maths apps have the potential to increase access to education and boost achievement outcomes, as reflected in England's Department for Education's EdTech strategy (DfE, 2019). However, technology alone will not lead to success. To understand 'what works' in the use of educational maths apps we need to consider factors that may impact children's learning outcomes (Outhwaite et al., 2019). This research focuses on children's proficiency in the language of instruction.

In our new study published in the *British Journal of Educational Technology* (Outhwaite et al., 2020), we found young bilingual children who used the maths apps Maths 3–5 and Maths 4–6 (developed by onebillion[2], an award-winning not-for-profit organisation), in their first (Brazilian Portuguese) or second language (English), made significant gains in mathematical achievement. While there was no significant difference between using the apps in Brazilian Portuguese or English, we did find that children with stronger proficiencies in the language of instruction made significantly more progress compared to children with lower language proficiencies. This evidence suggests that these educational maths apps can offer a valuable learning opportunity, and corroborates previous research with children of a similar age in the UK (Outhwaite et al., 2018) and Malawi (Pitchford et al., 2019).

This pilot study was conducted in a bilingual school in Recife, Brazil, with 61 children aged between five and six. Children used the maths apps for 20 minutes per day, four times a week for 10 weeks. The maths apps included topics on number, shape, space and measure. We measured children's mathematical abilities before and after the 10 weeks with the Early Grade

1 Original blog post, published 1 April 2020: https://www.bera.ac.uk/blog/language-counts-when-learning-mathematics-with-interactive-apps

2 https://onebillion.org/

Mathematics Assessment, an internationally developed and standardised assessment of mathematics attainment. Children's language proficiencies in Brazilian Portuguese (their first language) and English (their second language) were assessed with a questionnaire designed specifically for this study and completed by their teachers.

Young bilingual children who used the apps made significant gains in mathematical achievement, but those with stronger proficiencies in the language of instruction made significantly more progress than those with lower language proficiencies.

WHAT DOES THIS MEAN FOR PARENTS AND TEACHERS?

For teachers and parents thinking about using educational maths apps with their children it will be useful to consider the individual child's language abilities. For example, can they effectively understand and access this content? Is there the option of using the apps in the child's stronger language? Observing the child's initial and continuing interactions with the maths apps will help inform this and enable the best curriculum support and scaffolding of app use.

The use of educational maths apps in different languages may be particularly beneficial for children with English as an additional language (EAL) who may be struggling with mathematics. Current research at the University of Nottingham, led by Professor Nicola Pitchford, is examining whether interleaving the implementation of these maths apps in the child's first and second languages can benefit young EAL children, including those newly arrived in the UK. This research will shed more light onto best practices surrounding educational maths apps.

WHAT DOES THIS MEAN FOR APP DEVELOPERS?

Good educational maths apps need to consider the role of children's language development in their design features. To our knowledge, this is the first study to apply theories of bilingual learning to maths app design. For example, we observed that the maths apps provided good levels of contextual support, through matching auditory and visual information, interactive pictures, audio and animations, combined with an on-screen teacher providing clear task demonstrations and step-by-step instructions. However, we also noted that the apps may have required vocabulary beyond some children's current knowledge. This may have limited the progress of children with weaker proficiencies in the language of instruction. To improve access, educational maths apps could further incorporate context-embedded communication, such as supportive and concrete cues.

This blog post is based on the article 'Language counts when learning mathematics with interactive apps' by Laura Outhwaite, Andrea Gulliford and Nicola Pitchford, which is published on an open access basis in the *British Journal of Educational Technology*.

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QUESTIONS FOR DISCUSSION

1. How can apps like these improve access for a diverse range of learners?
2. How do we engage parents in the use of apps for learning?
3. To what extent is there any resistance to using apps for teaching and learning?

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Experience, represent, apply (ERA)

A heuristic for digital engagement in the early years

Presenting a powerful new mechanism for encouraging play-based learning that reflects a more up-to-date and holistic view of technology use in the early years.


TOM LOWRIE & KEVIN LARKIN
UNIVERSITY OF CANBERRA & GRIFFITH UNIVERSITY

Although a large body of research exists in relation to the use of digital technologies in a range of educational contexts, less is known about the use of tablet devices and apps in teaching science, technology, engineering and mathematics (STEM) in early years contexts[1]. In our recent article in the *British Journal of Educational Technology*, 'Experience, represent, apply (ERA): A heuristic for digital engagement in the early years' (Lowrie & Larkin, 2019), we propose a heuristic that can assist early childhood educators with embedding STEM learning in play-based contexts, in ways that move beyond 'passive' screen time. The heuristic contributes to a richer understanding of the use of digital technology by encouraging authentic connections between on- and off-tablet activities in play-based environments.

Given the more recent research into digital play (Fleer, 2018), descriptions of 'passive' versus 'active' screen time as a measure of educational appropriateness have largely become redundant. Instead, when evaluating the effectiveness of technology, educators should consider the play-based learning that happens 'before' and 'after' engagement with that digital technology, as well as the play-based learning that occurs 'during' (in this example) on-tablet engagement. Our way of assisting educators to implement this more holistic view of technology use is via the creation of a heuristic: 'experience, represent, apply' (ERA).

1 Original blog post, published 2 August 2019: https://www.bera.ac.uk/blog/experience-represent-apply-era-a-heuristic-for-digital-engagement-in-the-early-years

The ERA heuristic is a powerful mechanism for encouraging play-based learning (in STEM and elsewhere) in ways that incorporate children's digital and non-digital experiences in authentic ways.

The three stages of the ERA heuristic are cyclic in nature. The intent of each phase can be briefly outlined as follows.

EXPERIENCE (E)

This is what children already know. Children's lived experiences are used as the foundation for concept development through language and social engagement. Children participate in a range of play-based, off-tablet experiences that provide opportunities for them to use language in ways that connect personal experiences with new understandings.

REPRESENT (R)

Children play a variety of activities on the apps to engage with, and represent, various STEM concepts. These representations include creating images, interpreting pictures, visualising and using symbols. Children have opportunities to create their own representations to use within the apps via the microphone and camera tools on the tablets. We refer to these personal representations as user-generated content (UGC), where young children create and import their own content into the on-tablet activities. UGC is critical for play-based learning engagement that can best leverage the affordances and minimise the disruption of digital devices. Our use of UGC in early years apps is highly innovative, since the process allows children to decode other children's digital representations. The ability for children to incorporate their own UGC also ensures that screen time is a highly active experience for young children.

APPLY (A)

Children build on their learning from the on-tablet activities through a range of off-tablet activities, guided by their educators, their families and their friends. Engagement with the visual and symbolic representatives on the app serves to promote new child-centered play-based experiences.

***

In summary, using the ERA heuristic, we have provided opportunities for children to initially experience a concept first, largely in authentic contexts using their own, non-domain-specific language. This concept is then represented on the tablet in a play-based format. The digital experience is then followed with opportunities to apply the idea to the children's own contexts.

Although closely related to notions of digital play (Fleer, 2018) our stance is that children play, and that sometimes that play happens to involve a tablet, or the apps on the tablet, because the tool supports how the children wish to play. In our view, digital technologies are never a substitute for play-based engagement in the physical world, nor does their use constitute a separate play experience for children. Rather, digital technologies are part of the larger set of resources (blocks, bundles of sticks, dress up clothes and so on) available for children to use as they play (see Arnott, 2016). We suggest that the ERA heuristic is a powerful mechanism for encouraging play-based learning (in STEM and elsewhere) in ways that incorporate children's digital and non-digital experiences in authentic ways.

This blog post is based on the article 'Experience, represent, apply (ERA): A heuristic for digital engagement in the early years' by Tom Lowrie and Kevin Larkin, published in the *British Journal of Educational Technology*.

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QUESTIONS FOR DISCUSSION

1. How can we find the most educative and age-appropriate apps for engaging children in STEM learning?
2. What pedagogical practices can successfully connect children's digital play to non-digital experiences in early childhood settings?
3. How does the heuristic ERA assist the integration of digital play and STEM practices in early childhood education?

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Encouraging inclusion of at-risk students through co-op video games

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AALBORG UNIVERSITY

Every day, teachers face challenges with including students who are inactive participants in the classroom[1]. Such challenges may involve social difficulties – such as shyness, disruptive behaviour or social exclusion by classmates – or lack of motivation to learn and low academic performance. Teachers are generally positive toward using different types of games for supporting at-risk students in the classroom (Takeuchi & Vaala, 2014). Similarly, research has shown how online gaming behaviour may result in strong social ties and a sense of belonging, especially when gaming activities are combined with offline friendships (Domahidi et al., 2014). This raises an important question, which is the focus of a recently published study (Hanghøj et al., 2018) I conducted together with colleagues: Is it possible to encourage social and motivational inclusion of at-risk students through the use of multiplayer video games in the classroom?

The study is based on the 'school at play' approach, which combines the use of complex video games such as *Torchlight II*, *Lord of the Rings Online* and *Black and White II* with game-related assignments, analogue gamification tools and reflective dialogue (see skolenispil.dk). Based on positive experiences from a pilot study, we initiated a research project that explored how to use the school-at-play approach within the context of secondary education (age 9–12) in mathematics and Danish. Eight classes from four different Danish schools participated in the intervention, giving a total of 190 students. For each class, we identified four at-risk students with social and motivational difficulties. The 32 at-risk students were identified through a combination of teacher interviews conducted by researchers prior to the intervention (which focused on how the teachers perceived their students' well-being and motivation to learn), existing knowledge of student diagnoses (if any), and observations of the eight classrooms before the interventions.

Each intervention consisted of three-week teaching activities in all Danish and mathematics lessons combining the game *Torchlight II*, associated mathematics and Danish assignments, and classroom gamification. The co-op action role-playing game *Torchlight II* was carefully chosen for the intervention as it allows players to collaborate in teams against computer-generated monsters. The game was set to the highest level of difficulty ('elite') in order to make the game so challenging that the students were more or less forced to collaborate in order not to die and to progress together within the game.

1 Original blog post, published 2 August 2018: https://www.bera.ac.uk/blog/encouraging-inclusion-of-at-risk-students-through-co-op-video-games

The participating teachers were prepared for the intervention through two whole-day workshops, in which they played *Torchlight II* and learned to use the game tools of the intervention. The mathematics teachers were instructed how to identify basic game mechanics within *Torchlight II* such as attack patterns, damage-per-second, different types of healing potions, and how to use in-game problems as meaningful contexts for mathematics assignments – for example, how to use mathematics to help decide which healing potion to use when under attack. Similarly, the Danish teachers were introduced to the genre aspects of the action role-playing game, and instructed on how to create assignments that allowed the students to write game guides and character analysis based on their game experiences.

The intervention was based on a parallel mixed methods design, which allowed the combination of a repeated measures effect study with classroom observations and student interviews. The effect study involved teacher assessments of the students' social participation and academic performance both before and after the intervention, as well as measurements of the students' motivation using the Children's Perceived Locus of Causality scales (Pannekoek et al., 2014).

At-risk students strongly emphasised the value of collaborating with their classmates against the computer, solving conflicts and developing new friendships.

The main finding was a significant effect in terms of increased social participation for the at-risk students in comparison with their peers. In the interviews, the at-risk students strongly emphasised the value of collaborating with their classmates against the computer, solving conflicts and developing new friendships. Moreover, we found a major decrease in external regulation for the at-risk students, which means that the intervention lessened the experience of pressure for taking part in the subjects compared to the pre-measure. However, the student interviews also showed that some of the game-related assignments were experienced as being more meaningful than others. This calls for further research on how to successfully align the framing of games with curricular aims.

Based on the positive findings from our study, we strongly recommend that other educators use co-op games as pedagogical tools for creating playful and socially inclusive classrooms. They can level the playing field and position at-risk students as active participants overcoming shared challenges with their classmates.

Thorkild Hanghøj, Andreas Lieberoth and Morten Misfeldt's original article is available in the *British Journal of Educational Technology*, 'Can cooperative video games encourage social and motivational inclusion of at-risk students?'.

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QUESTIONS FOR DISCUSSION

1. How can we support students in understanding the value of game-based education?
2. What are the longer-term outcomes of these kinds of interventions?
3. Do game-based pedagogies work across subjects?

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Exploring open approaches to digital literacy

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The notion of open educational resources (OER) was set out in the 'Cape Town Open Education Declaration' (2007)[1], calling on educators, authors, publishers and institutions to release their resources openly and to share them freely through open licences[2]. This notion of openness, including the use, revision, translation, improvement and sharing by anyone, is implicit in the definition of OER as teaching and learning materials freely available online for everyone to use. Importantly OER are highly customisable and allow for reuse and sharing with few copyright restrictions, given that they either reside in the public domain or have been released under a licence (most commonly a creative commons[3] licence). Mackintosh (2011) has broadened this definition to incorporate three interrelated dimensions: educational values (in terms of barrier-free access to the resources), pedagogical utility (anyone accessing OER should be able to reuse, revise, remix and redistribute the resources) and technology enablers (that is, OER should be in a format which ensures that they are 'meaningfully' editable). This means that potential (re)users of OER are positioned not as mere consumers but as active participants in the process of creating and sharing the resources. Supporting this are online repositories, such as MERLOT[4], which consists of tens of thousands of discipline-specific learning materials, providing access to free learning and teaching resources created and contributed by teachers.

1 https://www.capetowndeclaration.org/
2 Original blog post, published 22 May 2023: https://www.bera.ac.uk/blog/exploring-open-approaches-to-digital-literacy
3 https://creativecommons.org/
4 https://info.merlot.org/merlothelp/index.htm

In terms of UK higher education (HE), a recent report (MacNeil & Beetham, 2022), looking at approaches to curriculum and learning design across UK HE, suggests that developing OER may be a route to encouraging open educational practice. However, a study of 11 HE institutions in the UK found lecturers reticent to share their teaching resources openly (Pountney, 2019). Indeed lecturers doubted that students would welcome an open curriculum and would perceive it as extracurricular and external to their learning. The promise of open education in HE to bring about the 'negotiated curriculum' in which teacher and student act as co-constructors of knowledge therefore remains largely unfulfilled.

Meanwhile, in the context of teacher education in the school sector, the debate about digital literacy has circulated since Gilster (1997) first coined the term, with subsequent promotion of digital literacy in schools and proposals for an 'open-source curriculum' to encourage teachers' freedom and autonomy. More recently the potential for digital literacy/ies for openness has become topical and has been picked up in the English context by the emergence of the Oak National Academy[5] and the announcement by the Department for Education[6] to establish a new independent curriculum body to 'support teachers' in the creation of curriculum content. This has attracted criticism from educational publishers[7] that it is a major intervention into the school resources market which teachers neither want nor need.

While teachers are keen to share their resources online with their immediate network, they are much more reluctant to share beyond the circle of people they know and to release the materials openly to educational repositories.

However, the idea that OER can be embedded in teachers' work is also problematic. While teachers are keen to share their resources online with their immediate network, they are much more reluctant to share beyond the circle of people they know and to release the materials openly to educational repositories. For the most part, they cite fear of negative feedback to explain their reluctance; some also state the perceived lack of control once resources are shared more widely. These accounts reflect the tension between understandings of digital literacy as a technical competence and a communicative practice, in which accounts of digital literacy and the (re)use of open resources are incomplete or only partially realised in school contexts (Gruszczynska et al., 2013). Therefore, while 'openness' covers a range of concepts in relation to digital teaching and learning practices, a clearer connection between OER and digital literacy is needed in order that practices continue to evolve, and in which learning packages and tools can be developed in close cooperation with their potential users and linked directly to classrooms and schools as the site of their production.

5 https://www.thenational.academy/

6 https://www.gov.uk/government/news/education-secretary-promises-to-harness-energy-and-expertise-of-teachers

7 https://www.publishers.org.uk/publishers-association-joins-call-to-suspend-future-curriculum-body-plans/

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QUESTIONS FOR DISCUSSION

1. How much involvement do teachers need in the development of curriculum resources?
2. Is the sharing of resources between teachers and schools viable, or indeed desirable?
3. How might freely available curriculum resources affect the quality (and value) of published materials?

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The future of the artificially intelligent examination

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In education, it is common for people to talk about the use of artificial intelligence (AI) in assessment as something in the future, but it's not – it's here, and it's been working away in the background for some years now[1]. AI in educational settings is still viewed with a degree of suspicion and commonly met with fears relating to the 'rise of the machines' (Richardson & Clesham, 2021). However, given the prevalence of AI technologies across so many aspects of our everyday lives, its role in educational assessment needs attention. There won't be many people reading this blog post who really think about the way that AI-led technologies already command aspects of our lives – from targeted advertising to satellite navigation or managing the weekly grocery shop. Such AI-led events are accepted as a part of the fabric of life and this is perhaps why they are invisible to us; it is only when they impact something really important, such as exam results, that they command our attention.

Over the past decade, there has been a significant growth in the development and application of AI within educational settings, particularly related to the value of big data, the development of algorithmic advances in testing and significant increases in computing power more generally. English language testing is at the forefront of using AI technologies within tests for selection to ensure that students have a valid and reliable assessment for entry into universities.

1 Original blog post, published 22 May 2023: https://www.bera.ac.uk/blog/the-future-of-the-artificially-intelligent-examination

Over the past decade, there has been a significant growth in the development and application of AI within educational settings, particularly related to the value of big data, the development of algorithmic advances in testing and significant increases in computing power more generally.

The loss of a 'human touch' in assessment raises some issues about trust in test experiences and results (Falkner et al., 2014). But our perception of new technologies is shaped by the trust we have in them, and the so-called grading 'debacle' in England in the summer of 2020 revealed a very flexible view of who test takers could trust when students could not sit national exams and data from their teachers was used in grade awarding. The teacher-assessment data met the statistical algorithms used to model data from markers in exam boards and resulted in a national outcry because some 39 per cent of students received lower grades than expected. The debates highlighted a poor understanding of just what algorithms do in assessment practice, including an infamous quote from the prime minister blaming a 'mutant algorithm' (Stewart, 2020); belief that a mathematical model might have a mind of its own! Such misunderstandings suggest we need better education about AI and its influence on assessment practice.

What AI brings to assessment are scoring models that are data-driven and verifiable in ways that human scoring often lacks.

Good practice in the use of AI technologies is well documented: see the Transparency Model (Chaudhry et al., 2022, p. 2) outlining the ethics of using AI and the need for EdTech companies to explain their technology in ways that are accessible and understandable. Trust underpins the intrinsic value of any assessment, but particularly tests. What AI brings to assessment are scoring models that are data-driven and verifiable in ways that human scoring often lacks. AI systems are faster and less error-prone than human beings; they don't harbour the 'halo effects'[2] that are a natural part of the human condition, but these promises come with a caveat. The AI systems have to be trained on sound and representative samples and there are some areas or types of assessment that just don't lend themselves to an AI-led approach. Despite recent claims from a Google employee that a chatbot was becoming sentient[3], it seems that we are a long way from seeing emotions rising in the machines. Good use of AI requires creative approaches to assessment; it's not good enough to simply 'put paper behind glass'. At the heart of assessment practice lies an imperfect, messy and complex process, and looking forward, the question to ask is not should we use more AI in assessment, but why not use more in appropriate ways?

2 http://images.pearsonassessments.com/images/tmrs/HaloEffects_and_Analytic_Scoring.pdf

3 https://cajundiscordian.medium.com/is-lamda-sentient-an-interview-ea64d916d917

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QUESTIONS FOR DISCUSSION

1. How can we make better use of AI in education?
2. What is needed to improve trust in the use of AI in educational assessment?
3. What prevents schools from engaging more with online testing?

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Preparing children for the future

Robot programming in early childhood education

WEIPENG YANG
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The field of early childhood education (ECE) has seen a rise in the use of programmable robotics to introduce coding, computational thinking (CT), and sequencing ability to young learners[1]. While this approach has shown promise, there is still a need for further research to compare the effectiveness of robot programming with more traditional ECE activities. To address this gap, our study sought to investigate the effects of a robot programming intervention compared to a block play program on kindergarteners' CT, sequencing ability and self-regulation. The findings of our study, as reported by Yang et al. (2022), provide important insights into the potential benefits of incorporating programmable robotics into ECE curriculums and highlight the need for further research in this area.

Researchers have claimed that screen-free robot programming is a developmentally appropriate tool for enhancing young children's STEM-related cognitive abilities, including CT and sequencing ability, in the context of ECE (Su et al., 2022). This approach has shown great promise in promoting children's engagement with STEM subjects and developing their problem-solving skills. However, it is important to note that traditional ECE activities can also be highly effective in promoting children's cognitive development. For example, block play has been shown in prior research to promote children's understanding of multiple concepts and skills, including maths thinking and even CT (Schmitt et al., 2018; Trawick-Smith et al., 2017).

In this study, the robot programming kit that we used is Matatalab[2], which provides a block-based, screen-free

1 Original blog post, published 22 May 2023: https://www.bera.ac.uk/blog/preparing-children-for-the-future-robot-programming-in-early-childhood-education

2 https://en.matatalab.com/

and tangible programming environment for children aged four or above. An unplugged CT assessment was used to measure and compare the effects of both robot programming and block play interventions among preschool children by six categories of CT concepts: algorithms, modularity, control structures, representation, hardware/software, and debugging (Bers, 2021).

Although the difference in CT between the two groups was non-significant, the results of our study showed greater improvements in response to the robot programming intervention across various outcomes in comparison to block play, particularly in sequencing ability, which has been identified as a strong predictor of early coding skills (Bers, 2021). Interestingly, our findings also indicated that children in the robot programming group who had lower levels of self-regulation at baseline demonstrated greater improvements in sequencing ability over time in comparison to the block play group. Additionally, we found that older children in the robot programming group showed larger improvements in CT over time when compared with the block play group. These findings highlight the potential benefits of incorporating programmable robotics into ECE curriculums and suggest that the effects of the intervention may be moderated by individual differences such as age and self-regulation.

Although the difference in CT between the two groups was non-significant, the results of our study showed greater improvements in response to the robot programming intervention across various outcomes in comparison to block play, particularly in sequencing ability, which has been identified as a strong predictor of early coding skills (Bers, 2021).

The present study makes the methodological contribution by using an unplugged CT assessment and a pretest-posttest randomised experimental design, breaking the limitations of evaluating the impact of traditional learning experiences on CT outcomes in previous studies. Theoretically, this study also provides an evidence-based argument that digital learning programs can outperform traditional learning activities in promoting children's school readiness skills such as sequencing ability and CT. Our findings shed light on the vital role of robot programming and CT education in promoting positive digital learning experiences in ECE and lend support to technology-enhanced curriculum reform in ECE settings. In addition, teachers are also suggested to receive training in robot programming in addition to more traditional skills such as scaffolding children's block play.

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QUESTIONS FOR DISCUSSION

1. Does digital learning outperform traditional learning experiences such as block play in terms of promoting children's higher-order thinking skills?
2. Is digital engagement needed in the early years?
3. What aspects are required to design and implement appropriate programming education activities for kindergarteners?

ABOUT THE AUTHORS

Jesper Aagaard is a lecturer in Aarhus University's Department of Psychology and Behavioural Sciences (Denmark). His research is currently focusing on the use of digital devices in school classrooms, with a specific interest in post-phenomenological accounts of technology.

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Ken Kahn first became interested in AI programming by children in the 1970s. He published the paper 'Three interactions between AI and education' (Kahn, 1977) while he was a graduate student at the MIT AI Lab and a member of the Logo Group with Seymour Papert and Cynthia Solomon. In the 1980s he built tools based upon the logic programming language Prolog to enable children to parse and generate sentences. Later he designed and implemented ToonTalk, a programming language that has the look and feel of a video game. For the past five years, as a researcher at the University of Oxford, he has been building and testing a library of AI components in the Snap! programming language.

Kevin Larkin is a senior lecturer at Griffith University. His research investigates STEM education in early years education; mathematics education in primary and middle school contexts; and pre-service teacher mathematics education. He has published widely in the areas of mathematics education, digital technologies, early years STEM, higher education, and activity theory. Kevin has received numerous teaching awards including Griffith University Teacher of the Year in 2016, a National Teaching Citation in 2017, and the Australian University Teacher of the Year Award in 2018.

Tom Lowrie is a centenary professor and the director of the STEM Education Research Centre at the University of Canberra. He has a well-established international research profile in the discipline area of mathematics education. Tom is leading the Early Learning STEM Australia pilot, funded by the Australian government's Department of Education and Training under the National Innovation and Science Agenda.

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Nikol Rummel is a full professor in the Institute of Educational Research at the Ruhr-Universität Bochum, Germany. One of her main research interests is on adaptive support for computer-supported collaborative learning (CSCL). Another focus of her work is on developing methods for automated analyses of process data combining multiple data sources.

Neil Selwyn is a professor in Monash University's Faculty of Education (Australia). His research is currently focusing on issues of datafication, digital labour and the AI-driven automation of education. Recent books include *Should robots replace teachers?* (2019, Polity), and *What is digital sociology?* (2019, Polity).

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Martin Weller is a professor of educational technology at the Open University. Weller chaired the Open University's first major e-learning course, T171, in 1999 with nearly 15,000 students. He was the first director of the Virtual Learning Environment, recommending the adoption of Moodle, an open-source learning platform. He is the director of the Open Education Research Hub, president of the Association for Learning Technology, and chair of the International Council for Open and Distance Education. Weller has authored several books including *The digital scholar* and *Battle for open* which are available under open licence. He is also co-editor of the open access journal, *Journal of Interactive Media in Education*. Weller's interests are in digital scholarship, open education and the impact of new technologies, and he writes a blog about these topics.

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