Integrating Mixed Reality Spatial Learning Analytics into Secure Electronic Exams

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Open Oceans: Learning Without Borders

35th International Conference
of Innovation, Practice and Research
in the use of Educational Technologies
in Tertiary Education

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ASCILITE 2018

Australasian Society for Computers in Learning in Tertiary Education

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25-28 NOVEMBER 2018

Conference Proceedings

OPEN OCEANS: LEARNING WITHOUT BORDERS

35TH INTERNATIONAL CONFERENCE OF INNOVATION, PRACTICE AND RESEARCH IN THE USE OF EDUCATIONAL TECHNOLOGIES IN TERTIARY EDUCATION

Editors:
Malcolm Campbell, Julie Willems, Chie Adachi, Damian Blake, Iain Doherty, Siva Krishnan, Susie Macfarlane, Leanne Ngo, Marcus O'Donnell, Stuart Palmer, Lynn Riddell, Ian Story, Harsh Suri & Joanna Tai

ASCILITE 2018 - Open Oceans: Learning without borders

The ASCILITE 2018 Conference is ASCILITE's 35th International Conference on Innovation, Practice and Research in the Use of Educational Technologies in Tertiary Education. This year's conference was hosted by Deakin University and held at the University's Waterfront Campus, Geelong, between 25 to 28 November 2018. Geelong is less than an hour's drive to the west of Melbourne, and is the second largest city in the state of Victoria, Australia, with excellent transport links to the city. The conference venue is on the seafront, in the heart of Geelong. Originally built as wool stores in the 19th century, the campus buildings have been extensively renovated, to create a modern, impressive campus.

The theme for ASCILITE 2018 was Open Oceans: Learning without borders. Picture sitting on a beach and looking at the ocean, stretching before you towards the horizon, and dreaming about the possibilities, reflecting on the past, or being mindfully present in the moment. The sea is vast. This vision captures the infinite possibilities when considering innovation, practice and research in the use of educational technologies in tertiary education.

Conference Streams

Conference submissions identified the conceptual, applied and theoretical research contributions on the following eight conference streams:

A. New ways of moving: Pedagogies and practices
The advance of technology provides new ways of conceptualising the delivery of content, creating effective learning activities, and capturing achievement as assessment. New teaching and learning practice may focus on key trends such as personalization, authentic professional practice or inter-disciplinary learning.

B. Sink or swim: Improving digital literacy
Digital literacy is a complex topic including strategies to build capabilities that develop and use educational technologies, and also digital equity for learners and teachers from diverse backgrounds. It refers to the knowledge and skills to use technology for educational purposes, be this from a staff or student perspective.

C. Deep Diving: Approaches that Foster Deep Learning
This stream looked at technology-enhanced learning for graduate attributes, WIL and employability, including fostering deep learning for 21st century skills. Our graduates are entering a world that is increasingly global, increasingly mobile and focussed on jobs that are yet to be created. Graduates will need a deeper understanding of these new skill sets, experience in their application and how they can demonstrate and evidence success.

D. The waters in which we swim: Redesigning Learning Spaces
Learning spaces are the physical and virtual spaces in which we work, teach and learn. They range from innovative uses of existing spaces through to newly designed learning spaces where cross-disciplinary co-creation or sharing is evident. They can also include the virtual learning space or hybrid spaces.

E. Exploring foreign shores: Advancing Cultures of Innovation
Creating cultures of innovative practice in the tertiary learning and teaching landscape is a way of fostering dynamic and progressive change. It is a means by which sustainability of innovative educational practices can be conceptualised and established. It also encompassed new educational technologies as well as global reach of our offerings. Effective innovation builds staff capability, resilience and agility in an era of rapid change.

F. Checking the gauges: Measuring Learning and Advancing Impact
Evidence-based practice is key in a globally competitive environment. Measuring learning with digital tools can contribute to monitoring progress for our students and ourselves, as much as the data from other formal and informal mechanisms helps steer our way. Learning analytics, including an understanding of student perceptions, behaviour and outcomes offers new ways to navigate a sea of data. Through such measures, we can help advance impact.

G. New treasures: Alternative and out-of-the-box thinking
The sea throws up many unexpected treasures. This stream invites disruptive thinking, emerging ideas and lateral connections with other disciplines. Bring along your alternative practices on the margins of the landscape of teaching and learning in higher education to spark a new revolution.

H. Avoiding the rocks: Lessons learnt from failures

There is not often a safe space or opportunity for colleagues to discuss situations that did not go as well as planned: what went wrong and the lessons learnt along the way. This final stream provides an opportunity to survey the terrain as good reflective practice and helps shine a light on things for those who follow.

Conference Organisation

The Deakin University's ASCILITE 2018 Conference Organising Committee, led by Professor Beverley Oliver, includes Professor Liz Johnson, Professor Malcolm Campbell, Dr Julie Willems, Ms Siobhan Lenihan and Ms Jodi Morgan.

The Conference Program sub-committee (encompassing the Social Committee and Editorial Board) was chaired by Professor Malcolm Campbell and included Dr Chie Adachi, Associate Professor Damian Blake, Dr Iain Doherty, Dr Siva Krishnan, Ms Susie Macfarlane, Ms Jodi Morgan, Dr Leanne Ngo, Associate Professor Marcus O'Donnell, Associate Professor Stuart Palmer, Professor Lynn Riddell, Dr Ian Story, Dr Harsh Suri, Dr Joanna Tai and Dr Julie Willems.

Review Process

All Full and Concise papers submitted for the conference underwent a double-blind peer review process. A third blind peer review was conducted if opinions between the two reviewers was divided. This process allowed papers to be ranked and selected for inclusion in the conference. A further review was conducted by the ASCILITE 2018 Program Committee for papers just above and below the anticipated cut line.

Symposia and Panel sessions, Workshops, and Poster proposals and workshops underwent a single-blind peer review. Presentation proposals that were at the cut-off line were also examined by the ASCILITE 2018 Program Committee.

A total of 207 submissions were received for the 2018 conference all of which were blind peer reviewed. A further 16 non-peer reviewed submissions were added to the program. The EasyChair Conference Management System was used for the submission and review process. An interesting and scholarly range of papers were received across the full range of conference themes.

Table 1: Summary of paper submissions and acceptances ASCILITE.

Contribution Types	Number Submitted	Number Accepted	Number Rejected	Converted to poster	Withdrawn
DOUBLE BLIND PEER REVIEW					
Full Paper	66	30	29	5	2
Concise Paper	87	47	35	5	
SINGLE BLIND PEER REVIEW					
Poster	29	32	7		
Panel/Symposia/Debate	14	7	7		
Workshops	11	5	5		1
Total Reviewed	207	121	83		3
NON-PEER REVIEW					
Keynotes	3	3	0		
AJET Session	1	1			
ASCILITE mentoring session	1	1	0		
SIG Sessions	7	7	0		
ASCILITE President Session	1	1	0		
TELAS Session	1	1	0		
Innovation Papers	2	2	0		
Non-Reviewed Submissions	16	16			
TOTALS	**223**	**137**	**83**		**3**

Acknowledgements

The ASCILITE 2018 Conference Organising Committee would like to thank the earlier contributions of Dr Craig Anderson who co-led (with Dr Julie Willems) the conference bid organising committee and who laid the groundwork and thinking for this wonderful conference. We also acknowledge the work of Ms Marika Thomson (formally Deakin Events Team) who supported the conference bid and completed much of the early conference organisation so ably.

The Open Oceans Conference Committee and sub-committee also acknowledge and thank the ASCILITE Executive for their guidance and support ensuring that this conference was a success. In particular, we thank the ASCILITE President, Professor Dominique Parrish, Treasurer Mr Allan Christie, ASCILITE Secretariat Mr Andre Colbert and our Executive member liaison, Dr Julie Willems.

Finally, we thank the Deakin Events Management Team, led by Ms Jodi Morgan, who provided great support to the Committees and managed every aspect of the conference organisation.

List of reviewers

The ASCILITE 2018 Conference Organising Committee and Conference Program Committee wish to gratefully acknowledge the efforts of the international body of reviewers for contributions to ASCILITE 2018. Their work in reading and reviewing the 207 submissions was appreciated greatly.

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Paul LeBlanc

President, Southern New Hampshire University

Dr. Paul J. LeBlanc is President of Southern New Hampshire University (SNHU). Under the 13 years of Paul's direction, SNHU has more grown from 2800 students to over 100,000 and is the largest non-profit provider of online higher education in the country, and the first to have a full competency-based degree program untethered to the credit hour or classes approved by a regional accreditor and the US Department of Education.

In 2018, Paul won the prestigious IAA Institute Hesburgh Award for Leadership Excellence in Higher Education, joining some of the most respected university and college presidents in American higher education.

Current projects include rethinking engineering education, social finance bonds, and expansion of the refugee camp work.

Margaret Bearman

Associate Professor (Research) within the Centre for Research in Assessment and Digital Learning (CRADLE), Deakin University.

Margaret Bearman is an Associate Professor (Research) within the Centre for Research in Assessment and Digital Learning (CRADLE), Deakin University. She holds a first-class honours degree in computer science and a PhD in medical education.

Over the course of her career in health professional and higher education, Margaret has written over 70 publications and received over $7.5 million in research and development funding. She has been formally recognised for her work as an educator and researcher, including awards from the Australian Office of Learning and Teaching and Simulation Australasia.

Margaret's interests include: assessment and feedback; simulation and digital technologies; sociomateriality; and educational workforce development. Her methodological expertise includes qualitative and quantitative research designs, as well as evidence synthesis.

Jan Owen AM

CEO, Foundation for Young Australians

Jan is a highly regarded social entrepreneur, innovator, commentator and author who has spent the past 25 years growing the youth, social enterprise and innovation sectors.

In 2012 she was named Australia's inaugural Australian Financial Review and Westpac Woman of Influence. Jan has been awarded honorary degrees (honoris causa) from the University of Sydney (DLitt) and Murdoch University, Western Australia (DUniv); and was awarded membership to the Order of Australia in 2000. She is the author of Every Childhood Lasts a Lifetime (1996) and The Future Chasers (2014).

Jan is currently the CEO of the Foundation for Young Australians; was previously Executive Director of Social Ventures Australia; and Founder and CEO of the CREATE Foundation.

Designing personalised, automated feedback to develop students' research writing skills

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Constructive and formative feedback on writing is crucial to help Higher Degree Research (HDR) students develop effective writing skills and succeed, both in their degree and beyond. However, at the start students have a poor grasp of good academic writing, and HDR supervisors do not always have the time or the writing expertise to provide quality, constructive, formative feedback to students. One approach to address this problem is provided by Writing Analytics (WA), using text analytics to provide timely, formative feedback to students on their writing, in the process introducing a clear set of terms to describe important features of academic writing. This paper describes how Swales' (1990) *Create A Research Space (CARS)* model was used to extend a writing analytics tool such that it could be applied to HDR students' writing, and how good feedback practices were employed to design constructive automated feedback. This work summarises a process that can be used to develop theory driven writing analytics tools that should facilitate thesis writing.

Keywords: research writing, thesis writing, writing analytics, learning analytics, genre, feedback

Introduction

A significant component of Higher Degree Research (HDR) students' training in writing is provided via supervisory feedback. Receiving this ongoing formative feedback is critical to helping HDR students develop and improve their research writing skills. While some supervisors provide timely, clear, constructive feedback, others provide feedback that is vague, confusing, too critical, or too late. Numerous studies have described problems regarding supervision feedback on writing detailing issues of timeliness, quality and usefulness. For example, Paré's (2010) study found that "supervisor feedback is often ambiguous, enigmatic, and coded – that is saturated with meaning, but difficult to understand". Paré goes on to say that "even supervisors who publish frequently may not be capable of conducting the sort of close textual analysis that leads to insightful feedback" (p.107). Other studies have found that while students were grateful for feedback on their writing, they were seldom positive when reporting about the quality of that feedback (Aitchison, Catterall, Ross, & Burgin, 2012). Indeed, Aitchison et al. (2012) found that many students felt frustrated when supervisors employed "less-useful feedback practices" (p.442). Some of these included feedback only on grammar and sentence structure rather than how to write for their discourse community; re-writing students sentences with no explanations; and inappropriate comments. Timeliness was also a concern, with a lack of feedback from supervisors, feedback that was too late, or feedback only received when approaching thesis submission. *Writing Analytics* is a potential solution that uses text analytics techniques to help provide timely, actionable and formative feedback on student writing. It is an active area of research in the Learning Analytics community, however, to date only two tools have been used in this HDR context (as reviewed below). This paper describes how an existing writing analytic tool was modified to generate personalised, effective feedback that can be used to develop HDR students' writing skills, focusing specifically on writing introductions and abstracts. The modifications to the existing tool were theory driven, deriving from genre and process based approaches to writing, along with sound feedback processes inspired by Hattie and Timperley's (2007) feedback model, and Nicol's (2010) 10 recommendations of good feedback. The design of these modifications is presented, with piloting indicating early positive feedback. While we have piloted the tool, this paper focuses on the design of the tool, not on the testing or evaluation of it.

Doctoral writing is challenging for students and supervisors

Effective written communication skills are essential for HDR students, not only to complete their dissertation itself, but also for their professional life post degree. They are necessary for publishing research, applying for research grants, and responding to criteria etc. in job applications. Indeed, effective writing is one of the core skills identified by employers as necessary for HDR graduates (McGagh et al., 2016). However, many HDR students find research writing difficult (Aitchison et al., 2012; Catterall, Ross, Aitchison, & Burgin, 2011; Ross, Burgin, Aitchison, & Catterall, 2011). For example, Aitchison et al., (2012) report that identifying and learning complicated linguistic practices is a challenge for many HDR students. Similarly, Maher, Feldon, Timmerman, and Chao's (2014) investigation of doctoral writing from the perspective of supervisors found a common complaint that students lacked familiarity with disciplinary writing patterns and were unaware of their audience. While some universities provide a wide range of writing support for doctoral students (including writing workshops, writing circles, or one on one consultations with academic language and learning educators), others do not. The apprenticeship model is still the main avenue for teaching HDR students to write, but this is highly dependent upon the quality of supervision that a HDR student receives. Paré (2011) asserts that doctoral supervisors are also writing teachers as supervisors introduce students to their discourse community's practices and guide students through the writing process with their feedback, instruction and suggestions. However, while some supervisors provide clear, understandable and actionable feedback, Parés' (2010, 2011) analysis of supervision meetings reveals feedback on HDR student writing is often ambiguous, confusing, unhelpful, coded and difficult to decipher. Even the most accomplished academics sometimes fail to provide insightful, relevant feedback on their students' writing. Some supervisors are confident helping students in the writing process, but many are not (Aitchison et al., 2012), and few have the writing expertise or pedagogical training to assist their students in the writing process (Catterall et al., 2011). So how can supervisors become more confident talking about and facilitating better quality writing? Paré (2011) suggests that easiest way supervisors can improve their knowledge about writing the dissertation is to learn more about academic writing by reading books on the subject that are theory and research based, exploring journals that focus on writing composition and scholarship, and looking at literature on rhetoric. However, most academic writing literature is focused on undergraduate academic writing and writing in general, with very few contributions focussing specifically on HDR writing.

The learning and teaching of writing: approaches and theories

Quality writing involves rhetoric; understanding the audience and applying rhetorical cues to help facilitate understanding. Rhetorical insight into the disciplinary discourse community is necessary for creating and disseminating knowledge (Tardy, 2005). However, HDR students find it difficult to develop an understanding of this rhetorical aspect to research writing, especially when writing the introduction section of their thesis (Paltridge & Starfield, 2007). The rhetorical complexity of the dissertation is a challenge for HDR students (Thompson, 2016), as this is one of the first times that they are expected to write for their discipline's discourse convention (Torrance, Thomas, & Robinson, 1992). Despite this expectation, most HDR students do not have the expertise in applying discipline specific discourse conventions in their writing, and few HDR students have the experience of writing for an academic audience (Torrance et al., 1992).

One theory that explores the different conventions used across academic disciplines is genre theory. Hyland (2007) argues that a genre based approach is a theoretically robust method to teaching writing because university classrooms have become more socially, culturally and linguistically diverse. This diversity of students means that educators and teachers cannot presume that students' previous learning experiences will afford them with the writing and genre knowledge needed for their studies (Hyland, 2007). Genre based approaches have received substantial attention in the teaching and learning of language, especially in L2 (second language learners) classrooms, because of their emphasis upon the purposeful and socially situated nature of language (Hyland, 2007). A genre based approach to teaching writing looks at how language is structured in texts to achieve a communicative purpose in particular contexts (Swales, 1990), and involves "being explicit about the way language works to make meaning" (Cope & Kalantzis, 1993, p.1). Hyland (2007) argues that genre-based pedagogies are beneficial for learners because a genre approach to teaching writing is explicit, systematic, supportive, empowering, critical and consciousness-raising. Being explicit helps students see how grammar and vocabulary choices create meaning in a text. This explicit emphasis upon the way that writing works to communicate meaning allows students to bring together the language, content, context, and purpose of a text, in a critical and deliberate way. By empowering students with the strategies and skills that are implicit with this approach they can tackle complex writing tasks and become more effective writers.

This research specifically draws on English for Specific Purposes (ESP). ESP places great importance on communication within discourse communities (Swales, 1990) where its membership to a community is based on communicative purpose, which is important for HDR students to master. In ESP the communicative purpose is considered the rationale of the genre which shapes the structure of the discourse and influences content and style. Its focus on genres, allow teachers to ground their lessons in texts that students will need to write beyond the classroom. ESP teachers identify the specific practices of discourse communities and how texts are used both within the community and beyond it in wider social contexts. Identifying these specific practices and how community members use language in their texts provides ESP teachers with an understanding of the rhetorical features required in texts, which provides them an insight to the rhetorical characteristics that their students' texts must satisfy for entry to particular discourse communities.

An example of this is Swales' (1990) Create a Research Space (CARS) model which describes the rhetorical and linguistic patterns that authors make in their research article introductions. Swales (1990) analysed a number of articles from a variety of disciplines and found that effective research article introductions followed three rhetorical moves:

- Move 1: Establishing a research territory
- Move 2: Establishing a niche
- Move 3: Occupying the niche

These rhetorical moves are made up of sentences that explicitly state the communicative goal. For example, in **Move 1 Establishing a research territory** the author conveys to the audience that the research is important, central and relevant, with sentences like *It is now widely recognised that feedback is critical in the writing process*. **Move 2 Establishing a niche** is where the research problem is stated or gaps in previous research are introduced, for example, *Despite the potential of writing analytics tools, little research exists on how automated feedback impacts students' writing.* **Move 3 Occupying the niche** states the goals of the authors research and/or paper, the solution, or results; *We present a pilot study that explores the impact of a writing analytics tool on students' writing process*.

The introduction to a research article and thesis is critical in order for authors to establish their contribution, and compete for reader attention (Paltridge & Starfield, 2007; Swales & Feak, 2012). There is intense competition to be published in highly regarded academic journals, therefore the introduction is strategically important. It is here that writers demonstrate that they have met the expectations of their audience (discourse community) and assert that their research is worthy of publication. This means producing engaging and effective writing by using rhetorical strategies to show that their research is relevant and significant (Move 1), the research problem is worth solving (Move 2) and establish their overall argument (Move 3). In thesis writing the introduction sets the scene of the dissertation that follows. Students need to explain the importance of their research and build on previous literature (Move 1), establish the research gap (Move 2) and present their original contribution to knowledge (Move 3).

The CARS model has been used to teach research writing in postgraduate contexts. Specifically, it has been used to help students identify the rhetorical features of research article introductions specific to their discourse community (Cai, 2016). It is a heuristic as its ease of use and broken down moves of the introduction and explanation allows students to identify the language features needed to achieve each particular move and communicative goal to participate in their discourse community, and also provides students a place to start, as they try to create a research space of their own. The CARS model has been presented in numerous books, some aimed at supervisors to help teach writing to their students (Kamler & Thomson, 2014; Paltridge & Starfield, 2007), another to help academics publish (Thomson & Kamler, 2013), and others to assist HDR students with their research article writing (Swales & Feak, 2012). It is for this reason that a genre-based approach and the CARS model in particular was incorporated in designing the writing analytic tool to develop and raise rhetorical awareness which is needed in HDR research writing.

While the genre approach looks at the textual features used to compose a text, it does not consider how students go about writing their texts. To help develop the writing skills of HDR students and teach research writing it is also important to understand the *processes* involved when they write. However, writing is itself a very complicated process (Hayes & Flower, 1977), and more than a set of skills (Curry & Hewings, 2005; Kamler & Thomson, 2014; Wellington, 2010), which makes it both difficult to teach, and hard for HDR students to learn. Understanding the writing process gives educators an insight on when and how to intervene to provide formative feedback on students' writing to improve their writing process and in turn improve their research writing skills. The process which people go through when they write a text is known as the cognitive process theory of writing (Flower & Hayes, 1981; Hayes & Flower, 1980), and has been a common model to understand the writing process. The writing process approach focuses on the important processes that writers do when producing a text: generating ideas, putting them together, and achieving a writing goal.

A key principle of the writing process approach is the iterative nature of writing and the importance of seeking and receiving feedback from others while a text is being produced (Curry & Hewings, 2005). Receiving feedback from others helps students to improve their writing and produce better texts. The process approach provides students an understanding of how they write which makes them reflect on their own writing process. Additionally, feedback in the writing process approach makes students aware of audience and better at critiquing their peers writing as well as their own, while also reinforcing the drafting process, as explained in the next section.

The importance of feedback

Feedback is important to help HDR students achieve their learning goal of producing a quality thesis. However, as has been discussed above by Paré (2010, 2011) and Aitchison et al. (2012), supervisors, the main source of feedback, do not always provide clear, understandable and actionable feedback. Rather than just being corrective, feedback should be actionable, providing information specific to the task and the student's performance, so filling the gap between their performance and the task objective (Hattie & Timperley, 2007). Therefore, there is a relationship between students' writing goals and feedback. This relationship is complex, because the feedback might not address the student's current performance and writing goal (Hattie & Timperley, 2007), similar to what was found in Paré's (2010, 2011) studies on supervision feedback (discussed above).

Several studies exist that provide indications of what best practice entails when it comes to giving feedback. One such study is Hattie and Timperley's (2007) review where they claim that there are four feedback levels that directly affect feedback effectiveness: task, process, self-regulation, and self. Their feedback model proposes that feedback should answer these three questions: How am I going?, Where am I going?, Where to next?. In the case of writing, this model suggests not only providing corrective feedback on the text, but also feedback that suggests how students can improve their text, which closes the gap between where they are and their writing goal. Another study by Nicol (2010) outlines 10 recommendations for best practice, claiming that feedback should be: understandable, selective, specific, timely, contextualised, non-judgmental, balanced, forward looking, transferable and personal. While these good feedback practices are aimed at teachers and educators, they can just as easily be applied to automated feedback tools, specifically writing analytics tools. This body of work gives an important point from which to start in developing tools to help HDR students learn how to write.

Writing Analytics as a possible solution

One approach to provide students with timely, actionable feedback is the use of Learning Analytics (LA), specifically, Writing Analytics (WA), which derives from LA by placing an emphasis on supporting student writing practices (Buckingham Shum et al., 2016). There are many WA tools currently being used to help students develop their writing. Examples of this can be seen in Automated Writing Evaluation systems (AWE) (Burstein, Chodorow, & Leacock, 2004; Roscoe, Allen, Weston, Crossley, & McNamara, 2014; Villalón, Kearney, Calvo, & Reimann, 2008) that provide students with automated formative feedback. Using computational techniques such as natural language processing, AWEs analyse student writing and generate instant feedback on students' texts. Here we will focus upon WA that is developed specifically for improving research writing skills.

Research Writing Analytic tools

Several research writing analytic tools exist to help HDR students learn to write. An example of this is *Mover* (Anthony, 1999), a text analysis software that was used to test how generalisable the CARS model was in software engineering journal articles. Mover annotates research article introductions against the CARS model and has been implemented in a classroom setting to determine if it helps develop HDR students' research writing skills (Anthony & Lashkia, 2003). Their results are promising; the students were able to both identify the discourse features of published research article abstracts, and annotate more quickly, when using Mover vs. when doing it by hand. Indeed, without Mover all students but one were unable to identify the CARS moves in the abstracts. Students were also able to analyse structural and discourse features of their own abstracts quicker with the help of Mover. However, the experiment was only conducted with six students and not within an HDR research writing program. Furthermore, while Mover analyses students' drafts and identifies the moves that students have used in their writing, it does not provide feedback of any sort on the moves that are missing or how they might be added to the draft.
Research Writing Tutor (RWT) (Cotos, 2016) is similar to Mover as it also detects Swales (1990) rhetorical moves in students' research writing. One significant difference between RWT and Mover, is that RWT provides actionable feedback to its users by showing students how similar their use of rhetorical moves is to that of published works in their discipline. RWT also contains learning and demonstration modules which help students to understand the genre of research writing through exposure to a corpus of research articles, and demonstrates

how the moves learned in the learning module appear in research articles. Studies that have been conducted with RWT demonstrated that the automatic feedback influenced students' revision process, helping them to develop new strategies, while focusing more upon the rhetorical composition of their drafts (Cotos, 2012). Other studies reported that students found the feedback helpful because it directly related back to the writing task and that RWT's feedback helped students think about and analyse their writing (Cotos & Huffman, 2013; Ramaswamy, 2012). However, the RWT tool is not open source and cannot be accessed by external students. This means that while these studies show promise for using AWEs to provide timely, useful, clear, formative, actionable feedback to help students develop and improve their research writing skills, this particular tool is unavailable for wider use beyond the university at which it was developed. In summary, AWE tools like RWT can help develop doctoral students' research writing but they are yet to be implemented in a scalable form that can be broadly used by any in the academic community.

So far, this paper has argued that HDR writing is difficult for students to learn and for supervisors to teach, with supervisory feedback on writing often unclear and difficult for students to understand. Receiving understandable, constructive, feedback is critical for students to improve their research writing skills and achieve their writing goals. Both the genre and writing process approaches show promise for helping HDR students to learn how to write, and WA tools are a possible way in which to deliver feedback that is theoretically grounded in these approaches. However, few tools exist that deliver this feedback, and the one tool that has shown promising results in this area is closed source and not available to HDR students beyond the institution at which it was developed. These gaps motivate the design, implementation and evaluation program underpinning an open source writing analytics tool, available whenever students need it to help them with their research writing.

Developing personalised feedback for HDR writing

At UTS a WA tool called Academic Writing Analytics (AWA) was developed to help students improve their academic writing skills (Knight, Buckingham Shum, Ryan, Sándor, & Wang, 2018; Shibani, Knight, Buckingham Shum, & Ryan, 2017). While traditional AWEs identify grammatical errors, discourse structure and topic-relevant word usage, AWA uses a rhetorical parser that identifies sentences that signal rhetorical moves by identifying discourse patterns. Students see identified sentences (moves) highlighted, which prompts them to reflect on what they have written. While preliminary work with the system has been conducted in undergraduate contexts (Gibson et al., 2017; Knight et al., 2018; Shibani et al., 2017), to date it has not been applied to the HDR writing context.

This section outlines how the tool, now called *AcaWriter*, has been extended to create a system that provides formative, actionable feedback on HDR student writing, that addresses the feedback needs described above, through application of the Swales (1990) CARS model.

AcaWriter's Rhetorical Parsing

AcaWriter's rhetorical parser is based on the concept-matching framework (Sándor, Kaplan, & Rondeau, 2006) where expressions that both convey contextual concepts and are grammatically dependent are classified and tagged as rhetorical moves. For example, in Swales' (1990) CARS model, the concept of 'Establishing a research territory' (Move 1) where an author refers to previous literature on a topic, can be expressed like this: ***Recent studies** indicate that the Earth's climate is changing rapidly*. AcaWriter identifies the contextual concept in the words ***Recent studies*** as 'Background Knowledge', that is syntactically connected to other content, and thus tags the sentence as the rhetorical move Background (see table 1). AcaWriter's parser will tag sentences with the overall concept of that sentence, even if they are syntactically and semantically different. For example, consider the following two sentences: (1) *Despite its popularity, **limited research** has been undertaken into esports possibly due to the **lack** of recognition by sporting associations* and (2) *Several studies have examined issues related to voluntary genetic testing, but these studies contain **insufficient data** on the emotional and social impact of genetic testing*. We see not just a difference in their syntax (or how the concepts are expressed), but a difference in their underlying semantics (i.e. meaning). However, each makes a similar 'Contrast' rhetorical move between two concepts. This is identified by AcaWriter and tagged. Finally, even though the parser relies on grammatical dependencies, a sentence can be grammatically similar, but still tagged as performing different rhetorical moves based on the words used. For example: (1) *This approach fails to address the issue of bullying* is syntactically similar to (2) *This framework provides a new approach to tackle bullying.* Each sentence has a similar structure, but sentence 1 will be tagged as 'Contrast', while sentence 2 will be tagged as 'Novelty'. This example shows that AcaWriter is able to detect the communicative goal of sentences, as Sentence 1 is signalling to the reader a gap in research, whereas, in sentence 2 the purpose is to show the results of research, that is a novel approach has been created.

Table 1: AcaWriter's analytical rhetorical parsing

Concept	Rhetorical move	Communicative function
Deictic	Summary	Authors' goals, contribution or conclusion
Position	Attitude	A perspective or stance
Surprise	Surprise	An unexpected outcome
Importance	Emphasis	Emphasis on significant, important ideas
Grow	Trend	A trend, growth, pattern or tendency
Contrast	Contrast / Question	Contrast, disagreement, tension, inconsistency and raising a question or missing knowledge
Background knowledge	Background	Consensus or background knowledge
New	Novelty	Novelty, improvement

AcaWriter can be extended to provide other parsers for other pedagogical contexts. As was mentioned above, it had previously been used in two learning contexts, an undergraduate law subject and a pharmacy and engineering unit. Two parsers were created as an extension to AcaWriter's original parser: reflective writing parser and the law essay parser (Gibson et al., 2017; Knight et al., 2018; Shibani et al., 2017) to fit these two educational contexts. AcaWriter's code has been recently released as open source so that other universities can also tailor AcaWriter to their unique learning contexts. This release is a part of the Higher Education Text Analytics project (HETA - see http://heta.io/resources/wawa-improving-research-abstracts-intros/ for more details) funded by Australian Technology Network (ATN). Automated feedback to students on their writing, analysis of student feedback comments, and analysis of curriculum materials are the three focus areas for the HETA project.

The CARS parser was created as an extension of AcaWriter as a part of this project. The moves in AcaWriter's original analytical parser, which identifies these rhetorical moves throughout a text (see table 2), were mapped to match the CARS moves identified by Swales and Feak (2012) (see table 3).

Table 2: AcaWriter's Rhetorical moves tags

Rhetorical move	Tag	Example
Question	Q	Current data is insufficient to conclude that…..
Background	B	Recent studies indicate that…..
Contrast	C	In contrast with previous hypotheses…
Emphasis	E	Studies on x have provided important advances..
Novelty	N	This model provides a new approach to…
Surprise	S	This discovery of x suggests intriguing…..
Trend	T	New models of x are emerging….
Summary	S	In this paper we show how….

Table 3: CARS Moves mapped to AcaWriter's moves (adapted from Swales & Feak 2012)

CARS Rhetorical Moves	AcaWriter Tags
Move 1 – Establishing a research territory: a. by showing that the general research area is important, central, interesting, problematic, or relevant in some way (optional) b. by introducing and reviewing items of previous research in the area (obligatory)	E - Emphasis B - Background
Move 2 - Establishing a niche: a. by indicating a gap in the previous research, raising a question about it, or extending previous knowledge in some way (obligatory)	C – Contrast & Q – Question
Move 3 - Occupying the niche: a. by outlining purposes or stating the nature of the present research(obligatory) b. by listing research questions and hypotheses (optional) c. by announcing principle findings (optional) d. by stating the value of the present research (optional) e. by indicating the structure of the research paper / thesis (optional)	S – Summary N – Novelty S – Summary

Not all of AcaWriter's moves were relevant, so they were removed. Out of the 8 original AcaWriter tags, 6 were kept. AcaWriter's tags were mapped to the CARS moves by looking at the communicative functions of the AcaWriter moves and comparing them to the three CARS rhetorical moves. The validity of the mapping was established by first performing a discourse analysis of a number of research articles, and then testing the emerging CARS parser to see that it found the same moves. After this, the same parser was used to analyse the Elsevier STEM corpus (Elsevier, 2015), with sentences checked to see which were tagged and whether they matched the CARS moves.

Developing actionable feedback

For AcaWriter to be useful for HDR research writing, clear, specific actionable feedback should be generated so that students understand what they need to do in order to revise and improve their text. The CARS parser aims to provide formative feedback specifically on the rhetorical moves made in Introductions and Abstracts. By identifying and highlighting the CARS moves students are able to see where there writing is at the time of submission to AcaWriter, which links back to Hattie and Timperley's (2007) first question of their feedback model, *How am I going?*.

AcaWriter's original parser highlights all the rhetorical moves that appears in the text (see figure 1) to prompt the student to reflect on their writing. This can be confusing for students as they may not know how to interpret the highlighting and what to do next. This is where the genre-based approach was incorporated. In the CARS parser each AcaWriter tag was assigned a colour that corresponded to the CARS rhetorical move that they were mapped against. This was done so that students would be able to see that the sentences highlighted matched back to the CARS model. Figure 2 shows the AcaWriter CARS parser, where the sentences identified are highlighted corresponding to the colour as assigned to CARS rhetorical moves. Highlighting the moves in students' text encourages students to analyse and think critically about their writing, all while performing a genre analysis implicitly.

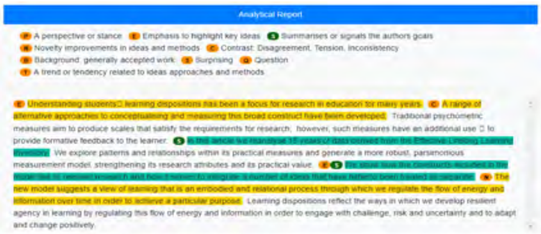

Figure 1: AcaWriter's original analytical parser

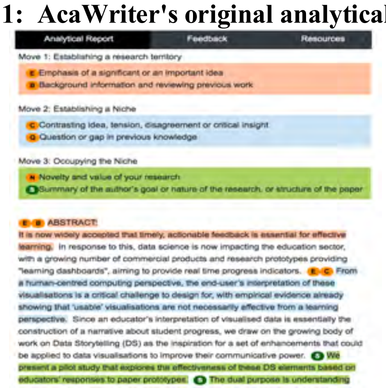

Figure 2: AcaWriter CARS parser

As Swales & Feak (2012) suggest that Moves 1 to 3 should follow consecutively, a rules system was developed to provide feedback when moves are in the wrong order (displayed in Figure 3), and if moves are missing (Figure 4). When students submit their writing to AcaWriter for feedback, the feedback provided is clear, understandable, actionable, transferable, specific, and timely, all characteristics of good feedback as discussed above (Nicol 2010; Hattie and Timperley 2007). AcaWriter's feedback also aligns with Hattie and Timperley's (2007) remaining two features of their feedback model, *Where am I going?* and *Where to next?*, as students are prompted to go back and revise their text specifically related to each move, with suggestions on how to improve their sentences. This feedback closes the loop between where students are and their writing goal, in this case to write an introduction or abstract. Students are able to go through the recursive nature of writing guided by feedback to help them achieve their writing goal. As AcaWriter is a web-based system, HDR students will be able to submit writing for feedback whenever they need it and receive feedback in real time. As HDR students are busy and supervisors time poor to provide immediate feedback on students' drafts, it is anticipated that AcaWriter will be able to assist HDR students to hone their introduction and abstract writing skills, encouraging the ongoing revision of drafts.

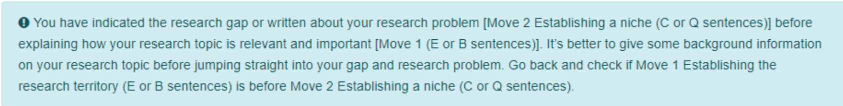

Figure 3: AcaWriter feedback moves in wrong order

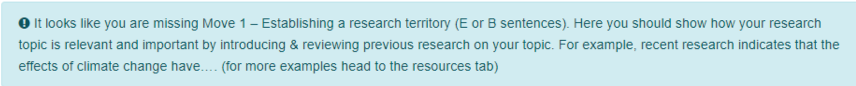

Figure 4: AcaWriter feedback missing move

Next steps

The work presented here is the first iteration of developing the AcaWriter CARS parser. It has so far been piloted with 12 HDR students at different stages of their candidature. However, the tool was not used standalone in the trail, it was embedded in an Abstract and Introduction workshop where students first learned the CARS Moves before using AcaWriter. All students stated that AcaWriter helped them think about the structure of their introductions and focus on the rhetorical moves in their writing. While some reported that AcaWriter helped them learn the CARS rhetorical moves, others needed more time to become familiar with tool and the CARS model. But, all students found the immediate feedback messages and highlighting useful making statements such as:

> Participant 7: I really liked the immediate feedback with the highlighted paragraphs. And the labelling where it said, oh, that's this move and oh you're lacking this move...
>
> Participant 1: ...I think it was very useful to use a piece of writing of my own and then when the software gives the feedback, maybe you think you're having the moves, you have the right structure but then it, it happened in my case the software told me ok, you're missing move 1, but I thought that it was there...I think in that sense, it challenges you in the way that you're thinking.

Although these initial responses are encouraging more work remains to be done to determine the effectiveness of the approach. In particular, an evaluation of how the AcaWriter CARS parser impacts upon students' writing must be completed to see if it improves students' writing process and the quality of their texts. Future trials will include using AcaWriter in discipline specific contexts. We also aim to embed AcaWriter in an online course where students learn how to write various sections of their thesis and research articles where additional parsers can provide feedback on those specific sections.

Conclusion

This paper has discussed the issues associated with teaching HDR students to write, as well as the essential nature of this task to their success (both as students and in their future careers). A theory-based approach to delivering WA tools designed to assist with this process has been discussed, specifically the technique for mapping the CARS model to rhetorical parsers. Early trials have been promising, and future work will continue to develop this important new tool. Providing tools that can help *all* HDR students learn to write will help to close the gap between those students who receive top supervision, and those who are not so fortunate. As the sophistication of the CARS parser improves we hope that it will help more students to navigate the learning of a key HDR graduate attribute in a timely and less stressful manner.

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Digital identity and e-reputation: Showcasing an adaptive eLearning module to develop students' digital literacies

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How and why is one's digital identity and e-reputation so important? This question underpins the "*Digital Identity: Making Your Mark!"* adaptive eLearning module which empowers students to critically engage and evaluate the impact of their e-reputation and the power of Social Media on their academic, professional and social lives – a vital digital literacy. The online adaptive module was developed by an Australian university cross-disciplinary team of academics, educational designers and librarians with the Australian-based global adaptive e-learning company, *Smart Sparrow*. The module's aim is to engage students via transformative personalised eLearning activities to explore the impact of their digital identities, e-reputation and the power of Social Media on their lives. Students explore how their e-reputation across various Social Media platforms can influence their social, academic, and professional spheres by interrogating their Social Media use and what constitutes responsible and ethical "digital citizenship". This paper showcases the module's design, innovations, and user evaluations that highlight its significant impact and success encapsulated in student voices, "Very eye-opening and engaging!" and "It taught me how to be a better person online!".

Keywords: digital identity, digital literacies, adaptive learning, e-reputation, digital citizenship.

Vast horizons – digital identity and the power of e-reputation

Why does one's e-reputation matter and why is developing digital literacies so vital? Michael Fertik, co-author of *The Reputation Economy* (Fertik & Thompson, 2015) suggests that "online reputation is more important than money or power" (Lewis, 2015). Consequently, evolving digital literacies matters because they form the "capabilities required to live, work and learn in a digital world" (JISC, 2011) – our e-reputations (digital reputations) matter more than ever. Australian universities, as well as in the UK and elsewhere globally, are addressing digital literacies and employability frameworks on their agendas as strategic university priorities given the importance of Social Media in students' lives (see Beetham & Sharpe 2013; Coldwell-Neilson, 2017; JISC, 2011 2014, 2015; La Trobe University, 2016; QUT, 2015; Salisbury, Hannon, & Peasley, 2017). Not only do university students need to be able to use and communicate via Social Media, they also need an awareness of the professional, ethical and legal aspects, and digital responsibilities and consequences across private, professional and academic spheres, which often intersect, blur and cross over. These capabilities are about developing "digital citizenships", and universities have ethical imperatives and responsibility to empower students towards *responsible* digital citizenship (NMC Horizon Report Higher Education Edition, 2017; Ribble, Bailey & Ross, 2004; Ribble & Miller, 2013). Digital literacies and the impact of e-reputations are critical gaps across the Australian higher education curriculum, albeit that there are emerging digital literacy student resources emerging from Australian universities. However, these resources tend to be linear, sequential, based on generic, mass user design and not personalised (e.g. Libguides platform used in Australian libraries and web-based e.g. QUT (2015)). The development of the *Digital Identity: Making Your Mark!* online module not only addressed a significant gap across the Australian Higher Education sector in terms of innovative content, learning design, interactivity and learning analytics, but in its use of an adaptive personalised eLearning platform. This paper unfolds to showcase the development of the module in terms of context, digital literacy framework, adaptive learning platform, pedagogical underpinnings; then moves to briefly give a flavour of the content and design innovations; and concludes with a snapshot evaluation of the module's impact and outcomes.

Synchronising our swimming – project background

The *Digital Identity* module brought together the vision of academics, researchers, librarians and educational designers working with an adaptive eLearning company, *Smart Sparrow*, to develop, design, share and evaluate educationally informed content and design. The module development informed new models and strategic partnerships for developing innovative eLearning solutions between universities and external companies. It was one of three modules developed to be shared across two Australian Innovative Research Universities (IRUs), which could be adopted and adapted by other interested stakeholders. The *Digital Identity* module was part of a larger IRU Digital Readiness initiative between La Trobe University and James Cook University in Australia. In 2016, it was deployed as stand-alone and integrated options across: a 2nd year journalism course of 255 students at La Trobe University, 5 postgraduate AusAID coursework international student programs, 25 Hallmark students at La Trobe, and 744 undergraduate students at JCU – collectively over 1,000 students. The module was designed to develop students' digital literacies.

Moorings – developing digital literacies

This project addresses the use of Social Media across these three spheres so students can reflect, assess and shape their e-reputation by understanding the power of Social Media. The project's aim is to develop students' Digital Literacy capacities – which are "the capabilities which fit someone for living, learning and working in a digital society" (Beetham & Sharpe, 2013; JISC, 2011, 2014; see also NMC Horizon Reports Higher Education & Library Editions, 2017), under the overarching Digital Identity and Wellbeing component (Figure 1). There are other valuable digital citizenship frameworks such as Ribble, Bailey and Ross (2004) which encompass additional broader aspects. The module raises students' awareness about how to use Social Media to shape their e-reputation. The module prepares students to be "work ready, world ready, future ready" based on La Trobe's (2015) *Digital future: Digital learning strategy 2015-2017*, shows students how to lead more impactful digital lives, and uniquely provides adaptive eLearning personalisation.

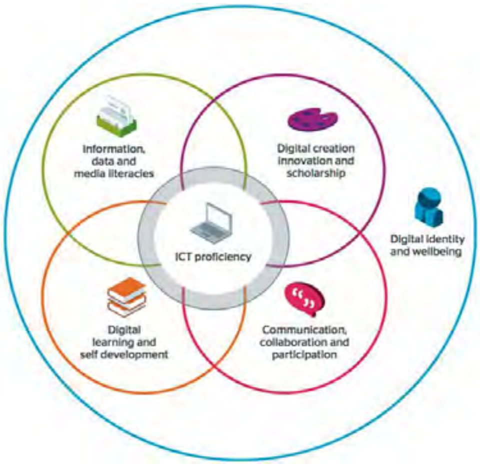

Figure 1. JISC (2014, 2015) digital literacy framework

The Intended Learning Outcomes (ILOs) of the lesson are for students to understand how to use Social Media effectively to promote their academic achievements, network professionally and socially, and for employability and entrepreneurship by:

1. Understanding the power of Social Media in creating their e-reputation
2. Exploring their digital identities across professional, academic and social spheres
3. Analysing, developing, promoting, and protecting their e-reputation.

Lighthouse outlook – adaptive eLearning platform *Smart Sparrow*

Adaptive personalised learning is a prominent feature of 21st Century investigation with the Bill Gates Foundation funding and promoting development of adaptive personalised learning solutions (Tyton Partner Papers, 2015, 2016). *Smart Sparrow* (a global award-winning company) is an emerging pioneer in developing engaging, adaptive eLearning modules across Australian universities and was specifically chosen by our strategic university digital leadership at the time through a collaborative IRU Digital Readiness Project. The project aimed to pilot an adaptive eLearning platform where online digital literacy modules were to be developed and shared across Australian IRUs (Innovative Research Universities). Recent interest in adaptive eLearning has seen Deakin becoming the first Australian university to partner with *Smart Sparrow* on a university-wide scale to deliver adaptive enhanced STEM education (Deakin University, 2016). The *Smart Sparrow* interactive adaptive platform allows for dynamic (real-time) personalised eLearning experience. This means that the module reacts to a user's input and provides customised feedback and specific activity branching pathways to adapt to user needs, interests and behaviours. For example, each user can progress at a faster or slower rate through the module, skip sections, proceed to easier or harder material, or retrace their steps – adaptivity and personalisation *par excellence* that moves beyond mass user design and website transmission platforms.

Pedagogical anchoring

The project's learning design is based on reflective and critical (digital) pedagogies (Beetham & Sharpe, 2013; Brookfield, 2005; Selwyn, 2015), learning analytics (Buckingham Shum, 2014), and adaptive personalised eLearning (Tyton Partner Papers, 2015, 2016). Dynamic learner analytics provide actionable insights into student performance to analyse learning and enrich learning designs and activities.

Underpinning the project is the value of adaptive personalised eLearning (Tyton Partners, 2015, 2016) "to make a significant contribution to improving retention, measuring student learning, aiding the achievement of better outcomes, and improving pedagogy" (Tyton Partners, 2015, p. 4). The benefit of adaptive learning provides "more sophisticated, data-driven" personalised learning experiences for students. The adaptive platform with its learning analytics enriches the learning experiences of students through strategic university digital future strategies and digital literacy frameworks (La Trobe University, 2015; Salisbury, Hannon & Peasley, 2017) to inform evidence-based learning design.

The content pathways are personalised for each student – for example, those who know more can accelerate through and skip certain sections and content while providing more support activity pathways and tailored feedback for novices. The module is narrated vibrantly and inclusively through Tash (a university student), and is accessible (e.g., transcripts for videos and alternatives for drop and drag exercises), with creative, personalised interactive multimedia. Throughout, each student reflects, engages, evaluates, and responds to adaptive individualised activity pathways.

Exploring shorelines and seashells – Content and design innovations

The module has novel interactive activities around Social Media and employability across social, academic and professional spheres to increase student engagement and motivation. As an overview the adaptive eLearning platform provides real time dynamic learning analytic dashboards. *Smart Sparrow's* adaptive eLearning platform is based on Intelligent Tutoring Systems and Educational Data Mining – Learning Analytics – to enable the authoring, delivery and analysis of personalised eLearning. There are significant issues around digital engagements (Selwyn, 2015), data mining, learning analytics, machine learning, and algorithmic education that are beyond the scope of this paper. But we touch on learning analytics towards the paper's end. The value for investment is high as the module is easy to duplicate, adapt, and deploy from fully online to blended modes across disciplines, or as a standalone. The module is cloud-based, and integrates with a university's LMS (Learning Management System). Duplicating the module and enrolling thousands of students is easy. Customisation is possible because of modular design. Overall, the technology can adapt teaching to individual learners' desires and needs. The module provides students with an individualised dynamic interactive eLearning platform where not only do they gain insights about themselves but staff get to know more about their students' digital literacies.

The module is innovative in its flexible, adaptive, personalised learning; inclusive, accessible design; content; and transdisciplinary design approach. It is user-paced and narrated through a student voice. It engages users via rich interactive multimedia and adaptive personalised activities and videos. This video clip highlights some of these (https://youtu.be/0uvAxq-yTzg). Innovation has been a hallmark of this module on multiple levels from the multidisciplinary design team, adaptive platform, engaging multi-textual and multimedia content, empowering reflective and critical pedagogical design, vibrant and engaging aesthetics, to student narrator voice (see Figures 2 & 3).

The content is underpinned by reflective, active, critical transformative pedagogies to explore the power of Social Media and how to use it effectively and responsibly. The JISC Digital Literacies Framework (JISC, 2011, 2014, 2015) elements of *communication and collaboration*, *career identity and management, media literacy* are interrogated to empower students to realise the impact of their e-reputation and how to showcase their university achievements and social networks for their careers.

Figure 2. *Your Digital Identity* welcome screen with Tash (student narrator)

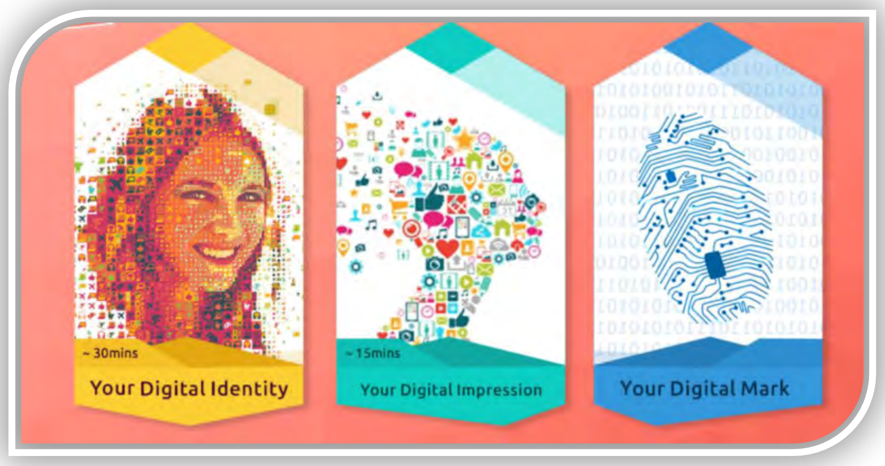

Figure 3. Module outline of the three sections

A sample of the thought-provoking activities and titles are outlined below (also see Figure 4):

- *Have you Googled yourself lately?*
- *Can Social Media really get you that dream job?*
- *Can Social Media really get you fired?*
- *Social Media and entrepreneurship*
- *Social Media platforms and uses across social, academic and professional spheres*
- *What type of Social Media user are you? (Prolific, Selective, Curious, Indifferent)*
- *Analysing and selecting images for Social Media profiles*
- *Digital detective, visibility, privacy and surveillance*
- *Social Media, ethics and legal aspects*
- *Evolving your Social Media Manifesto.*

Expanding on the reflective activities, some examples are outlined below:

- *How important is Social Media in employment?*
  Students rank employer responses about Social Media, and are then presented with results from a survey so they can compare their opinions against survey results. This either affirms or challenges their views.
- *Student Social Media user profiles*
  Based on their Social Media engagement and use patterns determined by responding to questions about time spent, platform choice, and purpose (e.g. across academic, professional or social spheres), students are placed in one of 4 profiles quadrants (Curious, Prolific, Selective, Indifferent) and provided with customised advice and content.

- *The nature of Social Media*
  Students respond to questions about Social Media definitions, limits, scope of Social Media and are provided with customised feedback based on their responses.

Users engage with the platform with real-time response feedback and the user data is stored on the platform. However, the module also has an optional notepad where students can take notes during the lesson and save these to email themselves at any point. The lesson culminates in students evolving their *Social Media Manifesto* as well as downloading a list of references and digital resources under these categories:

1. Social Media and You
2. Social Media and Your Career – Your e-Reputation
3. Social Media and Protecting Yourself Online.

Whilst the module is self-paced, it can be completed in around an hour. Students can spend as long as they wish on each section and return to activities, as well as proceed more quickly if they wish. Interactive design elements range across multiple choice selection, reflective answers, drag and drop exercises, matching activities, surveys, user Social Media profiling, media image selections, active short video viewing to name a few. The range of activities provides variety and elements of surprise. To experience the online adaptive *Digital Identity* module at the user end, *Smart Sparrow* have created a modified open link module demonstration that does not require a log in, without the full display and the full analytics of the platform (which can be seen in the licensed versions) at https://aelp.smartsparrow.com/learn/open/ib9ywd25.

Diving deeper – Evaluation and impact of the adaptive eLearning module

This section provides a snapshot of the evaluation feedback responses from deploying the module in a 2nd year journalism course on Social Media (255 students). Ethics clearance was obtained and feedback was anonymised via the online survey questionnaire at the end of the module (Survey Response for this cohort = 70). The feedback survey instrument was embedded within the *Smart Sparrow* platform screens with an audio clip of Tash inviting the students to complete the feedback survey. The survey instrument had 3 sections each with three to four questions using a 5-part Likert scale covering: value, engagement, and satisfaction in terms of the intended learning outcomes. There were another 7 open ended questions, as outlined in Table 1. A brief survey snapshot analysis is outlined here (due to word limit), more detailed thematic analysis will be forthcoming.

Table 1: Feedback survey instrument questions

Value	Engagement	Satisfaction	Open Ended
The lesson changed my views on using Social Media as a tool for my career.	I enjoyed the activities in the lesson.	I found the lesson challenging.	What has the lesson taught you?
I am more aware about the relationship between Social Media and my e-reputation.	The lesson was relevant to me.	How interesting did you find the lesson?	Was the lesson relevant for you? Why/Why not?
I would like to explore more Social Media platforms which I haven't used.	I found the lesson engaging.	How valuable did you find the lesson?	How could it be made more or less challenging?
		Did you find the overall look and feel of the lesson appealing?	What did you like/dislike about the design? Why?
			What improvements would you suggest?
			Other Comments


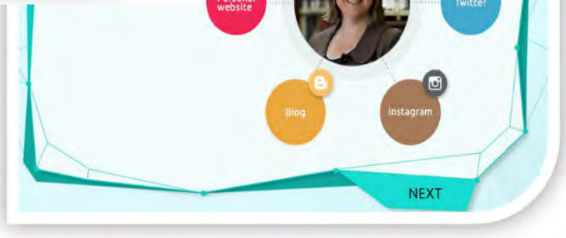

Figure 4. Snapshot sample module activities

We developed a vibrant and innovative *Digital Identity* a module that extends adaptive eLearning beyond objective, fact-based content to more subjective, open-ended and reflective learning experiences – and students were overwhelmingly positive about it. Learners appreciated and valued the vibrant, interactive, and reflective module, saying: "Very eye-opening and engaging!". Student feedback showed that the objectives of understanding the power of Social Media in their lives were achieved through the impact of Social Media on their e-reputation and its impact on employability. Students valued the educational aspects, vibrancy, interactivity, self-reflections and videos, as well as analysing various Social Media platforms. Student evaluations show that students valued the module and achieved insightful awareness of the impact of their Social Media and e-reputation. Students were taken by the vibrancy, interactivity, self-reflection, provocations and insights of the module, saying: "Well done on the creation of a fantastic resource – Great lesson!"

Student feedback showed that the module successfully highlighted the importance of judicious Social Media use. In an end-of-lesson survey (Tables 2 & 3), 76% of student respondents agreed or strongly agreed that "The lesson changed my views on using Social Media as a tool for my career." 84% agreed or strongly agreed that "I am more aware about the relationship between Social Media and my e-reputation."

Table 2: Student percentage response on module's value

Value	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Q1 The lesson changed my views on using Social Media as a tool for my career.	16 %	60 %	22 %	1 %	1 %
Q2 I am more aware about the relationship between Social Media and my e-reputation.	16 %	68 %	15 %	0 %	1 %
Q3 I would like to explore more Social Media platforms which I haven't used.	10 %	46 %	32 %	11 %	1 %

Table 3: Student percentage response on module's engagement

Engagement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Q1 I enjoyed the activities in the lesson.	7 %	54 %	29 %	7 %	3 %
Q2 The lesson was relevant to me.	9 %	71 %	16 %	4 %	0 %
Q3 I found the lesson engaging.	12 %	58 %	25 %	5 %	0 %

Tables 2 and 3 highlight the effectiveness of the module, and 90% of the 255 enrolled students in the 2nd-year journalism subject on Social Media completing the Digital Identity module (further individual question completions and time spent on each of the questions/tasks are possible through the learning analytics platform and will be explored in future publications). 17% described the lesson as insightful, 75% as positive, and 8% provided comments about future directions.

Clearly, there was significant awareness raising (55%) about the impact of Social Media (7%), cautions (13%) and carefulness (20%) with which it would be used given that the module was "very educational" (5%). This feedback is significant given that these were already relatively Social Media savvy 2nd year journalism students. In terms of the design, students liked the vibrancy of the module and the look and feel in terms of its colourfulness (22%), design interactivity and navigation (37%), mood, look and feel (24%), Interactivity (2%), as well as issues or concerns (15%). Overall, 80% of students responded with agree and strongly agree that the look and feel of the lesson was appealing. The student voices encapsulate what they gained in value, engagement, and awareness raising:

> To be a better person on the Internet and well done on the creation of a fantastic resource
> Great lesson! Very eye opening and engaging!
> How informal and easy it was to process, and the examples of other people's accounts.
> Explained each aspect of Social Media apps
> Log out of Facebook before I go out clubbing
> The variety of the content shown
> Glimpses at other people's Social Media profiles
> Social Media manifesto
> To always remind myself that my Social Media life can be seen by Future Employers and potential thieves
> It taught me how to use Social Media, to be more aware of what I post and to be more careful if I want to have a professional job
> The lesson taught me the scope and reach Social Media have. While it may be difficult to hunt me specifically down on the web using just my name (I (un)luckily have very common names), eventually someone from work or uni, or a friend of a friend will see what I've posted and it can get back to people in higher positions, or hiring positions. This could have a huge impact on my career moving forward. It is also somewhat worrying that typing my name into google or Facebook will bring up so many other people. This could cause a case of mistaken identity when potential research partners or employers do a Social Media search for me and come up with the wrong person. I may need to modify my privacy settings so that just the right amount of my content is accessible to people that I don't know, so that it will affect my career and social life positively.
> To be even more vigilant of what I share and limit my presence to positive output that may influence my career path.
> Overall I found it enjoyable.
> Good lesson, very relevant and important for any Social Media user to take part in.

Consequently, given the highly positive impact and successful outcomes of the module's implementation, the *Digital Identity* adaptive eLearning module was invited as a Demo showcase amongst the *Smart Sparrow* suite of Demos (see *Digital Identity* case study description). Since then it has been showcased by Deakin University in their systemic uptake of the adaptive eLearning *Smart Spa*rrow platform. Globally, it has been highlighted in the NMC Horizon Report Library Edition (2017, p.45): "A team of academics, instructional designers, and librarians leveraged Smart Sparrow's Learning Design Studio to develop an adaptive, personalized online module that helps students understand the power of social media in crafting their digital identities. Lessons include evolving privacy policies and career influence". Further impact for staff (internal and external) were:

collaborative design informed by positive student response; transdisciplinary team benefits; and sharable and sustainable platform content for use across Australian universities. Significantly, national impact and recognition of the module were achieved in being one of 4 finalist in the 2017 *Australian Financial Review Higher Education Awards* (Dodds, 2017) in the Learning Experience category from across 100 plus applications, and being invited as 1 of 8 national exemplar showcases at the *Smart Sparrow* Learning Innovation Summit (2017) in Melbourne.

Lighthouse beacons – safer harbours and swimming in open oceans

Whilst the success of the module has been overwhelming in how students have responded, the experience of coming together as a transdisciplinary team to evolve a module across two universities did provide for interesting and challenging 'rocks'. One vital aspect is the issue of Copyright across universities and the choppy ocean of the complex arena of digital and Social Media Copyright. We modified our seashells (content) and selections accordingly, and sought permissions for content reproduction and linking out to platforms rather than embed full screen shots for example. We also found that raising awareness about accessible and universal design was a significant contribution to the authoring tool designers. Significant to any such development is sustainability in terms of where does the adaptive module belong when it is created across various departmental affiliations? Who updates it and is responsible for it when there is multiple authorship? What of licensing costs and who pays for these? And significantly, who are its leaders and promotors (internally and externally)? Another pressing concern is that of the platform's learning analytics and the issues surrounding user data and visibility and where the data resides (i.e. internally on a university server or on the external digital technology servers). Whilst the focus of this paper is on the broader conceptual learning design and affordances of adaptive learning, learning analytics increasingly are embedded into technologies and ethical disclosure should be required. A limitation on our part was that we might have mentioned this at the start of the module with a consent option for every user. However, we were specifically covered through Ethics approval and only using the data of students who consented to provide feedback survey evaluation. The module indeed contains a section about the hidden aspects of user data use. Buckingham Shum (2014) and Prinsloo (2017) so aptly remind us of the ethical concerns of data for whom, by whom and for what purpose, which should be guiding principles.

Overall, we see the raising of students' awareness of their 'digital footprint' and 'making their mark' as crucial empowering aspects, as Fertik reminds us, "Reputation is becoming more valuable than money or power" (Lewis, 2015). He also cautions us that "as we move from an era of big data to the more considered and perceptive big analytics, the amount of information you give away about yourself – your 'digital footprint' – increases exponentially every time you go online. Fertik thinks it is only a matter of time before each of us has a reputation score, just as we now have a credit rating" (Lewis, 2015). This is echoed by 'futurist Marina Gorbis' who predicts that "we are moving towards … a new economy where your web influence and social connections will matter just as much as the money in your bank account" (Lewis, 2015). Being aware of surveillance aspects and understanding what this entails is a vital digital capacity. We see this happening already in China with the rise of the Social Credit System to rate the trustworthiness of its citizens which started in 2014 and is to become fully implemented nationwide by 2020, where an individual's digital data are algorithmically used to provide a credit score that socially stratifies a person's e-reputation and controls access to services in all sorts of ways (Brehm & Loubere, 2018; Zeng, 2018). Fertik's predictions are already upon us: "Fertik sees a day when numerous decisions will be made about each of us – about our lives and careers, even our dating prospects – based on reputation alone. … Soon, however, computers could become more involved in recruitment or what Fertik calls 'decisions almost made by machine'" (Lewis, 2015). Who we are online matters! "It's there forever" as one student participant suggested when exploring "The Internet Archive Way Back Machine". Understanding the impact of our digital footprints and digital marks and the complexities of ethical and responsible digital citizenship then is vital to what has underpinned evolving this adaptive elearning module. Significantly it is aligned to a commitment to a digitally-enhanced and flexible study experience for students and graduates that gives them a digital reputation advantage across their lives in understanding the power of a carefully considered and nuanced e-reputation.

Further, the module is a response to the challenges faced by institutions (NMC Horizon Report Higher Education edition, 2017, p. 22) in developing "digital fluency" and "digital citizenship" in that,

> Digital literacy transcends gaining isolated technological skills to generating a deeper understanding of the digital environment, enabling intuitive adaptation to new contexts and cocreation of content with others. Institutions are charged with developing students' digital citizenship, ensuring mastery of responsible and appropriate technology use, including online communication etiquette and digital rights and responsibilities in blended and online learning

settings and beyond. This new category of competence is affecting curriculum design, professional development, and student-facing services and resources. Due to the multitude of elements comprising digital literacy, higher education leaders are challenged to obtain institution-wide buy-in and to support all stakeholders in developing these competencies. Frameworks are helping institutions assess current staff capabilities, identify growth areas, and develop strategies to implement digital literacy practices.

Overall, the success of the *Digital Identity: Making Your Mark!* adaptive eLearning module development and implementation has been heartening. The module is integral to evolving sophisticated understandings of digital literacy capacities as it empowers students to leverage their digital identities – strategically, ethically, responsibly and creatively. Further, it could easily be adapted for staff use. The module's flexibility, adaptability, personalisation, and its empowering pedagogies elevate teaching across higher education. It's an innovation that needs to be applied across the sector for anyone wanting "to be a better person online!".

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Ready to Study: an online tool to measure learning and align university and student expectations via reflection and personalisation

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Despite widespread implementation of initiatives to support student transition into higher education, research reports that many students, both undergraduate and graduate, still lack awareness of expectations and preparedness for study (Baik, Naylor & Arkoudis, 2015; Ozga & Sukhnandan, 1998; Drew 2001; Haggis & Pouget, 2002; Wingate, 2007). In this paper we report on the design and development of an online adaptive diagnostic module to help students better understand the expectations of studying at a large Australian university, reflect on and evaluate their current skill level in relation to these expectations, and address any skills gaps. The module[1] was designed to (1) gather evidence of student needs through analysis of student perceptions and behaviours, (2) be personalised enough to maximise opportunity for students to reflect on and self-regulate learning, and (3) be scalable and sustainable enough to develop and maintain within resourcing constraints. Preliminary learning analytics and student surveys from the pilot (n=402) indicate that this approach allowed students, teachers and developers to measure current learning in relation to expectations and take action. Importantly, it was also easily embedded in and adapted for different contexts.

Keywords: Transition; first-year in higher education; personalisation; reflection; feedback; adaptive learning; measurement;

Introduction

Facilitating student transition into higher education has become a critical issue in Australia, with a growing body of international evidence to support the notion that a student's first year experience impacts academic success, wellbeing, retention and engagement with university services and communities (Baik, Naylor, & Arkoudis, 2015; Briggs, Clark, & Hall, 2013; Tinto, 2010). Both experience and preparedness for university are cited as key factors influencing student satisfaction, persistence and attitudes in first year studies (Baik et al., 2015; Tinto, 1999). Therefore, a key challenge for higher institutions lies in designing impactful programs and initiatives that align institutional and student expectations and help students prepare for the demands of university study. Achieving this relies on both staff and students being able to diagnose, or measure, current learning (knowledge and skills) in relation to institutional expectations, as well as understand perceptions and behaviours and how these might impact the learning experience.

Many universities have implemented initiatives aiming to support student transition; however, research suggests that despite these offerings, students still lack preparedness (Baik et al. 2015; Ozga & Sukhnandan, 1998; Drew, 2001; Haggis & Pouget, 2002; Wingate, 2007). One explanation for this is that engagement with such initiatives is often low; in fact, a recent report on the *First Year Experience in Australian Universities* indicated that only "three out of ten students reported that they had actively engaged with university orientation programs and fewer than half of these students (42%) believed that the programs helped them get off to a good start" (Baik et al., 2015, p. 32). This report also stated that for 18% of students, "university had not lived up to their expectations" (p. 30) and for 38% "the standard of work expected at university was much higher than they expected" (p. 31). This discrepancy highlights a need to review existing approaches to student transition initiatives to better help students understand expectations and develop the required skills. Ability to measure student learning and gather information on perceptions and behaviours at this stage in the student lifecycle could inform future development of resources and initiatives that truly meet students' needs.
It is widely accepted that as educators our role in this transition process is to help students to: learn about higher education (Briggs et al., 2013); bridge the gap between their previous learning experiences and those they are likely to have in their institutional context (Perry & Allard, as cited in Briggs et al., 2013; Wingate, 2007); recognise their learning habits (Wingate, 2007); and develop both "learner identity" (Briggs et al., 2013, p. 6),

[1] Participate in a demonstration module and view screenshots of module design at bit.ly/R2S-Research

and autonomous learning skills (Briggs et al., 2013; Wingate, 2007). Importantly, literature also emphasises the need for initiatives to encourage students to be actively involved in learning activities (Tinto, 1999), and occur early enough to allow both students and university staff to act on feedback and adjust behaviours (Tinto, 2010; Wingate, 2007). We, therefore, need to create conditions in which students can measure their preparedness and take appropriate action early in the transition process.

To help students develop these independent learning skills and take control of their learning process, Kellenberg, Schmidt, and Werner (2017) and Wingate (2007) advocate encouraging the development of self-regulation and reflection skills. Kellenberg et al. (2017) add that "an individual's metacognitive control of the learning process is an essential prerequisite for self-regulated learning" (p. 25), meaning that we must provide opportunities for students to reflect on and adapt their learning process. In this way, we are helping them to develop lifelong learning skills, defined by Kellenberg et al. (2017) as "(1) the motivation for and the interest in education (learning motivation intrinsic and extrinsic), and (2) the competence to apply these successfully in concrete learning situations" (p. 23). This shift in focus makes students active agents in their own learning, better preparing them for both university life and their future careers.

The Ready to Study project

This project aims to investigate the effectiveness of using a personalised, reflective diagnostic online approach to help students get ready for university study. While literature exists on developing self-regulation through collaborative e-assessment tasks (Marin & Garcias, 2016); developing academic literacy through self-regulated learning online learning (Lear, Li and Prentice, 2016); and online interventions to support mental health wellbeing and study skills (Papadatou-Pastou, Goozee, Barley, Haddad & Tzotzoli, 2015; Papadatou-Pastou, Goozee, Payne, Barrable & Tzotzoli, 2017), little literature was found on helping students to reflect on their past learning experiences and behaviours, evaluate their appropriateness in a higher education context, and take action to ensure their own success.

We wanted to explore how we could design an effective, useful, scalable and personalised online tool to help students better understand expectations of studying at a large Australian university, reflect on and evaluate their current skill level in relation to these expectations, and address any skills gaps. We considered three key questions in the design process: (1) could we design a tool to gather evidence of student needs through analysis of student perceptions and behaviours?; (2) could we personalise this tool to maximise opportunity for students to reflect on and self-regulate learning?; and (3) could it be designed in a way that allowed for scalability and sustainability? Having considered these aims in line with the technological affordances of products available to us, we developed the Ready to Study module using the SmartSparrow platform.

This paper reports on the progress of this project. We begin by outlining the principles that informed the design process, the features of the Ready to Study module, the development process and modes of deployment. Then, following a brief presentation of method and results, we discuss key findings from the data and propose future directions for research and opportunities for collaboration.

Re-designing our approach to student transition: key principles

Personalisation

Previously, we took a one-size-fits-most approach to resource development and student support; this was predominantly based on Academic Skills Advisor (ASA) understanding of skills students needed, rather than evidence from students. A limitation of this approach is that while it outlined general expectations and provided generic resources, it did not consider diverse preferences, backgrounds, motivations or experiences of students, or afford students much agency. This lack of personalisation did not create conditions in which we could scaffold development of self-regulation and reflection skills, and potentially made it appear less relevant to students, leading to low engagement.

Learning opportunities, not failures

We also wanted to move further away from a deficit model of support which focused on identifying weaknesses rather than strengths, and in which gaps in knowledge were presented as a failure rather than an opportunity to learn. By encouraging personal reflection on past experiences and behaviours we hoped to move away from the idea of 'support', which according to Haggis (2006) implies, "the existence of a superior group who function in a strong and 'unsupported' way, thus pathologising any student for whom these assumptions are not clear" (p.

525). In this way students could understand their progress towards both university and personal goals and connect strategies and behaviours to their own experience.

Scalability and sustainability

Although the primary focus was to develop a tool for use by all new students that could be personalised to their learning needs, we also wanted it to be scalable and sustainable. These factors were important given we have large enrolment numbers each semester with no increase in resourcing. The ease with which we could accommodate and adapt to diverse needs of students, faculties and departments was also a key consideration, because the student experience varies depending on subject, faculty expectations, cohort, year of study, and background, and while “some ‘skills’ are broadly generic... most of what students need to understand is more complex and importantly variable from discipline to discipline” (Channock, Horton, Reedman, & Stephenson, 2012, p. 2). Research has also shown that approaches in which support is tailored and embedded, rather than “one-size-fits-all” generic programs have been shown to result in improved outcomes (Catterall & Ireland, 2010; Salamonsen et al., 2009; Wingate et al., 2011, as cited in McWilliams & Allan, 2014, p. 4).

Design

The Ready to Study module is divided into three interdependent but conceptually separate components (see Figure 1). The modular design allows components to be modified and adapted without significantly affecting each other or the overall student experience.

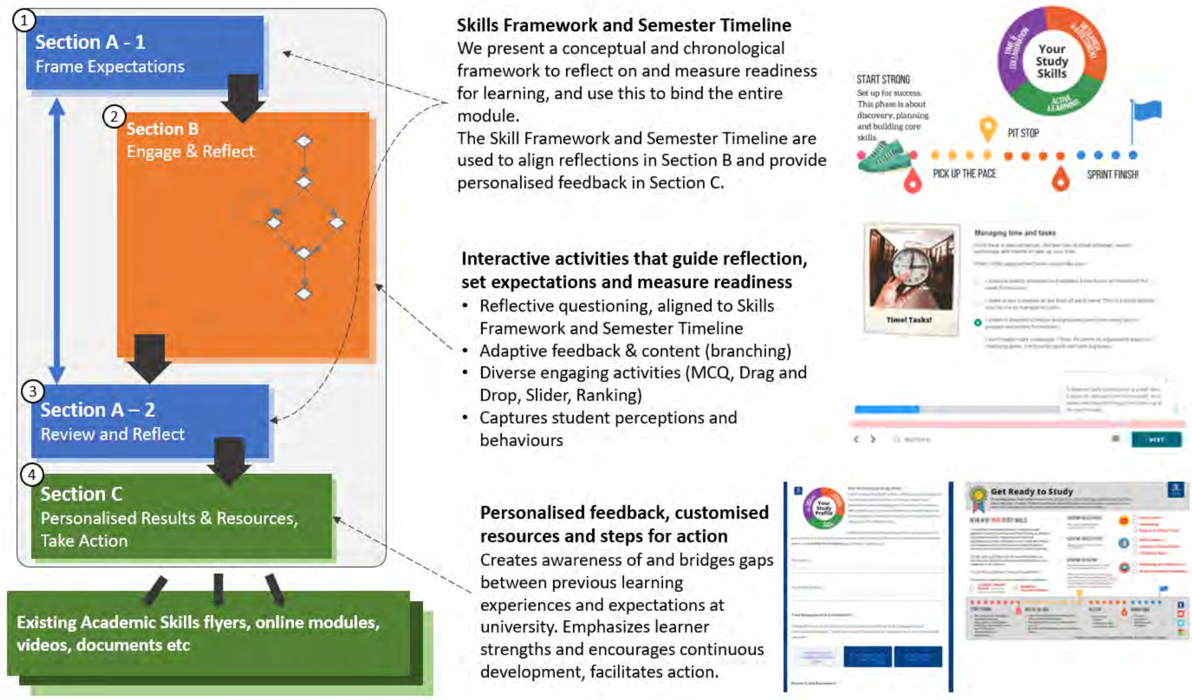

Figure 1: Overall module structure and design

1) Section A – 1: Frame Expectations

This section:

- gives students tools to understand, evaluate and articulate their study skills.
- creates a long-term and high-level view of how these skills will be applied at university.
- frames their experience in the module and the semester.

The two sub-components in this section are the Timeline and Skills Framework, as shown in Figure 2.

Timeline

The timeline is designed to help students see the relevance of study skills in the context of challenges they might face throughout the semester. This long-term view should also encourage a more proactive approach to developing academic skills. The interactive activities in Section B of the module are aligned with this timeline, so as students progress through the module, they also progress through the semester.

Figure 2: Timeline and Skills Framework

Skills Framework

As Figure 2 indicates, analysis of existing resources produced three categories of academic skills:

- **Research and Assessment Skills** – skills and approaches related to the assessment tasks and research required to complete them (for example, the writing process, presentation skills, incorporating sources)
- **Active Learning Skills** – positive study approaches to increase impact of learning (for example, note-taking techniques, revision strategies, critical thinking)
- **Time Management and Collaboration** – a broad category of productivity skills that impact study (for example, groupwork, general time management strategies)

Collating the range of specific academic skills required across the semester into these three main categories limits the likelihood of students being overwhelmed, highlights complementary or similar skills, and encourages holistic self-development strategies. This also creates a clear summary of the most important academic skills, and becomes the basis for designing reflections, measuring learning and personalising advice for action.

2) Section B: Engage and Reflect

This section consists of 10 interactive activities focused on specific learning experiences students might have at university relating to each of the three main skill areas (Table 1).

The activities are designed to:

- create awareness of academic expectations of studying at university.
- facilitate personal reflection on skills and behaviours required in specific learning situations.
- provide personalised feedback to align responses to expectations and encourage action to improve preparedness.
- gather evidence of needs and capabilities by capturing perceptions and behaviours.

Table 1: Specific learning experiences mapped to Skill Framework

Timeline	Activity	Reflection focuses on...	Skill Area measured
Start Strong	1	Note-taking in Lectures	Active-Learning
	2	*Approach to Tutorials OR Labs	Time Management & Collaboration
	3	Time Management Approaches	Time Management & Collaboration
	4	Revision Strategies	Active Learning
Pick Up the Pace	5	*Assignment Planning	Research & Assessment
	6	Research Strategies	Research & Assessment
	7	Critical Thinking	Active-Learning
	8	Group Work Attitudes	Time Management & Collaboration
Sprint	9	Incorporating Sources	Research & Assessment

Finish	10	Exam Preparation	Research & Assessment

**students are split into 2 pathways depending on discipline (Humanities or STEM)*

The activities are scenario-based and behavioural, and apply diverse engagement tools (multiple choice questions, drag and drop, sliding scales and sorting lists, see Figure 3). Each activity offers personalised feedback to students based on their input (between two and four unique responses). Rather than simply being corrective (identifying right or wrong behaviours), this tailored feedback aims to help students understand what they are doing well (reinforcement), reflect on strategies and behaviours to improve their performance (personal development), and select and apply those which they feel will benefit them (agency). In this way, it emphasises growth instead of support, thus avoiding a deficit approach and encouraging action.

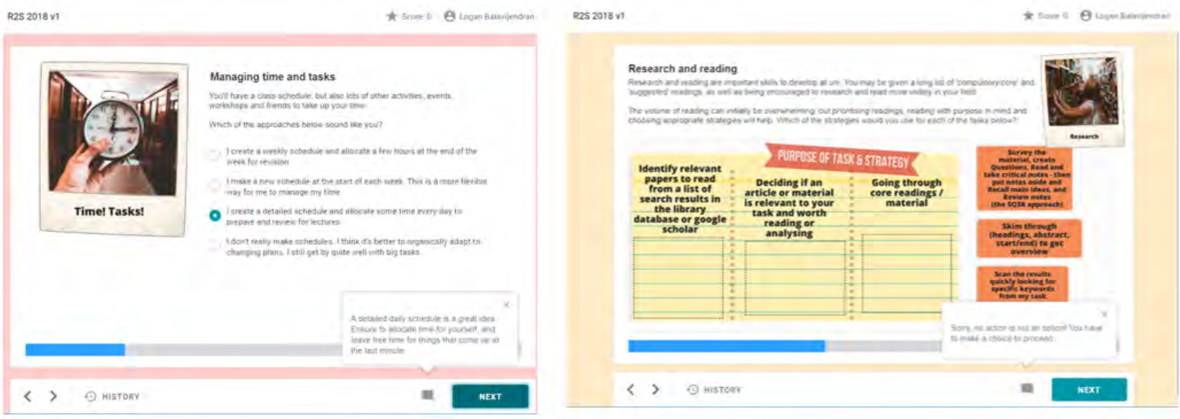

Figure 3: Scenarios are designed to create awareness, encourage reflection and provide feedback

3) Section A – Part 2: Review and Reflect

Based on their perceptions and behaviours in Section B, students are clustered into the HIGH or LOW band of each skill category. This is then used to give students immediate personalised advice against the skill categories (for both HIGH and LOW bands), and then to filter them into eight cohorts in preparation for personalised resources (see Table 2). These profiles and the sorting mechanism are not visible to students.

Table 2: 8 Skill profiles based on student reflections against the Skill Framework

Profile	Research and Assessment	Active Learning	Time Management & Collaboration	
1 – LLL	LOW	LOW	LOW	*Curated resources for Profile 1*
2 – LHL	LOW	HIGH	LOW	*Curated resources for Profile 2*
3 – LLH	LOW	LOW	HIGH	*Curated resources for Profile 3*
4 – LHH	LOW	HIGH	HIGH	*Curated resources for Profile 4*
5 – HLL	HIGH	LOW	LOW	*Curated resources for Profile 5*
6 – HHL	HIGH	HIGH	LOW	*Curated resources for Profile 6*
7 – HLH	HIGH	LOW	HIGH	*Curated resources for Profile 7*
8 – HHH	HIGH	HIGH	HIGH	*Curated resources for Profile 8*

4) Section C: Personalised Results and Resources, Steps for Action

This section of the module aims to:

- provide customised resources best suited to the student's skill profile.
- encourage and facilitate action for self-development.

Students are presented with a customised list of resources (based on one of the eight study profiles). Consistent with our focus on growth instead of support, they receive advice and resources aligned to all skill categories – including those they are strong in.

In the first iteration of the module students received a hyperlinked downloadable PDF document. Feedback indicated this approach did not afford enough agency, so in the second iteration we redeveloped this PDF document into an online form (using Qualtrics). This form allowed students to preview then choose which resources (and thus skills) they wanted to focus on. This generated a customised email with a list of resources (along with a link to the full list).

The design also included a follow up email later in the semester (three or four weeks in) to remind students of their insights and encourage further reflection, action and application. This was a manual process in the first iteration that has now been automated in the second.

Development and Deployment

In order to maximise sustainability and scalability, the module was developed using tools supported by and embedded into the University. It was developed internally as part of current scope of work (not a separate project) and involved two staff members spending about two days a week over the space of three months. Smart Sparrow was chosen for its ability to create engaging interactive experiences, build adaptive pathways and capture learner analytics. It is also relatively simple to create various instances and embed it into the Learning Management System (LMS).

The module was piloted in Semester 1, 2018. It was launched in the Academic Skills community within the LMS with minimal communication and embedded in six subjects. At the end of Semester 1 the module was evaluated, improvements were made and it was relaunched for Semester 2. A version was also adapted for fully online graduate students.

Method

We adopted a mixed model approach (quantitative analysis followed by qualitative focus groups) to evaluate the effectiveness of our design.

Three approaches were used:
1. Platform Analytics (captured using Smart Sparrow, Bit.ly and Qualtrics. This captures student reflections, engagement and action post module)
2. Student perception survey (captured via online survey upon module completion)
3. Focus groups (with students who completed the module)

The student perception survey had two parts: five statements (with a 5-point Likert scale response with 1 for Strongly Disagree and 5 for Strongly Agree) and two open ended questions.
1. *I am now more aware of the strategies and skills required to succeed at university*
2. *I will be able to apply the ideas and strategies from this module in my studies*
3. *The feedback provided after each question was relevant and useful*
4. *The module was engaging and interesting*
5. *The module was easy to use*
6. *Are there any improvements to the module? (open ended)*
7. *What was the most interesting aspect of the module? (open ended)*

For the purposes of this paper, we will report on and discuss only data from the platform analytics and student perception survey.

Results

Table 3 shows a snapshot of the four instances of the module that received the most engagement. These were all embedded in Semester 1, 2018. In all instances the module was optional and not embedded into the curriculum, with little or no extrinsic motivation to engage or complete it.

Table 3: Engagement with the Ready to Study module

Module Instance	Attempted Module	Completed Module		Accessed Results		Completed Survey	
Academic Skills Hub	308	225	73.05 %	177	78.7 %	201	89.3 %
Organisational Behaviour	37	22	59.46 %	20	90.9 %	19	86.4 %

Management	33	14	42.42 %	14	100 %	14	100 %
Nursing Science	24	16	66.67 %	15	87.5 %	15	93.8 %
Total	**402**	**277**	**68.91 %**	**226**	**81.2 %**	**249**	**89.9 %**

The Academic Skills Hub is a self-enrolled community in the LMS with over 5000 students. Organisational Behaviour and Management are subjects with a more traditional student demographic (school leavers, first tertiary experience, first and second year), whereas Nursing Science is a graduate subject with a smaller cohort from a less traditional background. All cohorts consist of local and international students. At this stage of the study, it is unnecessary to further delineate the cohort.

Overall, a substantial number of students who explored the module went on to complete it (69%), and of those who did complete it, a large proportion also went on to access their personalised results (81%). Analysis of resource links also show that the personalised reports were downloaded 147 times (65% of students who accessed their results), and resources linked within those reports clicked on 438 times (almost three resources per student who downloaded the report).

The most common study skills profile was low in every skill category (Table 4), followed by high Research and Assessment. Only one student was judged to be 'high' in all three categories.

Table 4: Breakdown of student academic skills profiles

	LLL	**LHL**	**Others**	Total
Academic Skills Hub	138	29	10	177
Organisational Behaviour	17	3	0	20
Management	12	2	0	14
Nursing Science	8	6	1	15
Total	**175**	**40**	**11**	**226**

Findings

This section highlights insights from preliminary data analysis and discusses the broad potential of this approach.

Evidence of student needs

The activity design and Smart Sparrow platform tools enable easy analysis of the answer distribution for each question. In the example below, we can easily see how students apply scheduling strategies. From this specific example we can assume this cohort has a predisposition towards unstructured or responsive scheduling approaches, which indicates a need for more training, information or tools.

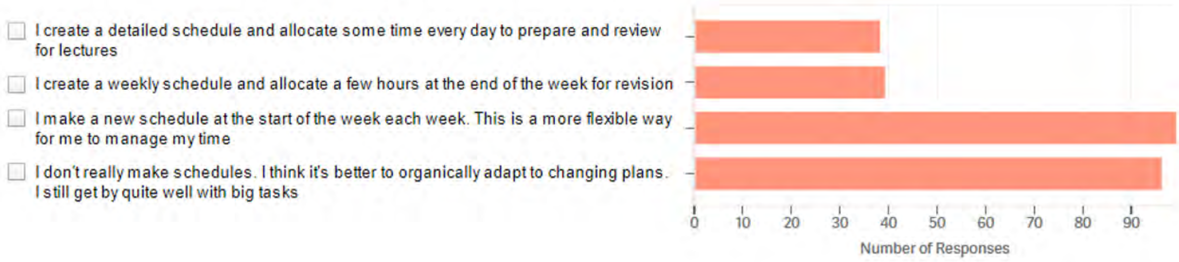

Figure 4: Instantly extract student perceptions of study skills and identify gaps

There are, however, some limitations. In order to further filter this data – for example, to see how many students from a specific faculty responded in a specific way – the data needs to be exported into another program (e.g. Microsoft Excel) for further manipulation. Furthermore, some complex interactive input tools (e.g. Drag and Drop) do not produce this detailed student input data, which creates a trade-off between using engaging input types and easy data analysis. It is still possible to identify how students interacted with these input types, but that requires manipulating the design.

Maximising opportunity for students to reflect on and self-regulate learning through personalisation

Table 5: Student perception: survey respondents who *Agreed* and *Strongly Agreed* (4 &5) with the statement *(vs Disagreed and Strongly Disagreed 1 & 2)*

Module Instance	*Liker t Score*	Academic Skills Hub	Organisationa l Behaviour	Management	Nursing Science	**Total**
n		201	19	14	15	**249**
Increased awareness of Strategies & Skills	*4 & 5*	55.20%	52.60%	42.90%	60%	**54.60%**
	1 & 2	2.5%	0%	0%	0%	**2.0%**
Can apply ideas and strategies in studies	*4 & 5*	52.24%	47.37%	42.86%	53.33%	**51.41%**
	1 & 2	1.99%	0%	0%	0%	**1.61%**
Feedback provided relevant and useful	*4 & 5*	53.20%	52.60%	35.70%	60%	**52.60%**
	1 & 2	3.98%	0%	0%	0%	**3.21%**
Module was Engaging	*4 & 5*	45.77%	36.84%	14.29%	40%	**42.97%**
	1 & 2	5.97%	0%	7.14%	06.67%	**5.62%**
Module was Easy to use	*4 & 5*	63.68%	63.16%	35.71%	53.33%	**61.45%**
	1 & 2	0.50%	0%	0%	0%	**0.40%**

As Table 5 indicates, overall, a majority of students agreed or strongly agreed that the module improved their awareness of skills and strategies and gave them confidence that they could apply them in their studies. This indicates that the module helped students reflect on knowledge or skills gaps and identify appropriate strategies for their needs. Importantly, the significant number of students who accessed the recommended resources indicates that they were able to identify areas for improvement and take action.

The open-ended comments also spoke to the impact of the module, with students identifying the feedback, timeline and strategies as especially valuable. The statements below are a selection of responses to "*what is most interesting about the module*":

- "The set up and organising the different strategies in phrases. On top of this the short sentences, instead of long paragraphs were extremely useful to understand specifically what the strategy is, and how it is most effective."
- "The use of a timeline of the semester gave me perspective on what to expect."
- "the immediate feedback given when an option is selected"

A very small number disagreed that the module had a positive impact (Table 5), with a sizeable number neither agreeing nor disagreeing (selected 3 on the 5-point scale), or not completing it (31%, from Table 3). One notable exception was the Management cohort, whose level of agreement was lower across all categories, especially in relation to how engaging they found it. Survey data provided limited explanation for this, indicating a need for further research.

Scalability and Sustainability

The Ready to Study module is easily scalable and relatively sustainable, as evidenced by the ease with which we were able to deploy it across seven instances (the Academic Skills hub and 6 subjects) and adapt it for a purely online cohort with relatively minimal effort. The Smart Sparrow platform allows for easy creation of instances (or "classes"), which enabled us to embed mirror versions of the module in different subjects. This allowed us to isolate student data, while retaining one point for updates and corrections. Embedding and accessing the module in the LMS as a LTI tool is also a smooth and uncomplicated process.

Moreover, we were able to easily modify this module in collaboration with colleagues from MSPACE (the Melbourne School of Professional and Continuing Education) to serve the needs of students enrolled in fully online degree programs offered at the University of Melbourne. This a unique cohort and substantially different from on campus full time undergraduate students, the main audience of the initial Ready to Study module. The modular design meant updates could be made in a few areas (such as the timeline, terminology and aesthetics), to personalise the student experience without having to redesign the entire module. Four activities were redeveloped and feedback and resources were updated without substantive changes to the module logic and framework. A new version – Ready to Study Online - was developed, tested and launched in under two months.

Key learnings, future directions and opportunities

Having implemented changes to the design of this module based on feedback, we launched the second iteration of the campus-based Ready to Study module and the new Ready to Study Online version in Semester 2, 2018. It is still too early to evaluate these iterations, but preliminary data show promising signs of engagement with the module and developmental resources.

Reflecting on findings to date highlights a number of opportunities, including:
- Adapting to cater for diverse needs of faculties and cohorts.
- Collaborating with other universities on the SmartSparrow network to deploy and evaluate effectiveness
- Differentiating impact by student background (international, years in formal education etc.).

Conclusions

Overall, preliminary findings indicate that the personalised, reflective approach embedded in the Ready to Study module was effective in helping both students and staff to measure current learning (knowledge and skills), as well as understand perceptions and behaviours and how these might impact the learning experience. The Smart Sparrow platform allowed us to gather useful information on student perceptions and behaviours, which have since been used to inform resource development in Academic Skills and adjust the module. Importantly, it also provided evidence that students were able to reflect on current behaviours, engage with feedback, recognise areas for development and take action to develop necessary skills. The technological affordance of this tool also made it both scalable and adaptable to different contexts.

Key limitations of this research will be addressed in future iterations. Recognising that the small sample size limits the generalisability of our findings, we hope to encourage greater engagement with this tool and embed it in more subjects. We also hope to use data gathered to help us improve the content (question design and feedback), thereby increasing completion rates and clickthrough to skills development resources. In order to better understand the impact of this tool on aligning institutional and student expectations and helping students prepare for the demands of university study, we plan to conduct a longitudinal study and hope to collaborate with other universities.

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The Momentum Program: digital badges for law students

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The Momentum Program is an extra-curricular model of digital badged based credentialing for law students studying at CQ University. In that program, students can choose to engage in online workshops and face challenges that earn credentials, recognising professional skills in both traditional and emerging 21st century lawyering. This paper is a reflection on the design process undertaken and the key insights derived from the first stages of creation and implementation.

Keywords: digital badges, micro-credentials, law clinical learning, curation, portfolios, open learning

Establishing the need for digital badges

With large numbers of law graduates competing for the same jobs, anything that can improve a student's CV and professional portfolio may give them the edge that they need. Employers are looking for graduates with evidence of practical skills, rather than the traditional academic results (Coleman and Johnson, 2016). While the imbalance between the number of law graduates and available jobs has been overstated in the Australian media (CALD, 2017) the job market is extremely competitive and legal careers are changing to require emerging 21st century non-traditional skills that are not necessarily part of the core law curriculum (Susskind, 2013).

Conventional approaches to enhancing student skills in law programs have involved hard-wiring skills modules into existing academic units, the creation of WIL (work integrated learning) subjects and the use of clinical programs, generally utilising volunteering opportunities at community legal centres. These approaches can be resource-intensive to administer and assess. Mandatory 'intra-curricular' approaches also become more difficult to administer for those students who are reluctant to engage or who do not perform well, a matter which can lead to reputational risk where situated learning involves outside parties and organisations.

Digital badges are a flexible format to allow educational programs to credential the learning that can sit alongside the curriculum (Ahn, Pelliconea and Butler, 2014). Badges also have a wider application than simply as tools for educational institutions, they can be created and mobilised by any organisation or individual. Badges are not limited by term dates or enrolments, students can complete them at their own pace and they can take up opportunities for authentic experiences as they occur, not at the university's convenience.

Crucially, badges can also provide a scaffolding for learning. If a *badging framework* (explored below) is well designed it can create a model whereby students can understand what types of extra-curricular and skills activities are expected of them and be guided toward what choices and alternatives are suggested. Many students who are first-in-family at tertiary education do not necessarily have the professional connections to get accurate information on what capabilities employers desire. Formal curriculum may not be in step with contemporary requirements, particularly where the content is determined by decades-old accreditation standards and where industry expectations change rapidly.

The digital badging technology

The open badging technology, gifted to the commons by *Mozilla*, provides a secure mechanism to certify skills and accomplishment. A digital badge is an electronic file that includes details of the issuer, the recipient, the criteria for achieving the badges and, optionally but also crucially, links to digital evidence of the accomplishment.

This technology is robust but in its infancy. The open badging code has been implemented though various badging services such as *Credly*, but there remains to be created a comprehensive badging management platform, especially one that allows badging frameworks to achieve their full potential. Some Learning Management Systems do implement badging but these suffer from the 'gated community' problems of all these systems. These are spaces in which outside parties such as employers and community groups are not able to participate easily. Data and credentials are not under the control of students, who risk losing everything once they graduate or the university changes policies and platforms. Mozilla open badges are the preferred format because, once issued, they remain in the control of the learner.

The CQ University Law Program uses *Credly* to issue badges while all the supporting materials and online workshops are contained in a Google Education Suite platform at cqulaw.net. At present the badges are only offered to current students but there has been interest from outside parties, such as community legal centres to use these badges to train their staff and volunteers. The MOOC-style supporting materials for the badges are published under a creative commons licence so they are free for others to use and adapt, with appropriate acknowledgement.

Badges are a useful vehicle for competency-based learning contexts where there is no requirement award a numerical grade, something which is easier with an extra-curricular or co-curricular model. Once a learner has been certified as competent, the attached digital evidence allows a viewer to judge the quality of the work for themselves. This reduces the need to place trust entirely on the issuer of the badge. Along with the more widespread use of professional portfolios, badging technologies indicate a change in the role of educational providers and the expectations of both learners and employers. Where once educators need to be trusted as credential gatekeepers, today they can work collaboratively with learners and employers to build the evidence-base of learner credentials.

The Momentum Program Model

The CQ University law program has made digital badges the foundation of its *Momentum Program* for engaged students. This is a voluntary and free program that allows students to engage in key challenges that lead to the award of badges as well as the creation of digital evidence for inclusion in their professional portfolios. Some of the challenges are linked to existing assessment tasks in units of study, but the higher-level challenges require the students to show initiative and commitment to extra-curricular learning.

The Momentum badges are grouped into themed clusters, arranged by level of difficulty. These badges increase in complexity where a student begins with a level one badge in a particular area and can eventually work through the levels to achieve a level five badge. The initial clusters of badges reflect a mixture of introductory material (Law Fundamentals), traditional clinical learning (Client Interviewing, Law Reform), 21st century lawyering skills (Law Concepts) and career skills (Career Navigator).

Once these initial badge sets have been fully trialled and evaluated there are many other capabilities that could be included in the Momentum Program. Badges on mooting, court visits, research apprenticeships, system design, risk assessment, change management, excel skills and digital coding skills have been considered. Some consideration needs to be given for using badges to promote ethical professional values and conduct (Millikan and Brydon, 2018). ‘Meta badges’ such as milestone badges may promote engagement through gamification, for example for reward achieving a goal number of badges in a particular category.

CQ University is, like all institutions, new to the concepts and practice of digital badging. A university development group has committed to creating a light-touch regulatory framework that manages risks without stifling innovation. The Australian tertiary education context is heavily regulated with substantial bureaucratic processes require to make changes in the formal, accredited learning context. Digital badges on the other hand are low-risk and provide an opportunity to be agile and innovative. They are like traditional ‘school certificates’, turbo-charged by the addition of digital evidence. The transparent and informal nature of digital credentialing makes it quite different to the development of formal degrees and qualifications, a process that can be opaque to outside scrutiny and ultimately incurs substantial costs for learners to achieve.

Developing the framework

Some of the research on digital badges indicates that a successful program should not just focus on individual badge design but also on the system of inter-relationships between the credentials; the *badging framework* (Beattie, 2016). This has particular impact on learner motivation, especially looking to a future where a learner may have accrued a significant number of badges. Gamification research suggests that in a successful system, learners should be able to see the relationship between badges that build on each other toward more ambitious challenges (Ostashewski and Reid, 2015; Beattie, 2016).

Each of the Momentum badge sets includes five badges, scaled from level one to level five. The first three core badges are supported by online learning modules and include:

- Level one: Observe. The learner observes a professional activity or a simulation/workshop on the topic and then writes a reflective blog post.
- Level two: Practise. The learner, with a group of peers, engages in a simulation activity and then posts a reflection along with any digital evidence created in the process.
- Level three: Apply. The learner applies the skill in a real situation under the supervision of a professional mentor. The mentor's feedback certifies the achievement and forms the foundation of a reflective post that explains what the student has learned.

There are also two higher level badges that recognise student initiative and leadership beyond the core. These are more free-form in definition and are not supported by online learning resources like the level one to three badges. They comprise of:

- Level four: Lead. The learner has been a leader in the learning of others, perhaps as part of a mentoring program.
- Level five: Innovate: The learner has created innovative new resources or systems that assist others learning in the field.

Digital badges work well in combination with digital portfolios. All CQU law students are provided with an online portfolio via *Google Education Suite* in their first term. They are encouraged to develop this throughout their studies through work experiences, volunteering and by achieving digital badges. They may submit their portfolio for assessment in a third-year elective unit. The foundation set of Momentum badges, 'Law Fundamentals' introduces students to badges, portfolios and career requirements. Completion of a basic online portfolio will earn a student the Levels 1 to 3 'Law Fundamentals' badges which can then be placed in the student's portfolio.

Initial Observations on the Momentum Program

The Momentum Program is still at early stages of implementation although the team has made some preliminary observations that have been iterated into future design strategies. These reflections were drawn from conversations with the law school staff, the development team and others in the university community.

Academics believe that graduates cannot rely on degrees alone. There is an ongoing need to guide students through the emerging evidence-based achievement context where employers will increasingly look to portfolios and digital evidence in addition to grades. Many students still remain disengaged, overcommitted and convinced that "P's make degrees" despite all evidence to the contrary. Digital badges may supply some incentive and motivation in addition to any inherent benefit extra-curriculars provide. Enthusiasm for badges, and extra-curriculars, does not always align to the highest academic achieving students. Passion for volunteering, active engagement and recognition of practical skills can occur throughout the student body.

Badging systems create new opportunities for student leadership and resource development. Badges are an ideal platform for mentoring and the design of the Momentum Program framework build this into the level four badges. Students with leadership badges might also be involved in the evaluation of lower level badge applications and even in the design and development of new badges.

There is an emerging internationally interest in competency-based learning (see Gibson, Coleman and Irving, 2016), although in Australia the term is often applied to vocational learning only. The ability to provide digital evidence of what the graduate can *do* rather than what they *know* creates potential for unbundled education delivery, recognition of new professional capabilities and some relief from the traditional and costly graded assessment process.

Digital credential developers also need maintain a focus on what his happening in the field of gamification, (Metzer et al, 2016) especially in the design of entertainment games from which the concept of badging emerged (McDaniel, 2016). As the age profile for gamers changes, there is increasing certainty that new students, as well as academics and employers, will be familiar with these systems as a matter of course and will understand and embrace the role of learning badges. Language around 'challenges' could be used rather than conventional concepts of learning tasks or assessment.

Stakeholder Observations

CQ University law program maintains close ties with the Central Queensland Community Legal Centre and students have the opportunity to volunteer their time with that practice. Because the CQ University law program is entirely online, there is a mixture of face-to-face and online volunteers. One of the advantages that the Momentum badges provide for this relationship is the ability to recognize volunteering in a more structured and robust manner.

Discussions with the Central Queensland Community Legal Centre have provided useful feedback on badge design and created new opportunities for collaboration. The Centre is acutely aware of the difficulties of providing quality clinical experiences for sufficient numbers of students. In addition, the legal professional environment has changed in ways that make old methods of student placement more difficult, or less likely to be valuable to learners.

In rural and regional areas law firms are traditionally much smaller than in the city, often run by one or two partners who can find it difficult to find the time to take on the supervision and mentoring of a law student. Even where a sole practitioner firm will agree to taking on a student, the student is often left undertaking menial tasks. In any event, the range of these administrative tasks which are associated with the operation of any law firm is in decline. Correspondence is mainly handled by email directly from the solicitor's desk so traditional tasks associated with producing and forwarding correspondence no longer happen. Filing of documents occurs electronically in the same way.

Likewise, with the introduction of online and digital conveyancing the tasks associated with both the titles office registry and the stamps office are all done online as are most of the searches associated with property work. Many traditional areas of ‘local firm’ practice have been removed by statutory schemes (traffic accidents and worker’s compensation) or taken over by other professionals who do not have to hold legal qualification (conveyancing businesses and the ‘do it yourself’ will).

So far as opportunities to be involved in client interactions is concerned, meeting with and taking instructions from clients face-to-face at the office is also in decline. This is particularly the case in the commercial area. Most business clients prefer to provide their instructions by email. This restricts the opportunities for students to see client interviews which are now predominately in the areas of family law and criminal law. While these experiences may be valuable, they are increasingly rare and internships are in high demand. Providing access to practical experience for any sufficiently large number of students is challenging.

One of the traditional areas of opportunity has been volunteering at a community legal centre. There is now also fierce competition for these spots with some Universities partially funding pro bono operations or even providing a legal staff member or meeting salary costs for existing legal staff member to guarantee places for their students.

The issue of time is also a relevant factor. Universities often unilaterally go to the marketplace to locate placement opportunities for students across a broad geographical area only to find that students are not willing or able to take up the opportunities at times suggested by the law firms. Real world practices do not, of course, confine their activities to the university calendar. There is a real need for the student to be involved in the negotiations for this reason firstly to demonstrate commitment and then to negotiate a particular timeframe for the clinical placement.

At a much more general level many students struggle to make the initial approach to a law firm particular where they have no pre-existing contacts in the legal profession either through family and friends or through previous business dealings. It can be a daunting task to make that initial approach without the backing of the University. From the University's perspective, without the framework of a program (such as the Momentum program) it is impossible to make a specific and detailed approach to a law firm which is likely to seek particulars of the commitment before agreeing to take on a student. From this perspective, the array of digital badges on offer can provide a ‘menu’ of skills and challenges that an employer may call on when arranging a clinical experience. Digital badges could potentially expand the reach of clinical education in two ways. The very traditional approach has students undertaking “work experience” with a legal firm observing the practice at a fairly superficial level an undertaking whatever tasks the solicitors feel comfortable delegating to the student. The badging program allows students and employers to control the specific direction that their practical experience will take. In the context of working at the Community Legal Centre, students are motivated towards undertaking more collocated tasks such as research and drafting to assist volunteer solicitors to provide a service to clients.

Secondly, the badging program allows the student to negotiate with a broad range of agencies for experience outside of the traditional local law firm. As a recent example, CQU law students negotiated placements with the Queensland Department of Justice in their "Justice Journeys Program". These placements took students to a diverse range of areas including the Murri Court in Brisbane and a prison visit in the company of community corrections staff.

Likewise, there are always opportunities to make contact with members of the local District Law Associations with a view to introducing students who can then be involved with DLA continuing legal education events. These often lead to invitations to attend Court as observers where the solicitor is involved in a court matter. Badges provide a learning framework which Barristers and Lawyers can easily understand. Like the paradigmatic Scouting Handbook (sometimes unjustly derided by educators) a badging scheme can comprehensively define the scope of clinical learning, clearly define and illustrate choices and provide a touchstone for the relationship between student and professional. This provides more practical guidance for learning experiences than the often opaque university language of learning outcomes and assessment.

The digital badging approach has the added benefit of providing a specific challenge to be completed rather than the more traditional work experience approach that was more ad hoc. Legal practitioners can set aside a very specific time to assist the student to complete the task. For example, without being interrupted in their other work it is possible to schedule an appointment or a court appearance with some certainty. Other very non-traditional opportunities such as the “Hackcess to Justice” hackathon competition run by the Legal Forecast group (http://communitylegalqld.org.au/node/2508) not only provides immediate experience which can translate into a badge but can lead to further experiences in the area of law reform.

One of the downsides of the digital badging approach is a requirement for the University to be more flexible about the opportunities which students are sourcing. This will require a mature approach to work integrated learning in the face of concerns regarding increased risk in placements and internships generally. There are certainly reputational and financial risks involved if a placement does not go well. Many of the risks are covered by insurance but only if the placement meets the usual standard for a vocational placement. This issue is not confined to digital badges alone, but it does mean that even informal micro-credentials need to operate in an increasingly regulated practical work learning environment.

Most universities are comfortable with vocational placements which meet the definition in the *Fair Work Act 2009,* which essentially defines them as unpaid employment undertaken as a requirement of an educational training course provided by a recognised training provider. Experiences which may earn a Badge will not always fall neatly within the definition. Universities will need to determine whether it is willing to embrace these types of clinical experience. If it does, policy will need to keep pace and the University may also need to open discussions with its insurer around an expansion of the existing coverage for students.

The benefits of badges may extend beyond what the student has learned and include the enhanced networking opportunities that may result from situated learning. Even more modest learning connections may also lead to more comprehensive experiences once external parties become familiar with the students. A recent example at the CQ Community Legal Centre has been the progression of two students through the experiences of evening clinic observers and volunteers through to regular volunteering at the Centre which in turn led to an offer of a paid cadetship. Students who were involved in the ‘Hackcess to Justice’ competition were competing for a one-month cadetship with the Justice Department in Queensland. In both of these cases the host agency was willing to continue the mentoring of students at their own cost. Digital badges may provide the first point of connection that can be developed into a relationship that is more mutually beneficial.

Badging allows the opportunity to act on feedback from practitioners and other agencies likely to employ graduates. Being in a position to understand what skills and attributes they would like to see developed in potential employees informs decisions about what type of badges to promote. This results in an innovation cycle much shorter than that of formal curriculum development. Digital badges also provide new opportunities to reduce costs by sharing opportunities for practical learning and collaborating on the development costs of badges and supporting learning materials – with other universities and with a broader range of stakeholders and organisations.

Reflections on the Momentum Design Process

It is presently an exciting time for innovation in digital badging as new ideas emerge and creative energies have yet to be regulated into policies and standardised models. The strength of digital badging is in its capacity to curate digital evidence of learner accomplishments, something that may face resistance from the conventional approaches to credentials and governance. This resistance comes from a mixture of legitimate concerns about risk as well as a reflexive adherence to older educational business models. The emergence of evidence-based educational practices may mean re-orientation of conventional learning design so that assessment embraces the production of credible artefacts that can be made visible to employers.

This badging innovation also comes at a time where there is increasing pressure for personalised learning opportunities, for more flexibility in course delivery and a greater consciousness of practical learning opportunities in work and volunteering contexts. Emerging academic conversations discuss the design principles of digital badging frameworks (for example, Ifenthaler et al, 2016) and the present evolving conversation is crucial.

The Momentum Program is, in 2018, being run on a trial basis with the CQU Law students. All of the badges and supporting learning modules were peer reviewed before being released to the students and the design team are monitoring student activity. A comprehensive review will be undertaken in 2019, involving the student participants, to determine the future of the program. The following are some preliminary observations made by the authors during the early design and implementation of the Momentum program.

Design for the future. Badging systems ought to be flexible enough to evolve over time, yet you should have a framework in mind to begin the building process. We adopted a consistent level-based approach to badge design which allowed us to develop an ecology of badges that made sense in relation to one another, rather than as an unrelated clutter of learning experiences.

Build student capacity to curate. Students need to be supported in understanding how to access the credential system and how to make the most of their badges. They need to be able to create a professional portfolio in a system that they can own, even after graduation (such as the Sites tool in *Google Education Suite*). They need to understand the curation process, known how to reflect on their learning, be able to develop an online footprint via blogging and professional use of social media.

Design with detail. While some flexibility is important, the badge challenges should be specific, well defined and oriented toward a particular professional capability. Some universities are using generic graduate attributes as a lens through which to create badges. This choice is, in our experience, is the opposite approach to what is effective.

Focus on evidence. Rather than start with the abstract capacity or outcome that you have in mind, think about what sort of evidence could be attached to the badge. Design challenges that will produce a video, a document, a reflective blog post and then work backwards to figure out how you will support the learner in creating this.

Create great supporting materials. Your badges are only as good as your supporting materials that need to be useful and approachable. These materials do not have to fit the 'academic' genre and should be oriented towards achieving the challenge itself. Ideally, they should be available on an open platform so that students can have continue to access throughout their career if they need to return to them. These materials can also be shared with others outside the university which makes them useful promotional materials. You may or may not be able to get specific university financial support for the design of these materials, but creation might be integrated into the workload of normal coursework development. Authors of these materials should be acknowledged in order to raise their profile alongside that of the institution. The Momentum materials were published under a creative commons license to facilitate sharing and development.

Make a space for innovation. Design a badging framework that creates as little friction as possible with university practices and quality assurance. Use the framework as a way of guiding extra-curricular activities, volunteering and other matters that are not otherwise represented in the curriculum. Parallel development is within the curriculum can be useful (for example some formal assessment tasks may earn a badge) but do not try to force students to earn badges or do anything that means the badges intrude on accredited coursework.

Create your own quality process. While a central administration may resist innovation, this does not mean that badges ought to be on the lawless frontier. A badging system should be located within its own governance structures, committees and standards. This can be light-touch but ought to involve representation of stakeholders with reporting to the executive of the academic unit.

Involve the students and the community. This is an ideal situation in which to address some of the demands and challenges to traditional education that are presented by students, employers and others. Some practical skills that are difficult to assess with a numerical grade are better suited for badges. Design with stakeholders' involvement and be transparent that the system as a work in progress, subject to review and iteration. This may involve a change in attitude for many educational institutions, toward facilitation of learning experiences (wherever located) rather than as a centralized vendor of knowledge capital.

Be aware of incentives. Stay in touch with what motivates learners and build around that. Enhancement of employability is a key incentive for motivated learners. Some learners are motivated by a focussed framework to help them understand and structure extra-curricular activities. Emerging research on gamification will also show how collectability and completionism can also provide a complementary drive.

Conclusion

Twenty first century professional practice is changing rapidly and educational institutions need to consider different parallel modes of learning. Digital badging provides an excellent informal platform to develop capabilities and evidence extra-curricular learning. It is a new technology and innovation requires the creation of a space in which to innovate and experiment. Through the sharing of practice, educators will be able to collectively benefit from the experiments, innovations and even failure of others.

In the near future, digital badges are likely to be regulated, codified, standardized and scrutinized by university quality processes and policies. At present there is a space for innovation and development, which must pay close attention to self-regulation practices and risk assessment. The field of extra-curricular activities largely escapes regulation as it sits outside the formal accreditation practices of a learning institution, unless student placement in external organisations is required. Digital badge designers need to be aware of the shifting educational context and the regulatory demands placed even on extra-curricular activities.

By gifting the open badge format to the commons, *Mozilla* has set the standard for new collaborations based on sharing. While formal degree credentials remain the marketable property of individual universities, digital badges can exist in a more open domain because of their informality. The text, framework design and learning materials of the Momentum program have been published under a Creative Commons license in order to foster sharing, subject to attribution and the creation of derivative materials under a 'sharealike' license that enables further sharing. Digital badges may be more than a new way to recognize informal and extracurricular learning. Along with MOOCs, this new educational technology provides new opportunities for open learning and global collaboration that will ultimately be in the best interest of all learners.

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Using continuous assessment with feedback loops to generate useful data for learning analytics

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The combination of feedback loops and continuous assessment through learning management systems can enhance student learning and produce data to illustrate it, to both students and educators. This paper presents learning designs, examples and data, representing this combination, in which students receive feedback from different sources and are given the opportunity to apply the feedback to improve their performance, hereby closing a feedback loop. The examples and data, presented in this paper, come from higher education in Denmark where assessment since 2016 has been in a transition phase from single end-of-semester exams to continuous assessment. Data in this transition phase is extremely helpful in documenting the effect of the learning design and in informing the teaching and learning process, for example in demonstrating how students use feedback to increase their scores and in allowing educators to identify students at risk of failing or dropping out. The generic learning design will be used as inspiration for educators to ensure that student learning is supported by both continuous assessment and feedback loops. In addition, the design will be developed further to strengthen the focus on the development of students' evaluative judgement.

Keywords: Continuous assessment, feedback loops, learning analytics, learning design, higher education

Introduction

Assessment and feedback are two of the strongest drivers for student motivation, engagement and learning (Boud & Falchikov, 2007; Hattie, 2009). From a research and development point of view, the bond between the two has been strengthened as the focus has shifted from assessment *of* learning, through assessment *for* learning towards assessment *as* learning (Brown, 2005; Weurlander, Söderberg, Scheja, Hult & Wernerson, 2012; Earl, 2013). Assessment is not merely an adjunct to teaching and learning, but is in itself a learning process, accentuating the importance of the inherent feedback in the assessment procedures (Dochy, Segers, Gijbels & Struyven, 2007; Carless, 2015).

Research suggests that assessment and feedback can be particularly effective, when (a) assessment occurs in the form of low-stake graded tasks distributed throughout the teaching period, here referred to as continuous assessment (Bassey, 1971; Heywood, 2000), and (b) students are actively acting upon the received feedback to improve their performance and thereby closing a feedback loop (Boud & Molloy, 2013; Carless & Boud, 2018). The combination of continuous assessment with feedback loops has the potential to enhance both students' engagement and their capability to make decisions about the quality of work of self and others, and by so developing students' evaluative judgement (Tai, Ajjawi, Boud, Dawson & Panadero, 2017) and supporting a deep learning approach (e.g., Heikkiläa & Lonkab, 2006).

One way to support educators in efficiently adding continuous assessment and feedback loops into their courses is to utilise technology and its ability to collect, monitor and analyse student data. Data, in this case, is the result of students engaging in feedback and online assessment activities in a Learning Management System (LMS), producing digital traces in great amounts. These traces can be analysed through learning analytics to provide information on how students learn during feedback loops and assessment. Resubmission of assessment tasks will provide valuable information about how the students utilise the feedback obtained (Boud & Molloy, 2013). Regardless of the great potential, however, translating data into substantial improvements in learner and educator experience has proven difficult (e.g., Ellis, 2013; Pardo, 2017) with researchers emphasizing the need for more empirical research evidence.

In 2016 continuous assessment officially became a possible form of examination in higher education in Denmark due to its potential impact on the quality of learning. Universities in Denmark are therefore presently in the transition phase from assessment *of* learning to assessment *as* learning. This paper will illustrate the first pilots introducing continuous assessment with three different types of feedback loops. The feedback loops are supported by technology and are ranging from simple automated feedback, through feedback from teaching assistants with rubrics and to peer feedback with self-selection. In addition, this paper gives suggestions for the analysis of the produced digital data and how it can inform students and educators about learning and points of action. These suggestions follow the mantra: Activity - Assessment - Analytics - Action. The paper gives specific examples of designs, tasks and data from such activities from four first and second-year undergraduate courses (units) and one Ph.D. course at Faculty of Science and Technology at Aarhus University in Denmark, each with 40-120 students in the fall of 2016 or 2017.

The design: Continuous assessment and feedback loops

Our generic design of tasks which combine continuous assessment and feedback loops is shown in Figure 1. The design is inspired by Learning Design Tool (LDTool) from University of Wollongong - see e.g. (Bennett, Agostinho, Lockyer, Kosta, Jones, Koper & Harper, 2007; Agostinho, 2011). In the model, students first meet a description of an assessment task, set by the educator, including feedback and assessment criteria. Hereafter they make a first draft/attempt to which they receive both formative feedback and a formative score. The students then complete the feedback loop by making a revised draft/attempt. In most cases this becomes the final submission, however, the number of loops can vary. The students finally receive a summative grade or a score for the final submission but no feedback. Note that tasks are set by the educator but when students engage in these tasks, we refer to them as activities.

There are several possibilities for adjustments in the design; the type of task, the source of feedback, the type of feedback and the number of iterations. The data collected in assessment tasks can be averaged, compared, combined and reported to provide a foundation for learning analytics, e.g. student scores, visualisation of "at risk" students, learning outcomes etc. But the learning analytics is only valuable when students or educators act on it. In the following section we present three examples of activities with different sources of feedback and different cycles of feedback.

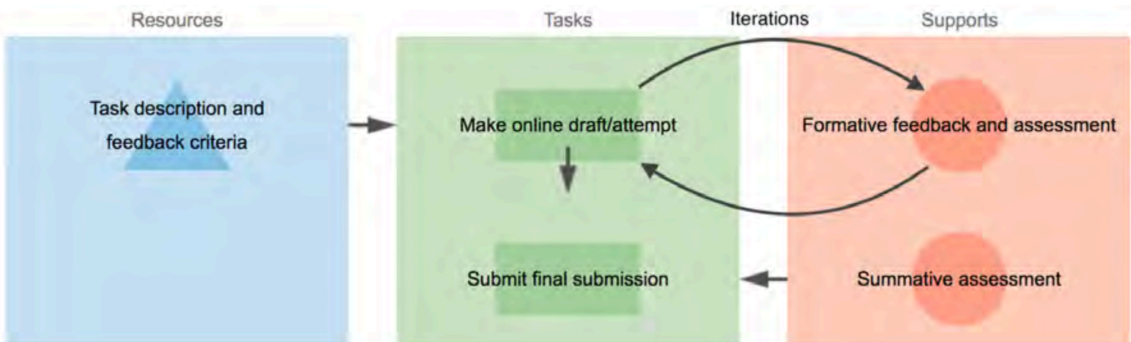

Figure 1: Generic design combining feedback loop(s) with continuous assessment. The design is represented in an alternated version of LDTool. The focus is the learning tasks developed by the educator. These tasks determine student activities.

Examples

In this section, we present short examples of tasks that were designed with analytics in mind. All four undergraduate courses used slightly different variations of multiple-choice tests with feedback loops, one course used assignments with resubmission. The last example is developed in a course for Ph.D. students and will in the future be deployed in one or more of the undergraduate courses.

Continuous assessment with automated feedback loops

Purpose: To practise scientific terms and concepts and to ensure that all students are at approximately the same academic level.

Context: Four first and second-year undergraduate course in relativity and astrophysics, nanoscience, molecular biology and ecology. This type of continuous assessment contributed 5-100% of the final grade.

- Activity: Online tests where students have the possibility to improve their performance through feedback loops (Figure 2). The students are here encouraged to practise and to improve their performance by engaging with the test until they are satisfied with their own result or to engage in voluntary homework (with multiple iterations) before performing the test.
- Assessment: Students receive both formative feedback and a score. The formative feedback guides the students towards the correct answer but does not provide the correct answer (indirect corrective feedback). Feedback is authored by the educator or publisher of the textbook but is provided automatically through the LMS.
- Analytics: The data collected during the assessment and feedback is scores, number of questions answered, difficulty, time on task. The data is averaged and combined and, subsequently, reported to the educator (for further details read the section: Analytics).
- Action: Students can engage with the test until they are satisfied with the result. Educators can follow the performance of individual students compared to the class average and may be able identify students at risk of dropping out or failing the course. Educators can contact students at risk (for further details read the section: Discussion).

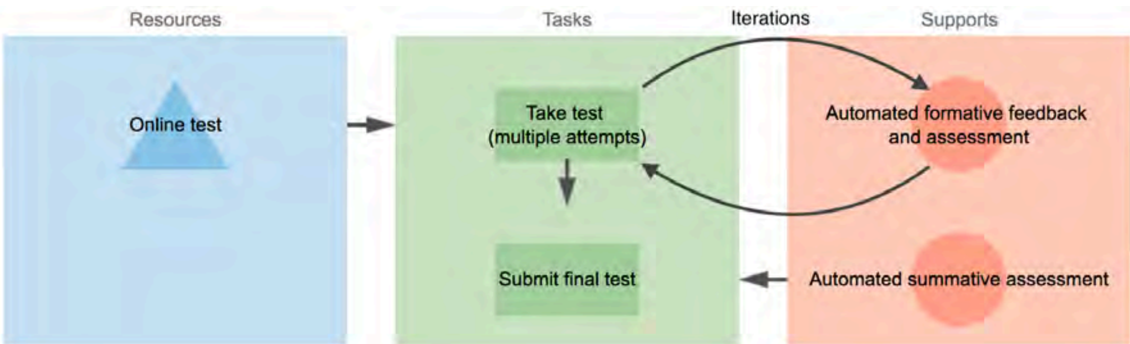

Figure 2: Continuous assessment with automated feedback loops.

Continuous assessment with formative feedback loop through rubrics

Purpose: To practise using correct terminology, academic writing and problem solving, incl. calculations.
Context: First-year undergraduate course in relativity and astrophysics. This part of the continuous assessment contributed 12% of the final grade.

- Activity: Online assignments with the possibility for resubmission after the first grading and feedback (Figure 3).
- Assessment: Teaching assistants give feedback and a score, using a rubric of predefined assessment criteria that students have co-developed at an earlier stage in the course. Based on the feedback and score, students improve their assignment and submit a revised version. This revised version only receives a score.

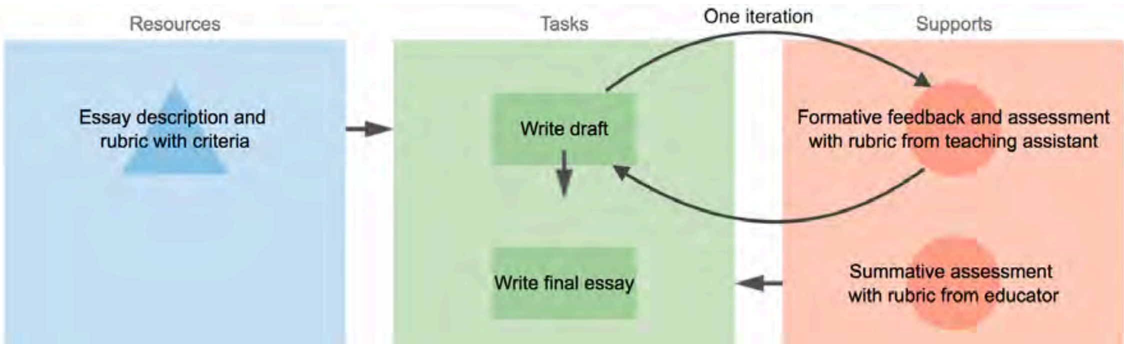

Figure 3: Continuous assessment with formative feedback loops through rubrics.

- Analytics: Students receive an initial score and a final score. These scores contribute to the final grade. After the grading is completed, students as well as educators can see the gain for themselves or for the entire cohort of students.
- Action: Students can use the initial score (and feedback) to improve their performance and the final score to see their learning progress. The educators can directly measure the effect of feedback and keep track on students' learning process.

Continuous assessment with double feedback loop

Purpose: To develop project ideas through feed-forward and to improve, be inspired and share the final project with peers with similar projects.
Context: Ph.D. course in Science Teaching for students acting as teaching assistants.

- Activities: Students initially describe an intended (teaching) experiment and receive feed-forward from educators (first feedback loop). The students hereafter perform the (teaching) experiment and report in a poster format. Student receive peer feedback on the draft poster (second feedback loop). A final version of the poster is submitted after revision, based on the received feedback (Figure 4).
- Assessment: In the first feedback loop the intended experiment (project idea) has to be approved by the educator before the students can proceed. In the second feedback loop the students provide formative peer feedback on minimum two draft posters, one assigned to them and one or more with free selection, where the student read peer posters and decide which poster(s) they prefer to review. The peer review is double-blinded. The feedback is based on criteria which the students applied on poster exemplars earlier in the course. The final poster has to be approved by the educators.
- Analytics: As scores or grades are not assigned in PhD courses these are not available. The data available is student responses to a peer feedback questionnaire.
- Action: The educator can adjust the peer feedback process to accommodate students' perception of the peer feedback process.

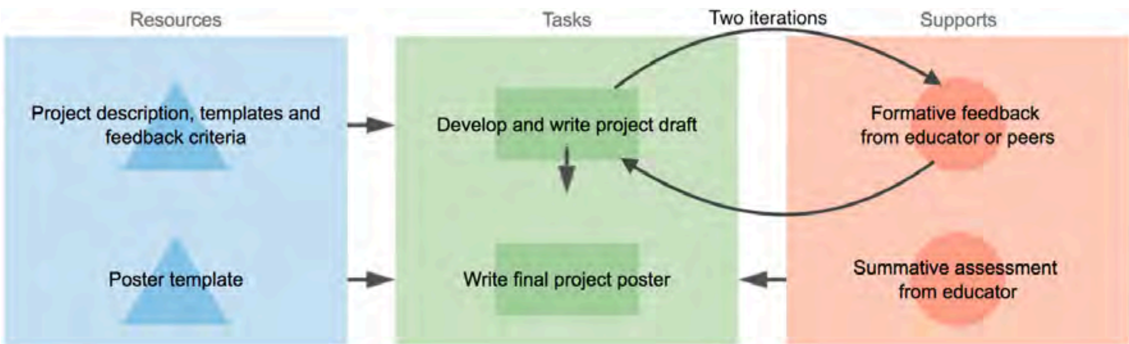

Figure 4: Continuous assessment with double feedback loops.

Analytics

In this section of the paper we present three examples of data, generated through a subset of the continuous assessment activities, described above. We defer a discussion of the data to the section below. All data presented here is generated through Learning Management Systems in undergraduate courses at Aarhus University in Denmark and for the Ph.D. course through a tailored peer feedback system.

Analytics with automated feedback loops

Figure 5 shows data from a first-year course using nine multiple choice tests as part of the continuous assessment. Each test contained seven questions, giving one point each. Feedback loops were introduced into the test such that students received automated feedback on the test after which they were allowed to retake the test, as many times as they wanted. Only the last attempt would count towards the final grade, each test weighing 0.7% of the final grade. Data shows that students, on average, used between 2 and 4 submissions, that average scores on first attempts varied between 3.4 and 5.7, and that practically all students obtained a final score of 7 (note the smaller error bars compared to the error bars on the first attempt). Question types were not only multiple choice but also included matching questions, ordering questions, questions with multiple correct answers, etc. The difference in number of attempts and correct answers in the first attempt can most likely be ascribed to this variation in question type and that the level of difficulty varied over the nine tests.

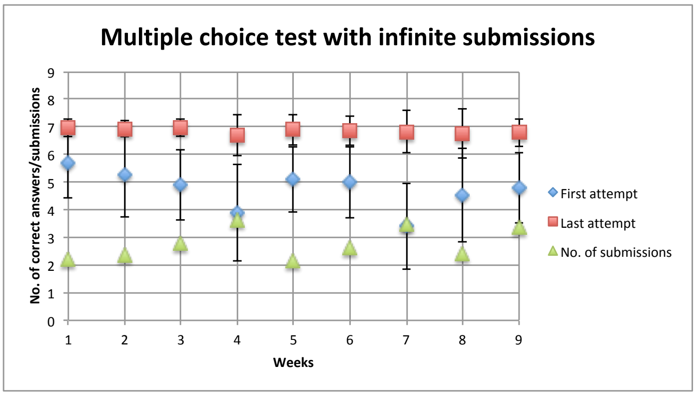

Figure 5: Analytics from continuous assessment with automated feedback loops in relativity and astrophysics. Number of correct answers to nine multiple choice tests with infinite submissions. Blue diamonds: Number of correct answers in the first submission. Red squares: Number of correct answers in the last submission. Green triangles: Number of submissions. Error bars on first and last attempts are one sigma error bars. Error bars on the number of submissions have been left out for aesthetic reasons.

In the course ecology students had multiple attempts when performing the voluntary homework, but only one attempt for the two tests each counting 15% of the final score. The analytics illustrated in figure 6 is reporting on student performance and engagement to the educator. For each homework/test the maximum assigned points is reported together with the class average score for all students. The individual performance for each student is indicated with the actual score for each test, the proportion of the questions answered, and whether the students are at risk of failing this part of the course. No correlation was found between the homework scores and the test scores or between the number of homework assignments completed and the test scores.

Test name	Homework A	Homework B	Test C	Homework D
Assigned Points	15.00	17.00	18.00	19.00
Class Average	11.0	12.9	12.0	11.2
Student 1	14.7	15.5	12.7	19.0
Student 2	8.3	0.0	12.7	0.0
Student 3	13.2	14.9	11.0	18.0
Student 4	13.7	13.9	12.7	18.8
Student 5	6.4	0.0	7.2	8.9

Figure 6: Example of analytics provided by a publisher showing continuous assessment with automated feedback loops from ecology (similar in nanoscience and molecular biology). Maximum assigned points and class average are shown together with individual performances for each student. Analytics for each student are: score for each homework/test; the proportion of the questions answered (rectangle ranging from white to blue; white indicates questions not answered, blue the questions answered) and risk level (increased intensity of the red colour indicate increased risk level).

Analytics from formative feedback loops through rubrics:

Table 1 shows results from a first-year course using four assignments with resubmission. These assignments tested academic writing skills, use of technical terms, problem solving and scientific argumentation. Feedback loops were introduced such that students received scores and feedback on their first submission, using a rubric. Subsequently they were allowed to resubmit, taking the feedback into account to improve their performance. Each test had a maximum score of 30 points and each counted 3% of the final grade. Table 1 shows the gain, going from submission to resubmission. The gain is calculated such that a student who obtained 24 points in the first round (initial score) and 27 points in the last round (final score) obtained a gain of 50% - or half the improvement that the student could have obtained. The calculation is

$$\textbf{\textit{Gain}} = \frac{\textbf{\textit{final score – initial score}}}{\textbf{\textit{30 points – initial score}}}$$

Table 1 is divided into students obtaining between 0-14 points as initial score, 15-20 points, etc. This selection was decided to track the progression between assignments. Note that a few students obtained a maximum of 30 points as initial score in each of the four assignments and, hence, were not able to improve their score. Some students chose not to hand in their assignment more than once and did thus not record any improvement. These students (9, 12, 12, 21 in assignment 1-4) performed below the class average and are not represented in Table 1.

Table 1: Analytics from formative feedback loops through rubrics in relativity and astrophysics. Shown vertically are the four assignments and horizontally is a division of students in terms of their initial score. Shown in percentages are the gains from submission to resubmission. In parentheses are the number of students in each point interval (shown in the top row), 30 points are max. Because of large standard deviations, none of the quoted numbers are statistically significantly different.

	0-14 points	15-19 points	20-24 points	25-29 points	30 points
Assignment 1	67,7% (39)	72,2% (19)	87,6% (15)	84,7% (11)	N/A (3)
Assignment 2	62,6% (11)	65,4% (22)	75,4% (34)	83,1% (17)	N/A (1)
Assignment 3	57,1% (12)	67,9% (13)	81,7% (28)	90,3% (22)	N/A (8)
Assignment 4	81,1% (7)	65,8% (12)	72,5% (33)	76,8% (14)	N/A (6)

An analysis of final grades vs. obtained gains led to no conclusions or statistically significant correlations of interest, apart from a remarkable number of students obtaining very high final grades (feedback loops may have had a role in this), only seven students failing the course and nine students dropping out during the course. Due to the low statistical value of this data, it is not presented.

Analytics from double feedback loop:

Assessment data is not collected for the tasks performed in the double feedback loop. The data collected here is from a questionnaire related to the peer feedback process (Papadopoulos, Bjælde, Lindberg & Obwegeser, 2018). Papadopoulos et al. find that students with a preference for the double-blinded peer feedback process are more engaged in the activity by reading significantly more peer posters and that they appreciate both receiving and providing feedback from and to peers. In addition, all students indicate that reading other students' poster was more helpful than receiving comments from peers.

Discussion and conclusion

The reason for developing the presented learning design has been motivated by current trends and issues within higher education in Denmark. These include a) a stronger focus on formative feedback to boost students' motivation and to strengthen dialogue between students and educators, b) a more competent use of digital tools in higher education - including a better knowledge base of the value that technology can add such as assessment and feedback analytics, c) better opportunities for continuous assessment, and d) higher retention rates (Uddannelses- og forskningsministeriet, 2018a). Based on these reasons, we divide the discussion of the presented examples and data into three categories: Improving retention rates, making student learning and progression visible to students and educators, and further development of continuous assessment with feedback loops.

Higher retention rates

The currency within higher education in Denmark is students. The more students, universities are able to lead through courses with passing grades, the more money they receive from governmental bodies. However, universities are not willing to lower the academic standards. This leaves two options; support learning sufficiently to help students pass exams or identify students in the risk of failing or dropping out and help them. Research on continuous assessment has demonstrated its potential to boost students' motivation to work continuously during a course rather than emphasising last-minute cramming before a final exam (Trotter, 2006;

Gibbs and Lucas, 1997), strengthen the effectiveness of (formative) feedback, including the possibility to act on feedback (Bearman, Dawson, Boud, Hall, Bennett, Molloy & Joughin, 2014; Richardson, 2015; Bjælde, Jørgensen & Lindberg, 2017), assess a wider range of skills than a traditional exam (Glofcheski, 2017), and to reduce exam anxiety (Falchikov and Boud, 2007; Shields, 2015). For these reasons and because of the possibility for giving frequent formative feedback and assessment, continuous assessment is suggested as an early intervention to strengthen the self-efficacy in first year students (Tinto, 2017). All in all, continuous assessment focus assessment into a more learning-oriented direction and should have potential to improve retention rates. Several studies have also reported on students performing well in continuous assessment activities (Bridges, Cooper, Evanson, Haines, Jenkins, Scurry, Woolf & Yorke, 2002; Simonite, 2003; Bjælde, Jørgensen & Lindberg, 2017), since students are more in control of the effort they invest in low-stake online assessment activities, compared to a traditional high-stake final exam. The examples provided in this paper follow this trend. Moreover, relatively unlimited time available for performing tasks, the possibility for collaborative work and the application of feedback through feedback loops in continuous assessment should also reduce the number of students failing our courses. This is exemplified by only seven students failing the first-year course using assignments with resubmission. Note in addition, that the number of students obtaining high grades in the same course was remarkable (Bjælde, Jørgensen & Lindberg, 2017).

The use of continuous assessment offers an effective way of identifying struggling students. Students who fail to answer or engage with automated feedback loops can be students in danger of dropping out. In two of the first-year courses mentioned (nanoscience and molecular biology) in this paper, the educators contact students who obtain below a (low) threshold score. Because the multiple-choice tests focus on learning fundamental technical concepts, students who perform poorly in these tests will struggle when these concepts become part of an expected knowledge base that can be built on. In one of the two courses, only two students out of 79 dropped out of the course, and the educator ascribes this primarily to be a result of the action to contact struggling students (personal communication with prof. Erik Østergaard). In addition, students with disabilities e.g. dyslexia can be spotted early and be supported.

Making student learning and progression visible to students and educators

Feedback loops provide opportunities for students to engage in dialogue and to act on feedback, thus avoiding a common pitfall coined “feedback as telling” with students as passive receivers (Tai et al., 2017, Carless & Boud, 2018). Often students are told of their strengths and weaknesses, but seldom get a chance to transfer this information into actual improvements of a specific deliverable. Or as put in (Sadler, 2015): “learners do not always learn much purely from being told, even when they are told repeatedly in the kindest possible way”. The absence of opportunities for dialogue and application of feedback are likely among the causes for why many students in the UK, in Australia and in Denmark are dissatisfied with both quality and quantity of feedback (Hounsell, 2007; Mulliner & Tucker, 2017; Carless & Boud, 2018; Uddannelses- og Forskningsministeriet, 2018b). The feedback loop examples provided here encourage students to engage with the feedback and to be an active participant in the feedback loop.

A multiple-choice test with infinite submissions and automated feedback is perhaps the simplest version of a feedback loop. However, as demonstrated in the previous section, students who engage in such an activity do what it takes to reach the maximal score, thus fulfilling the aim of the activity; to ensure all students grasp fundamental terms and concepts. The students are not forced to take the tests several times but actively choose to do so. The data presented from the course relativity and astrophysics showed that students used, on average, between 2-4 submissions to obtain a maximal score on all seven questions. Since each question had an average of four possible answers, this leads to the conclusion that none or only few students are randomly guessing. It may well be that they discuss and help each other in a group, however, learning does not have to be an individual activity. The fact that number of submissions and number of correct answers in the first attempt is more or less unchanged throughout the semester, furthermore suggests that students do not resort to randomly guessing once they become familiar with the type of activity. Multiple-choice tests with infinite submissions thus change the assessment focus from student performance to student learning as the majority of students are motivated to practise until they receive a “perfect score”. Allowing for multiple submissions of automated tests increase the learning without requiring additional resources from the educator.

In terms of assignments with resubmission, Table 1 show that, in this example, all students, who actively chose to resubmit, learned from feedback in a rubric and were able to improve their score. This learning is visible for both students and for the educator. Two quotes from the student evaluation of the course support this: “I really like that you can resubmit, because the focus is more on the learning process than a result.” and “Totally nice that you can resubmit so you don’t get stressed out and you learn much more.” There is a trend that students who made a good first submission were almost able to perfect their submission, after feedback. But, also students who obtained a low score in the first submission obtained an impressive gain, on average, after feedback. The improvements because of feedback will, of course, depend on the type of feedback given. In this case, feedback was given in a rubric with predefined criteria, and it would be highly interesting to be able to compare the gains quoted in this paper with gains obtained through other types of feedback. We leave this for future work. Had the data shown a correlation such that one group of students had not been able to use feedback, this would have called for action from the educator. This, luckily, appears not to be the case in the presented example as both low and high performing students benefited from the feedback.

In the near future, at least one of the undergraduate courses will use the double feedback loop in combination with a collection of assessment data. This combination will provide both students and educators with an insight into the feedback preferences and potential trends in learning gain from feedback loops. In addition, the exploration into the perceived quality of peer feedback from peers that choose to provide feedback on a self-selected piece of work compared to feedback to pre-assigned work will be interesting.

Further development of continuous assessment with feedback loops

Despite concern about use of online multiple-choice tests these can be time-efficient for educators and provide pedagogical benefits for students such as self-assessment and immediate feedback (Bennett, Dawson, Bearman, Molloy & Boud, 2017b). In the ecology course, tests included both multiple-choice questions and calculations where students had different variables. In the evaluation of the tests, one of the students wrote “It would be nice with more questions with different variables as all students have to calculate by themselves”. Questions with different variables can minimize plagiarism also when students are working together, which is encouraged in the course described here.

Although university educators develop learning designs, they seldom reuse learning designs created by other educators and they rarely represent and visualise their own designs (Bennett, Agostinho & Lockyer, 2017a). In this paper, we have simplified a learning design into a generic design combining continuous assessment with feedback loops. This design will be used as inspiration for Danish educators that are transforming assessment from one high-stake end-of-semester assessment to several low-stake continuous assessments, distributed throughout the course. Sharing designs will especially be important in the initial phase, as this is the stage where educators in particular need additional support (Bennett, Agostinho & Lockyer, 2017a). Another important feature of the assessment design is that it is supported by existing technology that will facilitate easy implementation. When educators are developing new assessments, they might abandon them quickly due to technical failure (Bennett et al., 2017b).

The generic design combining feedback loop(s) with continuous assessment is, in our view, also a way to put more focus on evaluative judgement where students are engaged with assessment criteria multiple times, assess peer work and are active in feedback dialogue (Tai et al., 2017). Tai et al., 2017 suggest that the use of exemplars and co-creation of rubrics are furthermore an important part of developing evaluative judgement among students. Two of the examples provided here are using exemplars and co-created rubrics in the tasks that students perform before “entering” a feedback loop. Hopefully, the learning designs used here could be a starting point for developing effective learning designs, as requested by Ajjawi, Tai, Dawson and Boud (2018) in a recent book.

Concluding remarks

The combination of continuous assessment and feedback loops can be seen as an agent of change of the nature of assessment into a more learning-oriented direction, informed by data. This data will not only inform the design of feedback and assessment activities but also serve as method to monitor student learning and progression, and thus lead to potential actions for educators and students.
Despite the simple nature of the learning design combining continuous assessment with feedback loops, illustrated in the paper, the learning design does indeed lead to informative data for both educators and students. In the presented examples, data is used by students to revise and improve tests and assignments and by educators to measure the effect of feedback and to identify and contact struggling students. Thus, the data helps to document the effect of the learning design, which can serve as inspiration for other educators, and to inform future changes and additions to the learning design. Future research could add to this body of knowledge by exploring the learning potential of other types of formative feedback as well as more examples of data, both quantitative and qualitative, and the actions they prompt.

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Developing collegial cultures of teaching innovation: Motivating influences and impact of university colleagues sharing digital stories of learning and teaching

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Fostering cultures of teaching innovation contributes to the transformation of learning and teaching practices in higher education. Enabling university colleagues to share their practice stories is essential for the development of collegial and collaborative communities of practice that provide peer support for colleagues engaged in continuing professional learning related to learning and teaching practice enhancement. This paper describes a university-wide technology-enhanced professional learning strategy aiming to provide a dynamic collection of multimedia digital narratives of teaching practices via an open education resources (OER) repository. This study investigated the factors that motivated university colleagues to share their learning and teaching experiences and practices, the value of sharing their practice with others and the perceived impact of creating these narratives. The results of a preliminary online survey of contributors included that respondents were very strongly motivated to share their practices with peers (92%) and found the process valuable for promoting reflective practice (75%). Semi-structured interviews with contributors indicated the value of collegial conversations involved in creation of the resources. Implications for developing sustainable cultures of university teaching innovation in discipline contexts and future directions for further studies are discussed.

Keywords: digital stories, peer professional learning, innovation, reflective practice, virtual learning environment

Introduction

In 2016, the central learning and teaching unit at Griffith University began publishing just-in-time professional learning resources called Faculty Stories and Faculty Sparks. The intent of this type of professional development is to promote a collegial culture of teaching innovation through a peer learning model that is scalable. By authoring a digital narrative, academics can reflect on their own practice (a learning experience for them) as well as share their successful teaching practices and experiences with colleagues in and out of the University. Faculty Stories and Sparks are publicly available on Griffith Explore Learning and Teaching (ExLNT), a professional learning open education resource platform / repository.

The purpose of the research detailed within this paper was to gain a deeper understanding of the motivations of academics who have shared their teaching practice as *Faculty Stories* and *Faculty Sparks*, the impact that participation has had on their own learning and teaching practice and the perceived value of sharing one's practice via authoring a *Faculty Story* or *Faculty Spark*. The academics in the study (members of all four academic groups) had authored one of two types of media enriched entries (i.e., Faculty Story (3) and Faculty Sparks 63) within the University's professional learning online education research repository.
The research team was guided by three research questions to guide:

- Research question 1: What are the motivating factors for university academics in sharing their learning and teaching experiences and practices in a Faculty Story or Faculty Spark?
- Research question 2: What do university academics and supporting colleagues perceive as the value of sharing one's practice by creating a Faculty Story or Faculty Spark?
- Research question 3: What has been the impact of participating in the creation of a Faculty Story or Faculty Spark on university academics' learning and teaching practice?

Important to note, the impact on the consumer of this type of professional learning (i.e., Faculty Sparks and Stories) was out of scope for this study. It will be addressed in a follow-up study.

Literature Review

Sharing professional practice: Motivation and impact

What motivates people to share their professional practice and subsequent knowledge? It would not be uncommon to refer to today's economy as a knowledge-based economy (Cheng, Ho & Lau, 2000). In this economy, Quinn, Anderson & Finkelstein (1996) see knowledge as a professional intellect that embraces know how, know-what, know-why and self-motivated creativity in an organisational setting. Davenport, De Long & Beers (1998) view knowledge as experience, context, judgment, belief and information. So, what makes people interested in sharing their knowledge? Yang (2007) says that knowledge sharing happens when an individual is willing to assist as well as to learn from others in the development of new competencies. When it comes to motivation for sharing knowledge, people perceive knowledge as one of three things, knowledge as an object, knowledge of individuals, or knowledge within a community (McLure Wasko & Faraj, 2000). When knowledge is viewed as an object, people feel motivated to share their knowledge for incentives such as pay or promotion (McLure Wasko & Faraj, 2000). If knowledge is deemed to be owned by an individual, people are motivated to share for reputation or self-esteem gains (Constant et al. 1994). Knowledge being viewed as a community commodity, the motivation was more for moral obligation or community interest (Ardichvili, Page & Wentling, 2003). Technology could possibly also be a motivating factor for knowledge sharing as the rise of social media platforms has made it easier and faster for knowledge to be shared in a range of formats. Brazelton and Gorry (2003) however don't agree with the idea that technology alone effectively encourages knowledge sharing. Trust can be seen as another motivating factor for an individual's willingness to share their knowledge. Trust relationships are critical to effective communication (Dodgson, 1993); trust improves the quality of discussion and enhances the knowledge-sharing. Kimmerle et al (2007) found that participants with higher trust in their colleagues were more cooperative with information-exchange.

Knowledge sharing will have inherent impacts. Cheng et al. (2000) see there being two non-exclusive ways of knowledge sharing, closed network (person to person) and open network sharing (through a central repository). The knowledge sharing process involves more than just collection and dissemination of information, so if the process is managed properly, the value of the knowledge is expanded when it is shared (Cheng, Ho & Lau, 2000). Organisations should be able to learn continuously and leverage off the knowledge that they capture to increase innovative knowledge (Liedtka, 1999) giving rise to one of the impacts of knowledge sharing being the gathering of organisational knowledge and creation of communities of practice. Participating and contributing to an online community of practice brings different benefits and impacts to its' participants. In a study completed by McLure Wasko & Faraj (2000), participants contributed to enhance standing in their profession, establishing a reputation that would hopefully translate into a job or a promotion. People also participated to enhance their own learning and self-efficacy, refine their thinking, and contribute to new developments. Organisational learning and knowledge sharing enables an organisation to improve organisational behaviours by way of the creation of advanced knowledge (Yang, 2007).

Peer observation of teaching: A valuable professional learning strategy

Peer observation of university teaching is acknowledged as a valuable strategy for fostering reflective practice and practice enhancement of the observed teacher. Within the Australian higher education context, peer observation of teaching generally refers to a process whereby a teaching academic invites a colleague to firstly observe their teaching practice and secondly provide constructive feedback in order for the observed teacher to reflect on their practice and identify areas ripe for enhancement (Carbone, Ross, Phelan, Lindsay, Drew, Stoney & Cottman 2015). These processes are implemented in a specific academic context in order to provide an opportunity for the observed teacher to reflect on their practice (Bell, 2001; Hammersley-Fletcher & Orsmond 2005) and plan for practice enhancement, thus supporting a developmental approach to continuing professional learning related to teaching (Drew, Phelan, Lindsay, Carbone, Ross, Wood, Stoney & Cottman, 2016). Research has shown that a peer observation approach not only leads to overall improvement in student satisfaction related to educational quality of units (Carbone, 2014; Carbone et al, 2015), it also effectively supports processes of reflective practice, leads to improvements in teaching practice, develops confidence of participants, provides ongoing professional learning and develops collegiality (Bell, 2001). In addition, studies have found positive impacts on the teaching practices of peer observers (Engin, 2016; Thomson, Bell & Hendry, 2015).

Research regarding the peer observation of university teaching within an online context is gaining momentum. Studies of online peer observation in synchronous virtual classrooms have showed that participants perceived an increase in their confidence and greater willingness to experiment; appreciated better how they fitted into the wider open university teaching community, built new professional friendships and flexible communities of practice, and developed a better understanding of how to progress their own self-development (Harper & Nicolson, 2013) and the use of synchronous conferencing tools was influential in shaping the relationship between participants on the programme (Walker & Forbes, 2017). Jones & Gallen (2015) studied the dialogue between peers' post observation and found that participants report experiences of self-reflection prompted by the discussions. Marsh & Mitchel (2014) explored the affordances of video-enhanced teacher education, highlighting the potential for video to be used to foster dialogue between theory and practice, build capacity for reflection; noting that asynchronous opportunities afford the luxury of time for post observation discussion and reflection. However, there is little research evidence evaluating professional learning opportunities that support both the teaching and observer colleague within an asynchronous online environment.

Open education resources repository as a structure in which to share professional practice

The term Open Education Resources (OER) was invented by UNESCO in 2002. In 2017, the NMC Horizon Report: 2017 Higher Education Edition stated, "OER, learning materials with free use and remixing rights for educators, offer another alternative to improve equity in higher education" (p30). It even reported that in many cases, OER positively impact learning (Adams Becker, Cummins, Davis, Freeman, Hall Giesinger, & Ananthanarayanan, 2017). To collect and make these resources easily available for intended audiences, web-based repositories are created. There are OER Repositories available from vendors who host resources for a fee, open source platforms for hosting by an institution as well as bespoke systems that are developed by the implementing University (Olcott, 2012). The key characteristic of all of OER Repositories is that the resources they host are openly available to the public and the content can be used and even customized by those that access it (Browne, Holding, Howell & Rodway-Dyer, 2010). In the context of the article by Browne et al, and many other articles regarding OER, the intended learners from the content are students.

The design and implementation of an OER must consider a multitude of factors including, resource quality, distributed curation, professional development, contributor trust, contribution recognition, sustainability, content curation, copyright, intellectual property, system maintenance, marketing, (Browne, Holding, Howell & Rodway-Dyer, 2010; Olcott, 2012). While these factors were identified for OER Repositories for student learners, they would certainly apply when learners are professionals. While there is a robust body of literature on the provision and use of OER for students, there is a clear absence of literature in their use and collection in support of professional learning.

Background

Faculty Stories are collections of inspiring digital stories of university colleagues and their students reflecting on their teaching and learning practices. The in-depth stories include short reflective videos based around contemporary themes; accompanying resources linked to each topic, such as further readings, templates, frameworks, lesson/unit plans and quotes; and question prompts for further professional learning. These stories are designed to encourage viewers/observers to engage with reflective practice regarding their learning and teaching practice, with the view that this will foster plans for enhancing their educational practices in order to transform the student learning experience. In this way, the Faculty Stories project enables online, self-selected, asynchronous, peer learning that is highly accessible, self-paced, 'just in time' and 'just for me'.

Faculty Sparks are designed to encourage sharing of knowledge around teaching practices with the ultimate aim of enhancing student learning. They are brief digital entries that share challenges and their solutions related to teaching practice. These resources provide brief reflective videos based around a specific challenge, together with descriptive content. They address topics such as active learning, embedding graduate attributes and using ePortfolios. The entries explain how the academic addressed the challenge, discussion of outcomes from the approach taken to meet the challenge including anecdotal feedback and statistics, followed by reflection about the process and advice for others who might like to follow the same approach. Supporting documents (e.g., rubrics, presentations and further readings) to support the discussion and provide context are included. They are an accessible, self-selected peer learning resource that can be accessed anytime.

Explore Learning and Teaching was developed to meet the need for a University-wide online repository of professional learning resources. Essentially Griffith's ExLNT is an Open Education Resources (OER) Repository that allows users (e.g., academics, students, learning and teaching professionals) to access learning experiences (e.g., case studies, *Faculty Stories* and *Faculty Sparks,* and workshop descriptions) related to teaching practices and supporting technologies. While the resources are available to the public, additional functionality is available to University personnel including favouriting entries and adding related experiences to

a given entry as comments. It was created in partnership with stakeholders from across the University to insure it met the needs and desires of the broader learning and teaching community. Currently the content is provided by members of the Griffith Learning and Teaching Community with distributed content curation as principal to its design.
Using OER for learning and teaching in the professional learning context is as appropriate as it is for the discipline content context. Contributing to ExLNT is one-way academics can share their successful practices with their discipline, institutional and global colleagues. As of June 2018, 80+ academics from across all four academic groups have contributed *Faculty Stories* and *Faculty Sparks*. The pace of contribution continues to increase as ExLNT's reputation as a source of professional learning increases.

Methodology

To answer the research questions, a mixed-methods approach was adopted, employing an online survey and semi-structured interviews. The questions within the survey focused on teaching practices and several aspects of the experience of creating a Faculty Story or Faculty Spark. For the purposes of this paper, we focus on the latter. The interviews focused on topics related to the creation and sharing of the Faculty Story or Faculty Spark.

Participants

All potential participants received an email from the chief investigator with an introduction of the research and link to a detailed online information page which identified the participatory status of participant individuals, and how the researchers will ensure that staff do not feel any pressure to participate. A link within the online information / consent page served as the entry to the survey. Clicking in the link to begin the survey served as consent for anonymous participation in the study. In addition, an invitation to participate in an interview was issued. Interested persons were asked to reply to the email to arrange a time and date that suited them. This method insured the anonymity of the survey results.

Data Collection & Analysis

Participants undertook a 20-minute online survey with quantitative and qualitative items and were then invited to participate in a semi-structured interview (approximately 45-60 minutes) at a time and location preferred by the participant. An online survey was constructed and published using a fit for purpose tool. Branching was used within the survey to customize question paths for the two participant pools, Creators and Supporters. Creators are the contributing academics who have completed a Faculty Story or Faculty Spark and university colleagues who have supported these. The 62 academics have published a Faculty Story or Faculty Spark made up this pool of participants. The pool included teaching academics (e.g., sessional staff, lecturers, demonstrators, tutors) and those that support them (e.g., educational designers). Supporters are the learning and teaching professional staff (e.g., Blended Learning Advisors, Educational Designers, Program Directors, etc.) who supported Creators before, during or after the creation process. Analysis of the quantitative and qualitative data was conducted. Descriptive statistics and thematic analysis of responses to the open-ended question are reported. Five interviews were conducted following closure of the survey. These semi-structured interviews were facilitated by the researchers using a set of 12 questions written by the researchers and approved by the ethics board. Interviews, lasting between 45-60 minutes, were digitally recorded (audio-only). Transcripts were generated. These were sent to the interviewees for member checking to increase the accuracy and validity of the transcripts (Birt, Scott, Cavers, Campbell, & Walter: 2016). In order to preserve anonymity, codes were allocated to each participant (such as P1 for participant 1) transcript. An initial inductive thematic analysis of open-ended survey questions and interviews was conducted to align with research questions in order to allow findings to emerge from the data, followed by a deductive method which compared data to established research frameworks.

Findings

Participant Characteristics

A survey response rate of 24% was obtained with 18 of the 75 potential participants responding. Of these respondents, 17 were Creators of a Faculty Story or Spark and one was a Supporter of a Creator. Lecturers or course convenors constituted 83% of the respondents. 93 percent of the survey participants identified as having greater than five years teaching experience with 72 percent of the respondents currently teaching undergraduate students. Academics with various levels of appointment (i.e., lecturer, senior lecturer, associate professor, professor) and serving in a variety of learning and teaching roles (i.e., sessional teaching staff, course convenors, program directors, head of department) participated. The Likert scale for all data reported is Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree.

Table 1: Motivation to share your practice by creating a Faculty Spark or Story. (N=12)

Statement	Percentage Agree & Strongly Agree
Desire to share my practice to help others	95
Requirement for grant application or expression of interest.	8
Requirement for a teaching award application.	8
Deliberate support of peers in my discipline.	75
Disseminate project information.	25
Deliberate support of peers in the teaching community in my Group.	75
Support of peers in the Griffith teaching community.	83
Fulfilling a goal in my Academic Staff Career Development (ASCD)plan.	25
Create a product for my academic portfolio.	42
Recognition for doing interesting and innovative practices.	75

Table 2: Value to colleagues of sharing one's practice. (N=12)

Statement	Percentage Agree & Strongly Agree
Valuable for yourself	88
Valuable for discipline-specific peers	42
Valuable for peers across the University	50
Valuable for peers across the broader higher education community	50

Table 3: Desired impact of creation and / or sharing of a Faculty Spark or Story. (N =12)

Statement	Percentage Agree & Strongly Agree
Enhanced practice to address issues such as graduate employability, quality of the education sector etc.	74
Contributed to collegial conversations practice at the discipline level.	75
Contributed to collegial conversations about practice at the Group level.	67
Contributed to the collegial conversations about practice at the University.	50
Impacted my teaching practice.	67
Impacted a colleagues' teaching practices.	16
Impacted my team's teaching practices.	60
Impacted my reflective practice.	76
My own innovation in teaching.	67

Table 4: Technical aspects of authoring a Faculty Story or Spark (N=11)

Statement	Percentage Agree & Strongly Agree
Ease of creating a Faculty Spark	91
Ease of creating a Faculty Story	88
Visibility of Faculty Sparks and Stories on the Explore Learning and Teaching platform	78
An effective approach to showcasing my innovative practice	81
Public resource accessible by anyone	61
Asynchronous peer to peer sharing/mentoring	73
A unique URL that can be shared via social media and email	91
Ability for viewers to share similar experiences on the same webpage as the Faculty Spark.	82

Discussion

Motivation for Sharing Practice

Participants were asked to indicate the degree to which they either agreed or disagreed with a series of statements regarding their motivation to share their practice through the creation of a Faculty Story or Faculty Spark. Out of the respondents, agreeing or strongly agreeing that the motivation was a desire to share their practice with their peers was quite high at 92%, with 83% agreeing or strongly agreeing that the motivation was in support of the Griffith teaching community. In deliberately supporting their peers in their discipline, 75% agreed or strongly agreed that was their motivation, with deliberate support of their peers in the teaching community of their Faculty Group also 75%. This led to a strong theme in seeing knowledge sharing as a community responsibility. Of the further results, 75% agreed or strongly agreed that their motivation was recognition for doing interesting and innovative practices, while having a colleague recommend that they develop a Story / Spark, 67% agreed or strongly agreed. The ability to tell their story through narrative followed up with 65% agreeing or strongly agreeing that this motivated them to share.

Themes that came through the responses to the open-ended questions included contributing to the profession.

> I have a very strong interest in giving back to the teaching profession and I saw this as one way of achieving that goal. It also was a powerful reflective tool to refocus on my practice.
>
> Sharing and discussion of practices; encouragement by others to share the discussion. Hoping to start a conversation with others.

An analysis of the interview transcripts revealed the following quotes which illustrate the three perceptions of knowledge (i.e., object, owned by individual or community knowledge.)

Knowledge as an object

> [this is] something that I can include in my Academic Performance document, my TERS [Teaching Excellent Recognition Scheme, point allocation based on various research factors where research funds are then allocated due to points gained] application. We get funding if we do research, we have teaching funding for various articles we publish in scholarship of teaching. Things like Faculty Sparks ... sharing your practice and innovation, goes towards point for funds so the more points you have by doing all the activities, the more funds you get, but that was the motivation for me to do it. (P3)
>
> I mentioned it in my fellowship and I've put a screenshot in my promotion document. (P2)

Knowledge as owned by the individual

> It's just a way I guess of, packaging up nicely, what & how, to share that internally and externally. It’s just providing in a nutshell what it is that I am doing when people ask (P2).
>
> One of the blended learning advisors or educational designers encouraged me to share the practice. And I thought OK I'll do it if you think it's cool because by this stage I thought ‘Oh that’s old news, who would be interested to find out about this’ because I've been doing it for so many years I didn't think it was cool enough anymore but she said, no it's OK let's do it. (P3)

Knowledge as owned by the community

> It's my nature to share, I don't believe in keeping information to myself… there's no point reinventing the wheel if it can be used by the people, then I think that many hands make light work … If I'm going to use other people's good ideas, it’s natural for me to share my own (P1)
>
> [It's a] good way to start sort of disseminating that information on varying things because we know from experience that many academics who run group work in their courses struggle with how to manage it and students struggle with it as well you know (P5)
>
> That was about sharing what I'm doing because I think it's new in the online space, so I can see, I can read a lot of about problem-based learning, in the literature and there's lots of material about that but there's not a lot in terms of how to do it in the online space (P2)

Value of Sharing Practice

Participants were asked to indicate the degree to which they either agreed or disagreed with a series of statements related to the value of sharing their practice: "To what extent do you agree or disagree that the creating and sharing of your Faculty Story or Faculty Spark has been valuable for yourself and / or others in the learning and teaching community?". Results indicated that respondents (N=12) perceived the greatest value for creating and sharing a Faculty Story or Spark has been for themselves (88%) (Table 2) with lesser value for peers across the university (50%) and peers across broader HE community 50% and least value to discipline-specific peers (42%). In addition, respondents perceived that the creation of the digital stories was valuable for promoting reflective practice (76%) (Table 3). Themes emerging from the open-ended questions and interview transcripts support these findings. Participants recognised the creation process as being valuable for creating a product or artefact that was a valuable personal record of innovation of practice:

> I think it is useful to have a permanent record of the innovation on the university Website (P1)
>
> It is something I can include in my Academic Performance document and Teaching Excellence Recognition Scheme (P3)

Individual reflective practice was also recognised as a valued by-product of the creation process:

> It has been part of a reflective process for me and the value is in that aspect (Anonymous)
>
> Having the videos ready and available is fantastic from a professional point of view, [but] to me the value was that reflection on my practice (P4)

In addition, participants expressed that their digital stories would be of value to their colleagues and students:

> A lot of us are just spinning around in circles redoing stuff that's been done ... Collectively we can improve our quality of teaching which then benefits students. (P1)
>
> There are aspects of teaching that are, you know, universal… so we thought this [Faculty Spark] was something that can help people of all persuasions around the world (P5)

Furthermore, interviewees discussed the value in facilitating collegial networks and communities of practice:

> We have all these remarkable examples of teaching out right here within these Sparks and that's good for everybody, it's good for the institution it's good for the person who's authored the spark. And it will also create longevity in terms of alumni." (P1)
>
> In the future there might be a community of practice that uses these to have their conversations (P4*)*

Impact of sharing practice

Participants were asked to indicate the degree to which they either agreed or disagreed with a series of statements regarding the impact the creation and / or sharing of a Faculty Story or Spark on their practice and that of others in the sector. The responses support the idea that the creation of a Faculty Story or Spark serves as a professional learning experiencing for the creator. The creation process was identified by 75% of the respondents to have "enhanced practice to address issues such as graduate employability, quality of the education sector". Sixty-seven percent agreed or strongly agreed that authoring the Story/Spark "Impacted my teaching practice." Both are strong indicators that the creation of this type of digital story does serve as a professional learning experience for the creator. Two-thirds (76%) of the respondents indicated that they thought the creation of a Faculty Story or Spark "Impacted my reflective practice." This finding reinforces the researchers' hypothesis that the creation of a digital story would impact a creators' reflective practice. With collegial conversations being a critical element of an academics practice, the fact that 75% of the respondents responded favourably to "Contributed to collegial conversations about practice at the discipline level" indicates the authoring of Story/Spark is a favourable endeavour. Respondents also agreed that authoring a Story/Spark "Contributed to collegial conversations about practice at the Group level (67%).

Themes that came through the interviews and open-ended questions within the survey included the value of reflection. These two quotes are illustrative of this point.

> Faculty Stories reminded me of the **importance of reflection**. I mean, I do it already and it's deeply ingrained, but the whole process allowed me to take it to a whole other level which was great.

> It has mean**t I continue to reflect upon** the issue of providing feedback to students more frequently and consistently.

A thematic analysis of the interview transcripts revealed that interviewees perceived that the creation of digital stories regarding one's practice is perceived by the creator as having a positive impact.

- Evidence of learning and teaching practice, scholarship & leadership
  > I'm going to be adding it into my citation, that's the point of the link, I've shared it with external people ... A link is a lot easier for me [than an article] to pop on an email and say, 'have a listen.' (P1)
  >
  > I mentioned it in my fellowship and I've put a screenshot, in my promotion document. (P2)

- Social media outlets
  > I put it on my LinkedIn, on Facebook, told my Head of department, our marketing staff and shared with department colleagues. (P2)
  >
  > I put it on LinkedIn Facebook and twitter… I got some 'likes' and comments on Facebook and LinkedIn from my colleagues in [my department] and graduate students. (P3)

- Shared across departments/university
  > Shared within our department [through] the newsletters from the PVC (P2)
  >
  > You know the immediate people that will have an impact on this, I think, is building this resource almost like a library, of best practice, in learning and teaching. (P4)

Technical aspects of creating and sharing digital stories

Participants were asked to indicate the level to which they agreed or disagreed with a series of statements regarding the processes involved and technical aspects of creating a Faculty Story or Faculty Spark is important. Respondents agreed/strongly agreed that it was easy to create both a Faculty Story (88%) or a Faculty Spark (91%). This confirmed that the process of making such a resource was not a barrier for academics to share their practice. Ninety-one percent agreed/strongly agreed that "A unique URL that can be shared via social media and email" was a positive result of having created the resource. This functionality allowed creators to share the link to evidence their innovative practice with 81% agreeing/strongly agreeing that this was valuable. The creators also valued the ability for viewers of their resource to comment (82% agree/strongly agree) and the visibility of Faculty Stories and Sparks through ExLNT (78%). Over half (61%) agreed/strongly agreed that being able to share theirs with the public had a positive impact.

Implications for practice

In light of the findings above, there are several ways in which the process of supporting colleagues in creating, using and promoting their Faculty Story and Faculty Spark may be enhanced.

Supporting motivation & perceived value to create and share
To support academics to share their practice, it would be beneficial to provide detailed information to all colleagues involved in learning and teaching, describing each initiative, the benefits for self and others in participating, the support mechanisms available and an invitation to participate. This would include highlighting the potential multiple purposes and uses of these resources: as evidence of practice for performance reviews, promotion justification, learning and teaching grants, awards and fellowships; to foster individual reflection, collegial conversations about learning and teaching and collaborative professional learning.

Supporting evaluation and the optimisation of impact of sharing
Few participants in our study indicated that they had thought about measuring the impact of their stories or weren't sure how to promote their stories. For example, one academic reported that she was not sure whether the Spark resource had been viewed or used by others "*I don't know if anyone has [used the resource], no one has said anything to me... I don't know if it's created any change yet"* (P2). To support the process of evaluating impact, information and support regarding indicators of impact and how to measure the impact of their stories could be provided. One participant suggested the use of altmetrics for tracking impact, *"You can actually see how many times it was shared, you get all these different metrics that give a different perspective of impact.*

That's a nice way to show that you're having impact" (P1). Another academic reflecting on ways the digital story had been promoted stated: "*I think for me it's a matter of I'm not sure how… I don't know how to promote myself"* (P1) and "*it would be really nice to know how better to actually share"* (P2) indicating that methods for how to share the stories with peers would be useful and appreciated by colleagues.

Enhancements to ExLNT
Interviewees recommended the following enhancements:

- Linking stories with professional learning: "*What I would like to see is those tags being then linked with the professional development ... microlearning opportunities of professional development*" (P4)
- Enabling 'favourites': "*It would be nice to favourite something … and then come back later"* (P1)
- Automated online creation: "*On the Spark home page you could automate it with a button saying, 'I have an idea' … we have an account, we could step through it and save it online"* (P1)

Creating sustainable support systems
Participants recognised the value of being able to discuss the creation and sharing process with a Learning Futures colleague and not just getting template to fill in. Suggestions were made that initially, interested contributors might view a selection of exemplar Sparks, with annotations and explanations of various valued features. Another idea included making the first creation experience face-to-face and fully supported with a completing handover explaining the process for future creations involving templates and support resources.

Limitations of the study

As the study intended to explore the motivations, value and impact of the creation and sharing of digital stories by colleagues at one Australian research-intensive university, the findings relate to a specific context within the Australian higher education sector. In addition, due to the limited number of participants in the online survey within this study, findings are not able to be generalised across contexts. However, insights gained and shared through the study may be relevant to learning and teaching colleagues in universities in similar contexts or may be useful for readers to reflect on similar concerns at their own university.

Future Studies

Further investigations are needed to evaluate professional learning from asynchronous peer sharing using digital stories, specifically measuring the motivation of, and impact on, the learner of engaging with a Faculty Story or Spark.

Conclusion

This study aimed to explore the motivating factors for university academics in sharing their learning and teaching practices via online digital narratives; the perceived value of sharing one's practice in this way; and the perceived impact of their asynchronous sharing. Findings indicated predominantly that *knowledge was viewed as a community resource* to be shared; the perceived *value of creating and sharing* the digital stories was a fostering of individuals' reflective practice and provided a personal record of innovation; and over two-thirds of the respondents identified that the *creation of the digital story positively impacted* their teaching practice and their reflective practice. Considerations for future research includes exploring the motivation of academics for interacting with open education resources, specifically Faculty Stories and Faculty Sparks, in order to engage in professional learning; and the impact of engaging with these resources on the academic colleague (learner).

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‘Everything is connected’: Exploring the intersections between life, work, play and education through student use of technology in self-directed learning

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How students engage in learning outside the classroom is complex and in part a self-determined activity. Occurring in spaces on and off campus and using technology students themselves bring to their learning or provided for them by the University, self-directed learning has increasingly become a fractured, unsupported and unstructured component of modern higher education. This article draws on the digital stories of 182 students at the London School of Economics and Political Science (UK) to interrogate how students respond and react to the requirements of learning arising from classroom teaching and summative assessment. The stories exposed liminal spaces in which students are constructing learning in unique and some fragile interconnections between life, work, play and learning.

Keywords: Self-directed learning, study, technology, higher education

Introduction

The ways in which university students engage in the activity of learning outside of the ‘classroom’ are part self-determined and part influenced by how curriculum, assessment and teaching (and the teacher) shape the kinds of social learning practices needed by or enforced on students to successfully complete a unit of study or programme (Huda et al., 2017; Lai, Yeung, & Hu, 2016). In the main, most learners are left to their own devices, with their learning not bound by the walls of a lecture theatre or the firewalls of the Learning Management System (Baird & Fisher, 2005; Kolb & Kolb, 2005; Lai, 2015; Merriam, 2001). They select and undertake activities to support their learning that best deliver their desired outcomes and fit with their often complex and compressed lives.

Sometimes referred to in the literature as study or self-directed learning, these learning activities have changed significantly in the modern area of higher education, impacted by pressures of work, transition from other forms of learning, use and availability of technology and social media, financial pressures exerted by high fees and increasing expectations of success connected with employability (Gale & Parker, 2014; Krause & Coates, 2008; McLaughlan & Kirkpatrick, 2014). Modern higher education places significant responsibility on the student to attend and interact with learners and teachers in lectures, tutorials and online as well as engaging in self-directed study in spaces both physical and virtual, where they work through readings, prepare for assessments or get ready for work required for the next face-to-face or online experience (Merriam, Caffarella, & Baumgartner, 2012). As these learning activities can happen off-campus or outside of the physical or virtual learning spaces created by the design of a course, technology is a critical and almost essential tool to facilitate learning (Deepwell & Malik, 2008; Norris, Hossain, & Soloway, 2011; Rashid & Asghar, 2016).

Self-directed learning has further evolved within the socially constructed environment of social media, exposing intersections between learning and the rest of a student’s life and challenging and defining notions of expertise, authority, informality, expediency, immediacy and representation (Dabbagh & Kitsantas, 2012; Ellis & Goodyear, 2016; Greenhow & Lewin, 2016; McLoughlin & Lee, 2008). Learning practices intersect personal, professional and educational lives in complex, inter-connected and personally defined and managed ways affording students the opportunity to make and share identity and to tell the stories of their lives to who they choose (Clark & Rossiter, 2008). Learning inhabits conversations, reflections, casual and fleeting connections, ambitions and expectations that are not always located in the classroom or even on campus (Bryant, 2015, 2017; Fried & Harper, 2017; Hare, 2018). Students make choices about the complex relationships informed by how academic endeavour and activity shapes personal and professional identity within the interconnectedness of life, work, study and play (Lairio, Puukari, & Kouvo, 2013). The use of technology and social media and the practices that emerge from them is at the nexus of these connections, creating personal ecosystems of engagement and relationships, with Fuchs (2017) arguing that the Internet and social media are part of the 'commons of society' and are as fundamental to human sociality as love, care, knowledge and food. Students, when engaging in self-directed learning in response to the requirements inherent in completing assessments successfully (or demonstrating knowledge, skills and competency more broadly), are challenging and reshaping the sources of authentic and credible knowledge. This is both as creators and makers of knowledge themselves (through social media making and sharing for example) (Hamid, Waycott, Kurnia, & Chang, 2015) and as aggregators of expertise or credibility from within their own peer networks or more fleeting and searchable links to networked knowledge residing on-line (Bridgstock, 2016).

LSE 2020 and the stories of the student

LSE 2020 was the core student engagement project within the overarching 'Teaching, Learning and Technology Futures' strategic initiative at the London School of Economics and Political Science (UK). Critical to this strategic educational change project was an organic and expansive programme of engagement that was intended to break down traditional didactic modes of consultation on change and replace them with cross-functional, authentic and useful conversations, using methodologies such as hacks, debates, narrative and storytelling, problem-solving, crowdsourcing and media making. LSE 2020 was the first iteration of this approach. The objective of the project to develop a better understanding of how students at the LSE used technology for their learning. Further, we wanted to develop a more nuanced and student-informed perspective of how students responded and reacted to the educational strategies that shaped their engagement with courses and programmes. Like any institution, we were awash with terabytes of data on student achievement, student participation, student retention and student satisfaction. Very little of this data informed our understanding of how learning happens and how students choose to enable and facilitate their own learning (Fielding, Dunleavy, & Langan, 2010). From a course design perspective however, developing this understanding on the nature of student learning was critical to ensure programmes and courses were designed *for* learning as opposed to being designed for compliance, assurance or against a historical standard of practice (Viberg & Grönlund, 2017).

Stage one of LSE 2020 consisted of short three-minute conversations with 100 students from the across the LSE community, individually and in groups. They were conducted around the campus and covered students from all undergraduate and postgraduate programmes and the spectrum of social science disciplines. These transcripts of the conversations were analysed and interpreted in 2016 and released as a project report (Liote & Axe, 2016). Stage two of the project (2017) involved a further 82 student conversations, supported by an online survey which attracted 352 student responses. Stage 2 built on the findings of the initial data analysis of stage one and attempted to engage more specifically in using technology and social media as a lens on student learning, asking students about specific platforms and devices and how they utilised them as part of their learning. This stage was also analysed and presented as a series of blog posts (Wilson, 2016a, 2016b). A further iteration was completed in 2018 that centred on the use of technology within face-to-face contact contexts. That stage was not included in this study.

In both stages, conversations were conducted by a recent LSE graduate working as an intern and colleagues *in situ*, finding students in learning spaces, cafes, outside in the sunshine and occupying vacant classrooms. There were no demographic or sampling guidelines, just the intention to let as many students as possible share their stories about learning at the LSE. The conversations were either filmed or audio recorded, capturing students in their learning environments. The way these conversations evolved was critical to the nature of the project. They were not based on a question/response model, with the interviewer and interviewee taking specific active and passive roles. LSE 2020 used students and recently graduates as conversant, initiating and participating in the stories of the students. This afforded the capacity for shared meaning making through the conversations, represented as stories of sometimes shared experience (Maslin-Ostrowski, Drago-Severson, Ferguson, Marsick, & Hallett, 2018). Inherent in a significant majority of these shared experiences was a sense of collaboration, ownership and a desire to give back to the institution. Supporting the University to do education better through bringing their student experience to the qualitative forefront (as a digital story) was a significant motivator for participants. Many of the students involved asked to be kept informed of both the reporting of their stories and how the project was used to enhance the educational experience of other students at the LSE. In that sense, the intention was to create a true dialogue where the complexities of the learning experience could emerge, in part through talking with someone who understood their experiences.

All the conversations were transcribed, and these were added to the free text comments generated from the survey in stage 2, providing a rich data set for analysis. We undertook a mixed-methods approach to the data, drawing out simple statistical inferences and undertaking a broad textual analysis of the free text comments from the survey and the transcripts of the video interviews. Finally, we undertook a more relational constructivist textual analysis looking at key phrases that were used by the respondent in the context of telling their life stories. Drawing thematically on some of the principles of constructivist grounded theory as posited by Charmaz (2006; 2008), we used the data to inductively explore the stories of our students as slices of narrative that could be used to generate theory, albeit still nascent at this stage. It is critical to note that LSE 2020 was not designed as a research study. It was designed to inform pedagogical change at the School and engage the students as active participants in that change. These students provided information and insights to the project to better inform their own and future colleagues educational experiences. It is through that lens that the data analysis used in this paper drew its conclusions.

The importance of storytelling to understanding the student experience

Central to LSE 2020 was the opportunity for students to tell their story and have that shared with colleagues, academics and the wider community. This form of digital storytelling represents a type of social pedagogy, where interaction, engagement and learning emerge from the telling of asynchronous and sometimes disconnected stories shared widely with participants and the wider community (Benmayor, 2008; Stewart, 2017). Sociality informs how other students locate themselves in the institution, both through the consumption of the stories of other students but more importantly, through the telling of them to others. These videos represented encounters between students that may never have happened without the intervention of the project. Learning in a higher education institution can be a lonely act, with assessment and the pressures of necessitating and promoting performance over the benefits of collective engagement, social interaction and connection-making (McLaughlin & Sillence, 2018). The use of digital stories provided an opportunity to share human insights into learning (Robin, 2016), a concept often blurred by the metrics of satisfaction and outcomes, to support '*…shared understanding, trust building, and healing'* (Stewart & Ivala, 2017). This project created fleeting encounters between students and their stories, which we hoped would provide insights to both themselves and the institution, and in part assist with enhancing learning through socialisation and connection to the community (Christie, Tett, Cree, & McCune, 2016).

LSE students tell their stories of learning

In stage one of LSE 2020, each conversation was started with the same simple question - 'What will learning technology look like in 2020?' The slightly flawed intention of this question was to afford the students an opportunity to see through learning experiences through an abstracted lens, projecting the present into a near enough future. In framing the prompts for the conversations, our initial assumption was that students had been exposed to variable uses of technology through their school and previous higher education experiences and in their wider engagement with personal and professional uses of technology. The intention of this design was to expose the deficits in the use of technology (both in terms of a decision to use technology and the expertise and skills inherent in it use).

Arising from the initial questions, students offered only limited suggestions for where more or different technology could be applied within the School. A significant proportion of the stories told by students critiqued how the School used technology, ranging from bad PowerPoint to dated understanding of social media, that confirmed our anticipated deficits in teaching practices. However poorly they viewed the Virtual Learning Environment (Moodle) or the benefits gained from downloadable slides, the stories exposed a clear value proposition for the students. Despite the digital skills gained from using Moodle, the lecture recording system or Turnitin being relatively non-transferable to other applications or uses outside of the University, these technologies were instrumental to support the pragmatic desire of students to pass and succeed in courses, and to that end the efficacy of their use was relatively unchallenged:

> (in) teaching I guess the lecturers they use PowerPoint slides in order to, emphasise or summarise what they are saying in their lectures and they upload these slides on Moodle platform that you use in order to like facilitate and everybody can go on there. And they also upload their readings and all the information regarding the course on Moodle so everybody is expected to use, Moodle in that capacity. Otherwise, we are not, I think from the lecturer's side otherwise technology I wouldn't say is used in any way. (Stage one student)

The normalisation of technology as a key part of the learning experience, critical to fundamental expected academic practices such as reading articles and texts, taking notes and engaging with other students was especially prevalent in stage one. When asked about the technology they used, many of the students did not mention their smartphone or laptop explicitly, instead describing a pragmatic engagement with technology to make learning easier:

> I think technology is the most important thing which is not just revolutionizing our work but making our life and our research work more easier and in the future I'm thinking of being an academician, so technology will play a very vital role in making my research more productive and it will make me more comfortable to do research. (Stage one student)

When seeking to understand this pragmatism more deeply, we started to interrogate how students used technology to support their learning through probing the story of their learning journey. For the majority of students, technology was inseparable from how they engaged in learning and how they enacted the requirements placed upon them by their courses and academics. Students were unable to produce an assignment without their laptops, nor were they able to seek feedback or support from professors or peers in the absence of email or Moodle, or social media applications. Their essays needed to be submitted through Moodle or an on-line dropbox. Timetables and classes were selected and allocated through a non-intuitive and unreliable web interface. Technology was an embedded, constitutive component of university life itself, in the educational, communicative, and social sense.

> **Interviewer: Cool and then one last question. How do you think you will use technology in your career? Very open.**
> Respondent: Well depends what I will choose to do in my career. But I think whatever I choose to do is going to be major part of it because right now we are connected through these devices. We use them for absolutely everything and I definitely feel that a lot of my – a big part of my job will actually revolve around technology (Stage one student)

In stage two of LSE 2020, we focused more on the students learning journey itself. We define the project in the context of the question 'how do students enable and access solutions to critical learning problems and how do they use the technology and practices they bring themselves?' Prompted by flash cards with different social media platforms, technologies and digital practices, students were asked to tell the story of their learning journey through the lens of the technology and digital practices they had in the hand, their head and their backpack

Most students began by talking about the physical devices they used, predominantly in the form of laptops (and increasingly smartphones), which they used to take notes and conduct online research when on campus and during lectures and seminars. Most of the student's work is uploaded to the cloud, to provide seamless access to documents from any number of devices and locations, which can be shared with others. Students share readings through Moodle but also with each other in annotated form. It is at this stage that the University technology interacts with the student's by providing a hub to authorised resources, curated content and formal communications channels:

> **Interviewer: So, compared to your phone, what would you use on your laptop instead?**
> Respondent: So, I think most of the functions are more or less the same because you just like read articles on both devices or sometimes you communicate in both devices it's just when I'm doing it if I am just like mobile I'm not sitting down I will be just doing everything. I'll be using a smartphone, but if I'm at the library or like I'm sitting down (or) I'm like relaxing in a coffee shop, I'll be opening my MacBook and even like messaging and all of the other functions I did on my smartphone I will just do it on a MacBook. (stage two student)

Hardware and devices are used again, especially mobile phones, to maintain connectivity and foster collaboration with other students when off campus. This way, less formal virtual groups are set up amongst students themselves, facilitating conversations and team decisions. Work can be organised, and group work files simultaneously edited by different group members in real-time, allowing for efficient management of team projects. It is at this stage that the student engages back with the University technology to afford the opportunity to upload completed assignments remotely via Moodle, ready for assessment from anywhere in the world, a sense of borderless inter-connectivity:

> The apps I most use are I must say the Microsoft Office products, they are quite helpful for everything, sharing presentations, thoughts, ideas, projects with my colleagues and my family, the One Drive is very helpful as a Cloud. I think most of the things I use in my personal life in terms of applications I use also for the university, because everything is connected and so the fact that, and also in our, it's not like we get to an office and we open our email, refresh our emails, nowadays our professional, our office is with us all the time in our cell phone so our personal and more professional and academic life are very connected. (Stage two student)

Work. Live. Play. Learn

> For my studies I use my smartphone. For the majority of it it's my laptop. I look at readings on my laptop. I take notes on my laptop. Sometimes side by side I'll have the readings, the pages I'm taking notes on concurrently so I can switch back and forth very easily. If I want supplemental information, I can very easily Google up certain things I might have questions about or articles I might immediately relate to any theoretical concepts that I am studying or practical studies that I'm looking at. I also use Facebook when I see a particularly interesting concept that either makes me mad, is quite controversial or I really agree with or something that I'm trying to puzzle out. So, I will reach out to social media and ask my friends, okay what do you think about this? Do you agree with this? Where do you think this might be wrong or where do you think it's strengths are or how controversial the statements are, how they are wrong in all the wrong ways. (stage one student)

This response from an undergraduate student explored the complexities of her life, work and study and how they were shaped and conducted through and with technology. She challenges the authenticity of knowledge, the primacy of the voice and opinion of the academic, the criticality of the experience of 'being there' at the lecture and the importance of her network. Her story is one of connectivity, not in the boxes and wires sense, but the connected world that affords her immediacy and access to information. She is connected to knowledge and expertise, both inside and outside the academy. The student makes the case for technology as connecting tissue, representing the critical importance of her capability to make actions happen in concert with knowledge, skills and understanding to act in a complex, co-ordinated fashion. Technology as the location for personal and professional intersectionality was an experience shared by a significant majority of students. They described, to varying degrees of individual and collective reflective criticality, the efficacy, ethics or societal impacts of using technology or social media for learning and living.

Discovering and describing their own capability and advocacy for the benefits of technology was positioned as contrary to the deficit of technology capability the students observed within their institutions. In stage one, when asked about technology and learning, students almost exclusively described the technology and platforms the University gave them. Underpinning this criticism was a clear and pragmatic belief that despite the idiosyncrasies of the technology and the relatively unsophisticated nature of their use, the technology provided to them was critical to them, primarily to ensure they passed. These tensions exposed stark differences between how students used their own technology and their way they used the technology that was provided for them. In part, the students use of technology and social media for their learning was a choice they made, in response to a learning or educational requirement. A learning task was set by the academics and students were told to respond or engage with the requirements of that task to pass. The students decided whether Google offered the answers, or whether they needed to engage with lecture recordings, the VLE or more widely with their network of peers, both inside and outside the University. The students determined how much credibility was afforded to these sources.

In the survey conducted in parallel with the stage 2 conversations, the majority of students identified sources of help outside the academy, with students on average 2.7 times more likely to consult Google over a friend or peer, as 2.8 times more likely to use Google over Moodle or the teacher as a source of reliable, immediate clarification or information. This reliance on different sources of perceived authentic knowledge was also present in the conversations in stage 2. This interaction between two students in the same conversation is indicative of how technology has facilitated a distributed form of expertise, where authentic knowledge is constructed through less explicit frames than positional authority or intellectual stature or reputation:

> Student 1: If I just want some sort answers really quickly I might just like, I don't know, go online, students that are not necessarily from the course but they maybe from I don't know, other universities, but then it I want more in depth understanding of something I would definitely to the professors.
> Student 2: I think I tend to rely more on like my friends and then like if my friends don't understand either or something like that I go to my lecturer like for my professor, tutors. (stage two students)

In the context of learning at the LSE, this debate about authentic knowledge was an especially interesting finding. The LSE's motto is *Rerum cognoscere causas* which translates from Latin as 'to know the causes of things'. Understanding, interrogation and questioning are at the heart of what an LSE education stands for and what the institution hopes its graduates will take out into the world. What this study identified is that in a modern, digital society, students are drawing on multiple, connected forms of knowledge and understanding residing in both strongly and weakly formed networks to better their capacity to know the causes of things. Whilst institutional technology offered students a single source of truth for requirement gathering, minimum frames of knowledge (such as readings or assessment) and a formalised pathway to assessment, students used their own technology to fill in the gaps using skills and capabilities often gained through personal and professional uses of technology and social media. Fellow students were not colleagues or group members, they were friends. They were part of their Whatsapp groups, they shared pictures on Instagram and they friended each other on Facebook. Figure 1 shows the relational word cloud, generated in the first instance by word frequency, and then using an algorithm within the software, identified words closely related to the most frequent word counts (i.e. words that were used with the keywords in a sentence).

Figure 1: Sample of the word cloud analysis

The most dominant interrelationship extant in both stages was between technology and critical activity to support and facilitate learning. For example, the word 'think' was most commonly used within the context of aligning 'think' to a wider frame than simply education. The word think was used commonly with words such as 'life', 'play', 'hard', 'work' and then the word 'class'. Learning to think and thinking to learn were both concepts that suggested to these students that their education was not a bounded space, where completing an assessment an arbitrary task that progressively contributed to the completion of a degree. LSE students used technology as a means of creating time to think, whether to afford a more efficient pathway through the mandatory requirements (watching lectures, accessing slides or handing work in online) or as a way of engaging with others to think or validate. Coming back to the story of the student that started this section, she encapsulated much of the experiences of other students by noting how technology facilitated access to knowledge, but also the capacity to validate, critically evaluate or add to that knowledge through networks and contexts in which the knowledge has been applied, noting;

> Especially the commentary helps me when I'm looking at the lecture in the sense that I have an even greater understanding of the material so that when looking at the lecture I can attach it very immediately to physical… especially if it's side theory I can connect it to physical concurrences in the real world I suppose. Yes, so basically helping me to understand it… the material better. (stage one student)

The uses of technology in the stories shared across both stages to facilitate communication, collaboration and community were multifaceted and often complex. Transcending role and location, social media (for example) afforded students the capability to be part of a discipline-based community that extended past the walls of the institution. They could engage with colleagues, they could maintain links with other students after classes had finished, they could participate in discussions and forums with students across the globe and they could begin the formative steps to being practitioners within that discipline:

> I think in some way if the discussion topics for that week were broken down into mini tasks, and perhaps a visual illustration of this person did this task, this person did this task and when they bring it together technology can be used to bring the pieces of the jigsaw together, so you can see everything. So that way you have done an individual piece of research rather than having to research everything and that you've gone into depth and you can share that with your colleagues and everyone shares what they have done and kind of together, brings it together, that form of technology that allows for collaboration. (stage one student)

Conclusions

The futurist and information scientist John Seely Brown has written extensively about what modern learning looks like in the digital age. He makes the case that learning has changed, that learners through how they use technology to learn have in fact changed the nature of learning itself (or perhaps that it has allowed dormant ways of learning to come to the surface that only the connected and massified modes of communication made possible by technology could afford). He notes that:

> The most profound impact of the Internet, an impact that has yet to be fully realized, is its ability to support and expand the various aspects of social learning. What do we mean by "social learning"? Perhaps the simplest way to explain this concept is to note that social learning is based on the premise that our understanding of content is socially constructed through conversations about that content and through grounded interactions, especially with others, around problems or actions. The focus is not so much on what we are learning but on how we are learning. (Brown & Adler, 2008)

Following his argument to its logical conclusions, we cannot assume that all our students will or need to communicate through Twitter, nor does it mean that crowdsourcing, Google searches and Yelp recommendations will replace academic knowledge. But it is in those very defences against using technology that one of the most fundamental tensions in higher education lies; you are either with us or against us. It is a polarised debate, with no middle ground and a series of entrenched positions backed with rigid institutional structures and policies and with all the risk dumped heavily on the shoulders of students. This can be seen in dozens of articles (both academic and popular) advocating for and against technology in the classroom and assessment (e.g. Holstead, 2015; Luo, Kiewra, Flanigan, & Peteranetz, 2018; Sørensen, 2014). How do students respond to this? Through LSE 2020, many of them told us (the academics and the institution) to use our technology better, and through action work to make the educational experience better. They demanded usable systems that afforded them the opportunity to succeed, to complete the academic requirements expected of them and to supporting them to move onto the next stage of their lives.

The analysis also identified how the intersections of student's life, work, play and learning, defined in part through the practices of using technology and social media substantiate the liminality of the student experience at the School. In these liminal spaces, there is a shared understanding of what binds them together (study, pursuit of knowledge, academic qualifications and certification). There is also a sense of flux and uncertainty arising from the practices of doing, the fear of getting it right and the necessity (real or imagined) for success. There are fragile trusts built up between students, forged in the common pursuit of academic achievement which bleed into relationships, both personal and professional, networks and how they are leveraged and cultivated and the broader, more tacit notion of connection. For the students at LSE who took part in LSE 2020, these liminal spaces exposed some of their fears around social media, their sense of connection (or lack of) to their discipline or profession and asserted the emancipatory power of technology to give them ownership over their own learning. The results of stages one and two challenged the assumptions made by designers and academics as to how students engaged with and submitted the educational tasks set for them. It was clear that they students involved in LSE 2020 had a strongly held and defined intention to do something with their education and to be a part of something bigger than a participant in a course or unit of study. They were also clearly committed to sharing their experiences in order to identify improvements for the next cohort of students, to play their part in making the educational experience better. That said, whilst bound by these intentions and motivations, they still exhibited much of the characteristics of liminal beings, they were unsettled, between states and sometimes in spaces that were troubling, transitory and fluid, all of which can be triggers for or results of learning (Simpson, Sturges, & Weight, 2010).

Returning to the student quoted at the top of this section, she was asked '*If you can give me one word that would describe what you would want out of technology, what would it be?*' Her response encapsulates an aspirational desire to use the learning coming from her education at the LSE, with technology providing a magnifying capacity to make that happen by saying '*Access. I would like access to things that I need to further my understanding of the world.*'

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Designing a Virtual Health Faculty Hub

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In this paper, we discuss the design of a 360-degree virtual environment experience for Health School students to explore seven university health disciplines within the School of Clinical Science. This teaching approach uses the Seekbeak 360-degree online platform to create a virtual environment and a rhizomatic learning pedagogy to encourage participatory and negotiated community engagement. Participants engage with a 360-degree virtual scene that allows exploration of each of the health disciplines. This allows the student to experience core competencies and example environments for each discipline via a centralised single hub. Informed by a Design-Based Research methodology we discuss the first prototype stage of the virtual health hub that has been developed using Seekbeak. The virtual health faculty hub aims to create an inexpensive mobile BYOD immersive environment for 578 first year Health School students to explore and experience the health teams with whom they will collaborate in real world situations upon graduation.

Keywords: Virtual Reality, Authentic Learning, Interdisciplinary, Design-Based Research, Mobile Learning

Introduction

Providing interprofessional understanding within a virtual environment ideally leads to an improved interdisciplinary understanding that removes the barrier of professionals in silos and breaks the barrier of physical dispersion of health disciplines across multiple university campuses. The goal of the project design is for students from each cohort to be able to authentically explore and critique the unique elements of “what is” health school via a virtual world. Currently, there is limited understanding between one profession and another, which are represented by separate departments at the University. For example, Paramedics do not have an in-depth understanding of the complexity and skill set of midwifery and vice versa. The hub is designed to allow a detailed and in-depth exploration and encourage participants to adopt a mind-set of unrestricted and creative inquiry into what each discipline offers by way of an educational and professional community model.

The current approach within the university is to promote study of core semester one subjects that all health school students take together. Whilst here each discipline connects, there is no sharing of knowledge outside of that core subject to allow interprofessional understanding or knowledge. In essence, the students are ignorant of the intersection between the seven discipline educational and career pathways. This concept of education is centred in local siloed knowledge economy pedagogies (Farrell, 2001) that assume that the learning process should happen organically in isolation with a defined beginning and curriculum based end goal.

Knowledge seekers in cutting-edge health care fields are increasingly finding that ongoing appraisal of new developments is most effectively achieved through the participatory and negotiated experience of rhizomatic or decentralised community engagement through involvement in multiple global communities where new information is being assimilated and tested (Otterness, 2017). Rhizomatic learning acknowledges that learners come from different contexts, that they need different core capabilities, and it can never be presumed as to what those capabilities are. Learning is a complex process of sense-making to which each learner brings their own context and has their own needs. It overturns conventional notions of instructional pedagogy by positing that “the community is the curriculum”; that learning is not designed around content but is instead a social process in which we learn with and from each other (Cormier, 2008). Rhizomatic learning draws upon and extends the concepts developed in social constructivism and connectivism. We chose Rhizomatic learning as the underpinning pedagogy for the design of the virtual health hub. Thus the development of the immersive virtual health faculty hub is informed by rhizomatic learning principles and founded upon a design-based research (DBR) methodology (Bannan, Cook, & Pachler, 2015; McKenney & Reeves, 2012) that follows four key stages: analysis and exploration, development of prototype, evaluation and redesign, and dissemination. In the following sections of this paper we outline the initial exploration and prototyping phases of the DBR project.

Literature review

The first stage of the project is an exploration of relevant literature to guide the identification of design principles for the project and the initial prototyping.

Mobile Virtual Reality

We chose mobile VR as the enabling technology for the project development because of the ubiquity of mobile device ownership (International Telecommunication Union, 2016), the ability of mobile VR to create and share authentic learning environments (Burden & Kearney, 2016), the low cost of development (Amer & Peralez, 2014), and low technical expertise required for development (Dolan & Parets, 2016).

The design principles (DP) we identified through the literature on designing authentic mobile learning and scaffolding innovative pedagogies, explored in Cochrane, Cook, et al., (2017), are summarised below and were used to guide the development and implementation of the project:

- DP1: Basing the project within a design-based research methodology (Bannan et al., 2015; Cook & Santos, 2016)
- DP2: Supporting the project through the establishment of a community of practice (Cochrane, 2014; Cochrane & Narayan, 2016)
- DP3: Using heutagogy (student-determined learning) as a guiding pedagogical framework (Blaschke & Hase, 2015; Hase, 2014)
- DP4: Designing around the authentic use of mobile devices and VR (Burden & Kearney, 2016; Cochrane & Narayan, 2017; Kearney, Schuck, Burden, & Aubusson, 2012)
- DP5: Integrate collaboration and team-work into the project activities (Kearney et al., 2012; OECD, 2015)

Simulation is a key technique utilised in most health care educational environments (Merchant, Goetz, Cifuentes, Keeney-Kennicutt, & Davis, 2014; Pike & O'Donnell, 2010), however the use of mobile virtual reality to enhance simulation educational environments is relatively new (Birt, Moore, & Cowling, 2017; Hussein & Natterdal, 2015). Our main restriction was budget, however this also led to the development of an agile BYOD approach as a model for learner-generated content and contexts (Cochrane, Cook, et al., 2017), informed by DP3 – heutagogy or student-determined learning.

DBR methodology for mobile VR development

The project has developed through various experiences and iterations (Cochrane, Cook, Aiello, Harrison, & Aguayo, 2016; Cochrane, Stretton, et al., 2017), from which we have developed a Design-Based Research methodology and established a design team to guide the development of mobile virtual reality for health education (Cochrane, Cook, et al., 2017). Building upon the work of Bannan, Cook and Pachler (2015), Cook and Santos (2016) argue that DBR is good fit for designing and researching mobile learning environments.

DBR provides a structured approach to educational design that is concerned with generating research outcomes that are potentially transferable to contexts beyond that of the original research domain, and therefore has the potential to impact teaching and learning practice in a wider sphere than a simple case study approach (Amiel & Reeves, 2008; Reeves, Herrington, & Oliver, 2005). We are primarily concerned with the first two stages of design based research outlined by McKenney and Reeves (2012) in this paper: analysis and exploration, and development of a prototype intervention.

Analysis and exploration
The first stage of a design based research project is analysis of the need for the research and exploration of existing literature relevant to the proposed research. The previous sections of this paper overview the research context and drivers for the research. This is then followed by a review of pre-existing literature to establish initial design principles to inform the development and prototyping stage.

Development and prototyping
A key element in mobile VR development is the choice of tools to support and enable the development process (Hussein & Natterdal, 2015). These tools comprise a collection of interdependent elements that can be described as an 'ecology of resources' (EOR) (Cormier, 2008), from which learner centric environments can be designed (Cochrane, Antonczak, & Guinibert, 2014; Luckin, 2008; Pachler, Bachmair, & Cook, 2010).

Methodology

The context of the project is a University Health School with seven distinct health departments: Paramedicine, Nursing, Physiotherapy, Occupational therapy, Midwifery, Oral health, and Podiatry.

Research Questions

The main research question for the project is: How can we use mobile VR to design an enriched and authentic environment for health students to gain an understanding of the seven related health disciplines offered at the University?

Participants

Participants in the project included the three year-based student cohorts, and the project design and research team. We limited the scope of the prototype to three of the seven health disciplines: Paramedicine, Physiotherapy, and Nursing. Ethics consent was applied for and granted through the university's ethics committee.

Project Design Team

Table 1: Design-Based Research Team

DBR Collaborators	MESH360 Project Design Team				
	Paramedic Lecturers	***Physio Lecturers***	***Nursing Lecturers***	***MMR Development Team***	***Academic Advisors***
Key responsibility	Discipline context experts	Discipline context experts	Discipline context experts	Technology implementation advice	Educational technology foundations

As shown in Table 1 the research project involved the collaboration of four teams, each with specific expertise required to design and develop the theoretical and practical elements of the project. These included five teams based at the University: three discipline expert teams (Paramedic, Physiotherapy, and Nursing lecturers); academic advisors as educational technology experts; and an MMR development team providing MMR platform choice and integration advise.

Design of Prototype

In this section we outline the key steps in the development of our initial mobile VR Health Hub prototype.

Design Principles
The design principles identified in the literature review provided a foundation upon which to choose an appropriate ecology of resources to support and implement the project.

Mobile VR Ecology Of Resources
The ecology of resources has six core elements: a project collaborative hub, enabled by BYOD devices and low-cost HMD technologies, simple mobile VR content creation tools, a cloud-based VR content sharing platform utilizing Seekbeak for interactive panoramas and YouTube 360 for immersive video, and user-centric content sharing platforms. Example tools utilised for each of the six core EOR elements are illustrated in figure1. These are not exhaustive, and we recognize that the selection of actual tools used may well change and develop over the life-span of the VR hub project.

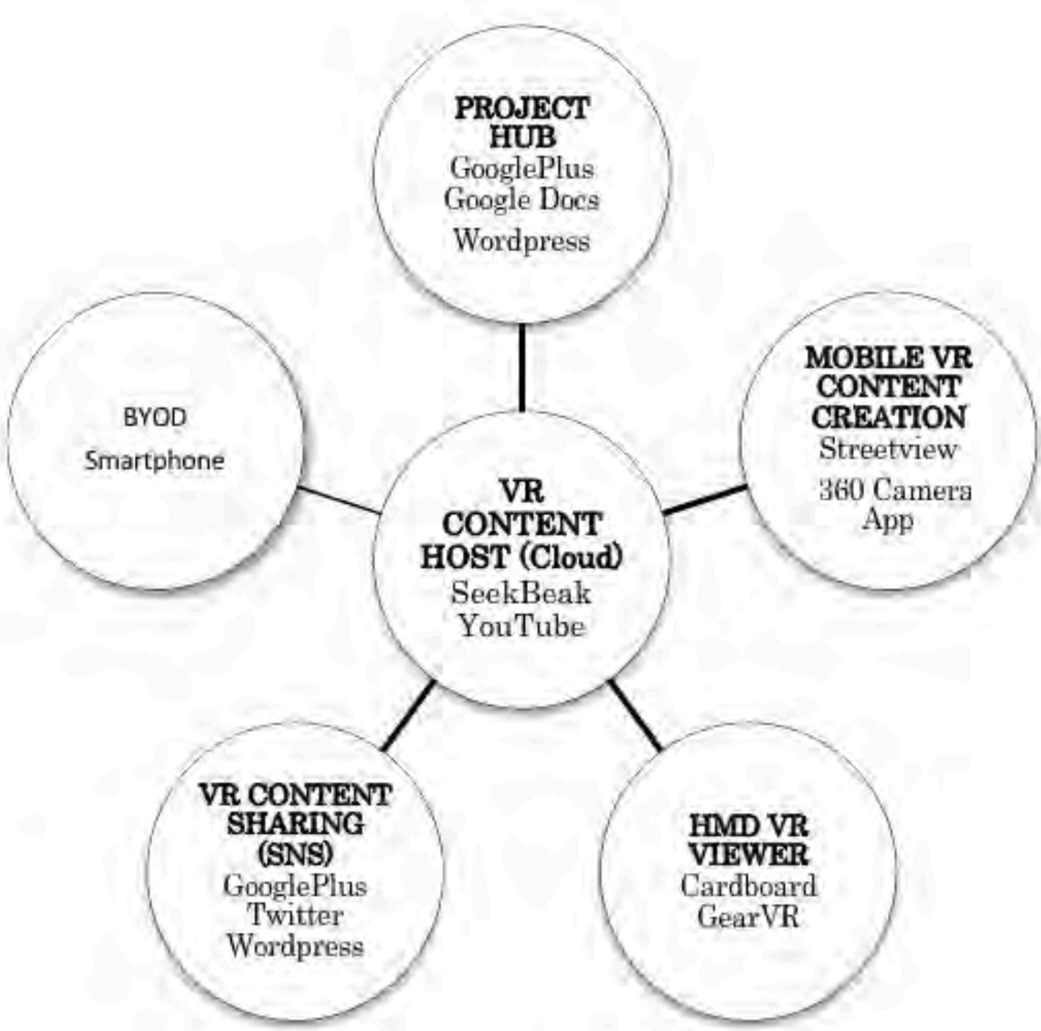

Figure 1: Mobile Virtual Reality Ecology Of Resources

Development Workshop

The research team were invited to a collaborative day-long workshop to introduce the ecology of resources and in particular to provide a peer-support group in the use of the development platform, SeekBeak. By the end of the workshop the team had developed the basic structure for three interlinked VR scenarios to introduce students to the disciplines of Paramedicine, Nursing, and Physiotherapy, as well as a basic storyboard for an interprofessional handover VR simulation.

SeekBeak Prototype

SeekBeak proved to be a simple and agile development and sharing platform for the mobile VR project. Brainstorms between the research team members led to the initial concept map of the elements of the prototype mobile VR Health Hub shown in Figure 2, and screenshots of the three prototype sections that were subsequently developed are shown in Figures 3-6. Key elements of the VR health discipline hub included a central VR hub entry page, with links to each of the seven health disciplines, and a planned interdisciplinary patient handover scenario illustrating the interaction between the seven health teams in real life. Each of the seven disciplines would feature links to further modes of resources for students and community building such as: Google Plus Communities, YouTube Channels, Twitter hashtag searches, expert and team blogs. The initial prototype of the VR Health Hub involved the development of resources for three of the disciplines: Paramedicine, Nursing, and Physiotherapy.

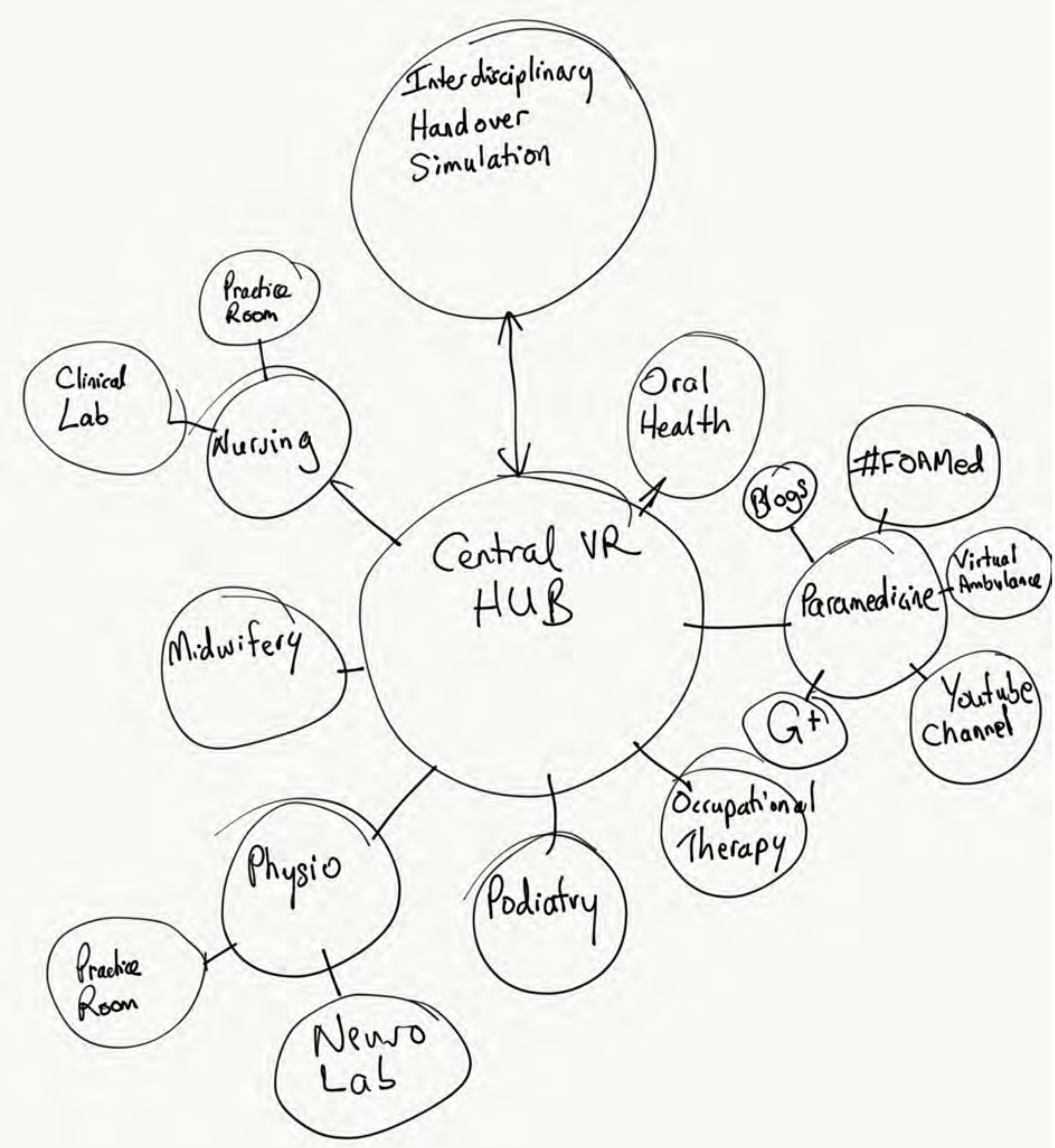

Figure 2: Mobile VR Health Hug concept map.

The link to the entry page of the VR Health discipline hub can be found at:
https://seekbeak.com/v/GYbjNx9p1A7

The screenshots (Figures 3-5) illustrate the use of visual hotspots for VR navigation, thumbnails of the VR environment sections, and basic user view statistics. Using SeekBeak provided device independent interface that could be viewed in any web browser on any device, with the option of a VR mode for display on a HMD when using a smartphone. Navigation of the VR environment in SeekBeak is determined by the display device – either mouse-based or touch-based on PCs or tablets, and gaze-based on smartphones when in VR mode for use in HMD (Head-Mounted Displays).

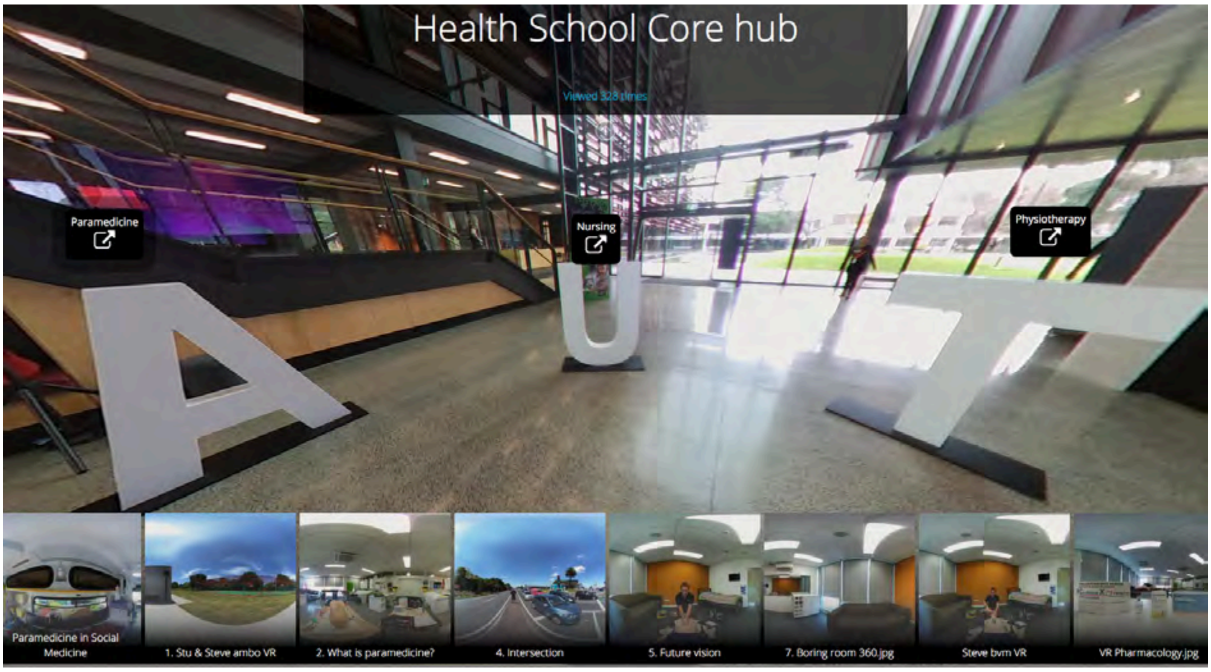

Figure 3: Entry page of mobile VR Health Hub

Figure 3 shows the main entry page of the virtual Health School Hub. Thumbnails at the bottom of the scene provide previews of the linked VR environments.

Figure 4: Paramedicine main page of mobile VR Health Hub

The Paramedicine environment (Figure 4, linked via a hotspot from within Figure 3) depicts a both a simulation suite and the back of an ambulance. We are able to provide the student breakdowns of our equipment and 360 videos of example practice simulations. Embedded within the VR scenes links are to key partner suppliers and manufacturers of equipment and medical supplies informational PDF’s or websites. This allows the student to have a clear understanding of equipment placement in the ambulances they will be in for their clinical placements. The hub allows the student to see authentic examples of equipment and see how they fit in the context of the ambulance and paramedic practice.

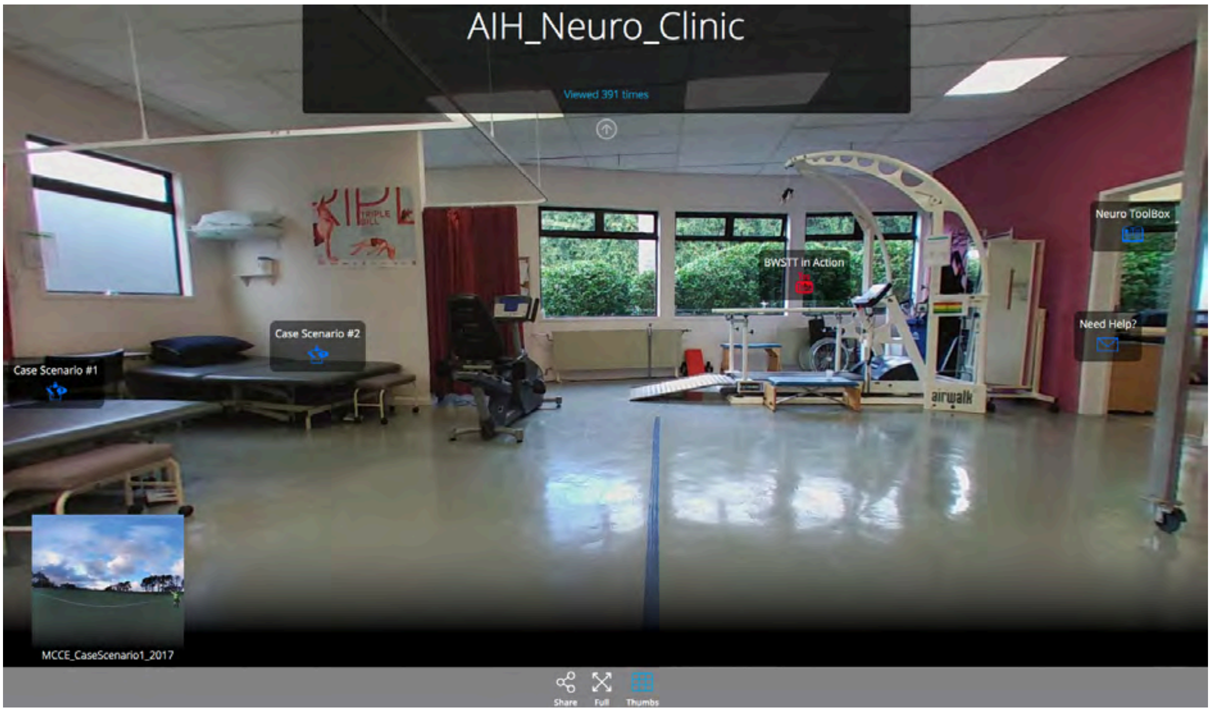

Figure 5: Physio main page of mobile VR Health Hub

The physiotherapy environment (Figure 5) depicts a typical neurological clinic. Information is provided on different types of equipment that may provide a link to a video of its use, or a question for the student to consider the clinical application of that equipment. Links to resources that they have used during their University based learning are able to be accessed within the virtual clinic (via Blackboard) and case studies typical to the clinical area are introduced (using Google Forms). Students can also access reflection forms on the use of the virtual clinic, as well as reflection on their daily experiences while on neurological physiotherapy placement.

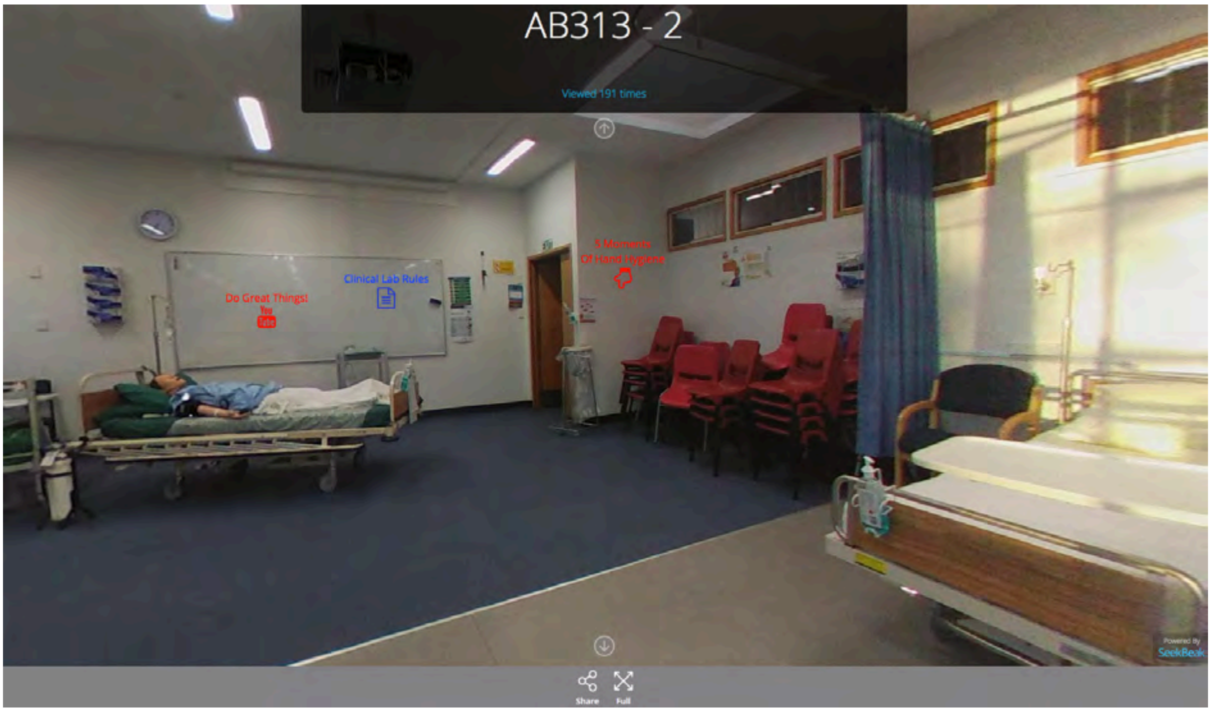

Figure 6: Nursing main page of mobile VR Health Hub

The nursing snap (Figure 6) was created to introduce new and prospective students to what they may see or experience at the university when beginning study. This includes links to information about the BHSc (Nursing) website, some of the equipment and videos of current students and graduates discussing their time at AUT. The VR room represents a ward like environment where students can learn skills prior to their practicum. For our new students, this virtual environment gives some context to what they may experience in a "Simulation Lab". Currently this snap is used in a paper where students begin their clinical paper to add context to their timetable. Students can navigate other virtual rooms that are used in blended case-based learning to allow students to notice the environment and impact this may have on their patients while collecting health information.

Discussion

In this section we discuss the key elements of the design process through implementing the identified design principles.

DP1: Basing the project within a design-based research methodology
Utilising a design-based research methodology has given the project a solid implementation structure, which has been particularly important when managing an interdisciplinary and transdisciplinary project team, and allocation of responsibilities.

DP2: Supporting the project through the establishment of a community of practice
The project represents the latest output from a community of practice of health lecturers and academic advisors established in 2015 to explore the integration of technology into authentic health education environments. The initial community of practice has expanded and grown over this time, and resulted in the establishment of trust and research informed practice as the community of practice has been recognized by the university through their establishment of a formal research cluster in 2017 to disseminate their practice, and the core team were awarded the Vice Chancellor's Award for teaching and learning.

DP3: Using heutagogy (student-determined learning) as a guiding pedagogical framework
The ethos of the project has been one of building and supporting the development capability of the end-users – the academic lecturers, in the guise of modelling student-determined learning that will hopefully filter into the future design of the curriculum.

DP4: Designing around the authentic use of mobile devices and VR
We chose an ecology of resources to support the key project goals that included the use of BYOD mobile devices and a focus upon establishing a culture of sharing and collaboration throughout the School of Health at the university. While the seven health discipline graduates will be required to work closely in interaction between various health team experts this is rarely modeled in the design of the health education curriculum. The project also serves to explore the increasing relevance of mobile devices as user-centric devices supporting health care services.

DP5: Integrate collaboration and team-work into the project activities
The interplay between the health disciplines is best illustrated in the VR Hub prototype by the interdisciplinary handover simulation (Cochrane, Stretton, et al., 2017). The lack of funding for the project has also been mitigated by the establishment of a transdisciplinary project team (Table 1) with access to various expertise and resources that have been integrated into the prototype development. The academic and technical advisors have provided support for the developers who have been the end-users (the lecturers), thus creating a development model that is not dependent upon an expensive external multimedia development team.

Future directions
The next stage of the DBR project will involve evaluating the impact of the VR health hub through gathering feedback from users – both students and department academics. The evaluation will inform the redesign of the VR Hub and the roll-out to encompass all seven health disciplines. The final stage will be exploring the potential to collaborate with other institutions who may be interested in implementing a similar methodology.

Conclusion

In this paper we have outlined the initial exploration and prototyping phases of a virtual reality health school hub Design-Based Research project. This VR environment allows students to experience core competencies and example environments for each of the seven health disciplines via a centralised single hub. Informed by a Design-Based Research methodology we have discussed the first prototype stage of the virtual health hub that has been developed using Seekbeak. The virtual health faculty hub aims to create a model for developing inexpensive mobile BYOD immersive environments that can potentially be implemented in a variety of educational contexts. Future papers will discuss the evaluation and redesign of the project prototype and refinement of the design principles.

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Comparing spaced repetition algorithms for legal digital flashcards

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This study compares two digital flashcard spaced repetition algorithms to evaluate whether the SuperMemo 2 (SM2) algorithm produces better outcomes for law student learning as measured by assessment results than the older Leitner algorithm. Academic staff prepared hundreds of digital flashcards related to an undergraduate law unit – Introduction to law. Undergraduate law students (n=47) were randomly assigned flashcards using two variations of a software program *FlashCram*, one version of which used a simple Leitner algorithm, another version the SM2 algorithm for spaced repetition. Students completed three practical assignments, two worth 10%, one worth 20%. and a theoretical examination worth 60% of their final grade. The results confirmed SuperMemo 2 to be a superior algorithm over Leitner with respect to the theoretical examination. There was no significant difference between the algorithms for practical assessment that was skills based, not dependent on memory and not subject to any significant time pressure. The results suggest that the usefulness of spaced repetition digital flashcard systems for legal studies may depend upon the nature of the assessment task.

Introduction

This article follows a series of articles exploring the use of digital flashcards in the context of legal education (Colbran, Gilding, Oyson, Nauman, 2017; Colbran, Gilding, Marinac, Saeed, 2015; Colbran, Gilding, Colbran, 2014).

Colbran et al (2015) explored digital flashcards as a method to teach contract law. The empirical design involved three randomly selected cohorts. Two experimental groups were provided with digital flashcards and printed flashcards, respectively. The control group was not provided with flashcards. Participants were surveyed and an interview was conducted with the academic coordinator. Undergraduate law students responded positively to the use of flashcards, although the use of the flashcards made no statistically significant change in their assessment results. The 2015 research did not involve any spaced repetition system merely the absence or provision of printed or digital flashcards. There was also an absence of scaffolding. The flashcards were not integrated into the study notes nor were students given any instruction on how the cards could be used to assist with memory retention

Colbran et al (2017) considered the impact of student generated digital flashcards on student learning of constitutional law. It was anticipated that a 'learning by doing' approach (students creating their own flashcards), opportunities for collaboration (students sharing flashcards) combined with an authentic task would improve outcomes from the use of flashcards. The assessment task was one undertaken over several weeks without any need for content to be memorized. It was clear that students did not value the exercise. Students did not find their creation of flashcards assisted them with examination preparation. They found the production of flashcards to be a challenging exercise and expressed a preference for problem-based assessment rather than creating flashcards.

The above research suggests that the full potential of flashcards identified by Colbran (2014) was not being realized by law students. Several clues to this issue were evident in former studies: the usefulness of flashcards may relate to the form of assessment (assignment or skills-based versus examinations), the extent of memorization of content associated with assessment tasks, time pressure, the level of scaffolding provided, and the use of spaced repetition systems. This article sought to examine all these issues in the context of legal education.

There are several commercially and publicly available sources of flashcards for legal education; for instance, on the website www.flashcardexchange.com and *Law in a Flash* distributed by Aspen Publishing, which have now been developed into mobile phone applications. The flashcards developed in these sources are, however, generally electronic versions of old-fashioned typed or handwritten cardboard flashcards. They have not taken advantage of multimedia elements within the construction of the flashcards or spaced repetition algorithms to assist with memory retention.

This research used a web-based product, named *FlashCram* (Colbran, 2017) to enable the development and distribution of many new types of digital flashcards for legal education. Digital flashcards extend the design of a physical two-sided printed card to incorporate further dimensions (such as hints or prompts), hyperlinks, digital media (audio and visual), data analytics and interactive exercises.

In other disciplines, the use of flashcards is more widespread and the concept of an “electronic flashcard” as a node of information, linked in flexible and creative ways into wider networks of information, has become more prevalent. Examples include diverse fields such as language studies (Dogidovic, 2013; Albers and Hoffman, 2012; Altiner, 2011; Basoglu and Akdemir, 2010), organic chemistry (Pursell, 2013), psychology (Golding, Wasarhaley & Fletcher, 2012) and air traffic controlling (Qinetiq North America, 2012).

Spaced Repetition

Many studies have concluded that spacing tests of memory recall produces superior memory retention (Carpenter et al, 2012; Delaney et al, 2010; Cepeda, 2006). Spaced repetition, a term coined by Woźniak (1990), is a memory technique which may be used with flashcards to overcome the forgetting curve identified by Ebbinghaus (1885) – figure 1. The forgetting curve suggests that memory recall falls exponentially to around 28% after two days of encoding the memory.

This phenomenon has significant implications for education in the form of or based on the retention of knowledge. For example, in legal education, it is difficult to learn the subject civil procedure, if there is no knowledge of causes of action based on retained prior knowledge of contracts or torts.

While it is clear that testing improves memory compared with study alone (Roediger & Karpickle, 2006; Larsen, Butler & Roediger, 2013), there is a common myth that cramming (short repetition spacing) is more effective than long repetition spacing (Zechmesiter & Shaughnessy, 1980) for memory retention. The generality of the spacing effect however is not consistent across domains. Cepeda (et al, 2006, p. 355) notes:

> Moss (1996) reviewed 120 articles… conclude[ing] that longer ISIs facilitate learning of verbal information (e.g., spelling) and motor skills (e.g., mirror tracing); in each case, over 80% of studies showed a distributed practice benefit. In contrast, only one third of intellectual skill (e.g., math computation) studies showed a benefit from distributed practice, and half showed no effect from distributed practice.

Just as there are inconsistent effects of spaced repetition in some domains such as motor skills (Wulf & Shea, 2002) it is possible that spaced repetition systems will only be useful where memory retention rather than temporary acquisition is the desired learning goal. For example, law assessments based on application of skills to derive an outcome over an extended period of time have less need for memory retention, compared with theory examinations under time pressure, where application of memory to problems is of critical importance. Our current study is unique in that it examines the impact of two spaced repetition systems across skills based and memory-based assessments.

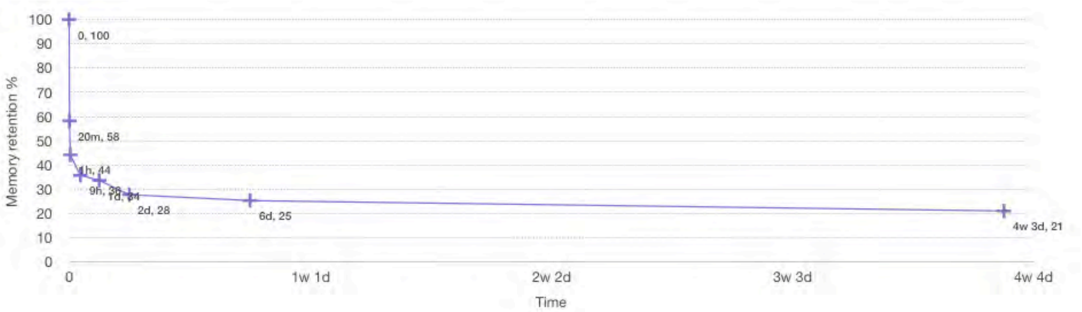

Figure 1: Ebbinghaus forgetting curve 1885

Spaced repetition affords the opportunity to retain memory by overcoming the impact of Ebbinghaus’s forgetting curve - see figure 2. In essence, tentative memory in the form of neuron pathways associated with new memories are reinforced through repetition. Repeated retrieval appears to be the key to long-term retention of information (Karpicke, Roediger, 2007). A useful summary of the literature has been prepared by Gwern (2018). Regression analysis is a common methodology used in examining the effects of spaced repetition, e.g.

(Rohrer, Taylor, 2006; Seabrook et al, 2005), as is the use of ANOVAS, e.g. (Maass et al, 2015; McDaniel et al, 2013).

Apart from naming spaced repetition, Woźniak's major contribution was to study and systematize the optimum interval for spaced repetition in a series of SuperMemo algorithms implemented on paper and ultimately by computer. The history of his achievement can be found at https://www.supermemo.com/en/articles/history including the detailed description of the SuperMemo2 algorithm used in our research. The great advantage of spaced repetition systems is the ability to recall in excess of 90% of encoded information from permanent memory.

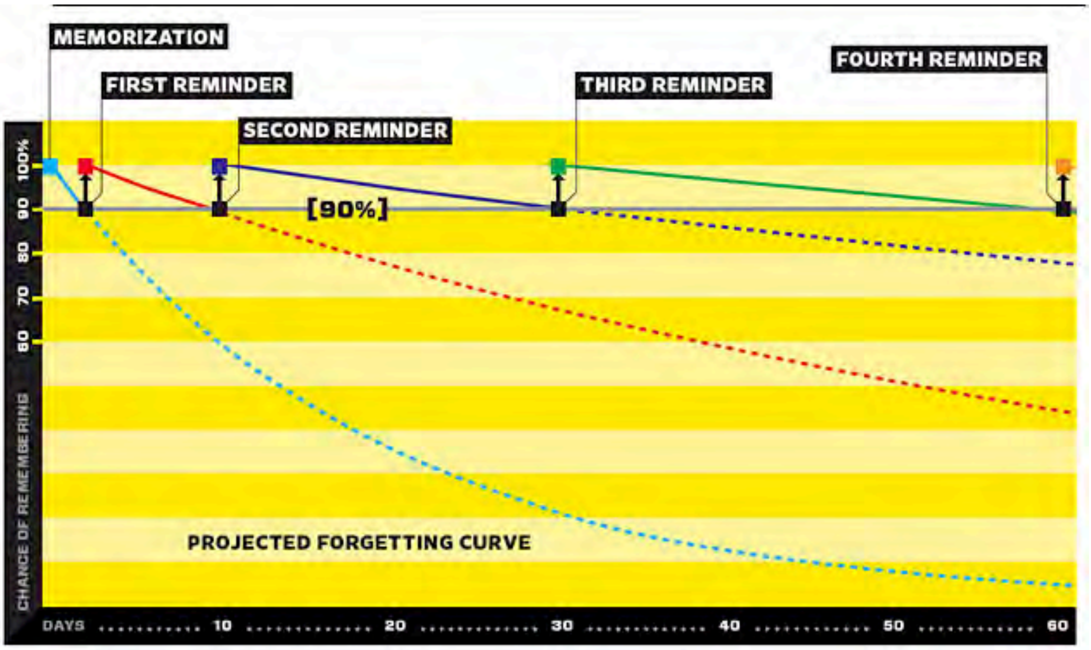

Figure 2: Projected forgetting curve
Source: http://www.gwern.net/Spaced-repetition <accessed 30 April 2018>

Our research involves exposing experimental groups with two spaced repetition algorithms: The Leitner box system and the SuperMemo 2 algorithm. The Leitner system developed by Sebastian Leitner in 1972 is a simple design to enhance memory retention. In the Leitner system, flashcards are grouped into packs of increased levels of memory retention - or current levels of knowledge. Correct answers progress a flashcard to a higher-level pack, incorrect answers revert a flashcard to the lowest level pack. Common Leitner systems have five levels of flashcard packs. The version of the Leitner box system used in this research does include fixed static intervals. Lower level packs are reviewed more often than higher level packs, e.g. pack 1 - 1-day review cycle; pack 2 - 3 days; pack 3 - 7 days; pack 4 - 15 days; pack 5 - 20 days. As the information is committed to memory and user responses to questions are accurate all flashcards move to the 5th level. The Flashcram software encoded the intervals into a bring up system based on the cycle review outlined above. Woźniak (2018) argues the original Lietner box system is a prioritization tool rather than a spaced repetition tool. Woźniak (2018) however acknowledges that 'When the Leitner box is used regularly on a small-sized collection of flashcards, it simulates the behaviour of spaced repetition.' That is the exact approach used in our study.

Progression to higher levels of memory retention reduces the inefficiency of frequently repeating information already memorized. The order of flashcards and the spacing of their display is designed to optimise memory retention by focussing attention on flashcards in which the user responses contain errors or misunderstandings. Groupings may be based on automated marking of cards – e.g. based on multi-choice or pre-set answers - or may be set by the user as they review their response to a card. A user may perceive a particular concept or task as difficult requiring more repetition to be understood and memorized. Hence the flashcard should be placed in pack 1 on a more frequent repetition cycle.

Leitner systems, while widely used and traditionally print based, have in recent times been recreated in a digital flashcard environment. Users may specify the number of flashcard boxes and also the sequencing of the spaced repetition. More complex algorithms may be implemented, that adjust to determine the optimum rate of repetition for each individual learner's memory retention.

The SuperMemo (SM2) algorithm is said to be a more advanced spaced repetition system developed by Piotr Woźniak from 1985 onwards. This system optimizes expanding spacings rather than fixed intervals associated with the version of Leitner used in this research. The SM2 algorithm is defined at http://www.supermemo.com/english/ol/sm2.htm. SM2 algorithm separated items previously grouped in pages and introduced E-Factors – an easiness factor reflecting the easiness of memorizing and retaining a given item in memory. The E-Factor was initially set at 2.5 and decreased with errors in memory recall. E-Factors could fall to 1.3 before recalculation. The quality of the repetition response was graded from 0-complete blackout to 5, a perfect response. Repetitions are continued until all items score at least 4 (correct response after hesitation). The SuperMemo system seeks to apply optimization procedures to smaller items of memory and also differentiates items based on their user's perceived difficulty. Woźniak reports long term information retention rates of 92%.

From the perspective of a law student, they would view flashcards presented in the order determined by the spaced repetition system they were allocated. Students sitting side by side, each using a different algorithm, would be aware of the method by which flashcards were presented. Leitner presents a correct or incorrect solution, whereas SM2 presents six choices: 5 - perfect response, 4 - correct response after a hesitation, 3 - correct response recalled with serious difficulty, 2 - incorrect response; where the correct one seemed easy to recall, 1 - incorrect response; the correct one remembered, 0 - complete blackout. In both cases the algorithms adjust to the individual's memory performance.

Hypothesis

In this study our research hypothesis is that the SuperMemo 2 (SM2) algorithm will produce better outcomes for law student learning as measured by assessment results than the older Leitner system. The null hypothesis is that there is no significant difference between the two-spaced repetition system and that any observed difference is due to sampling or statistical error. It is anticipated that this effect will be more pronounced where memory retention is an important feature of an assessment task, such as a theoretical examination under time constraint in comparison to practical skill-based exercises without any significant time pressure.

Methodology

A set of 443 digital flashcards (See Figure 3) were created for LAWS11057 Introduction to Law and distributed electronically to 47 students in Term 3, 2015. The cohort consisted of 29 female (61.7%) and 18 male (38.3%) mature age students. Ethics approval was H15/11-260. The age profile of students in quartiles is shown in Table 1.

Table 1
Age profile of students

Range	Frequency	Percentage
16-24	12	25.5%
25-27	12	25.5%
28-33	11	23.4%
33-55	12	25.5%

LAWS11057 Introduction to Law is a first-year core unit included in an accredited undergraduate law degree leading to admission to the Australian legal profession. Both female and male students were separately randomly allocated into two groups. One group were given access to the Leitner spaced repetition system, the other group were given access to the SM2 spaced repetition system. There were two independent categorical nominal variables – Type of spaced repetition system and Gender (female vs male). The third independent variable was age in years.

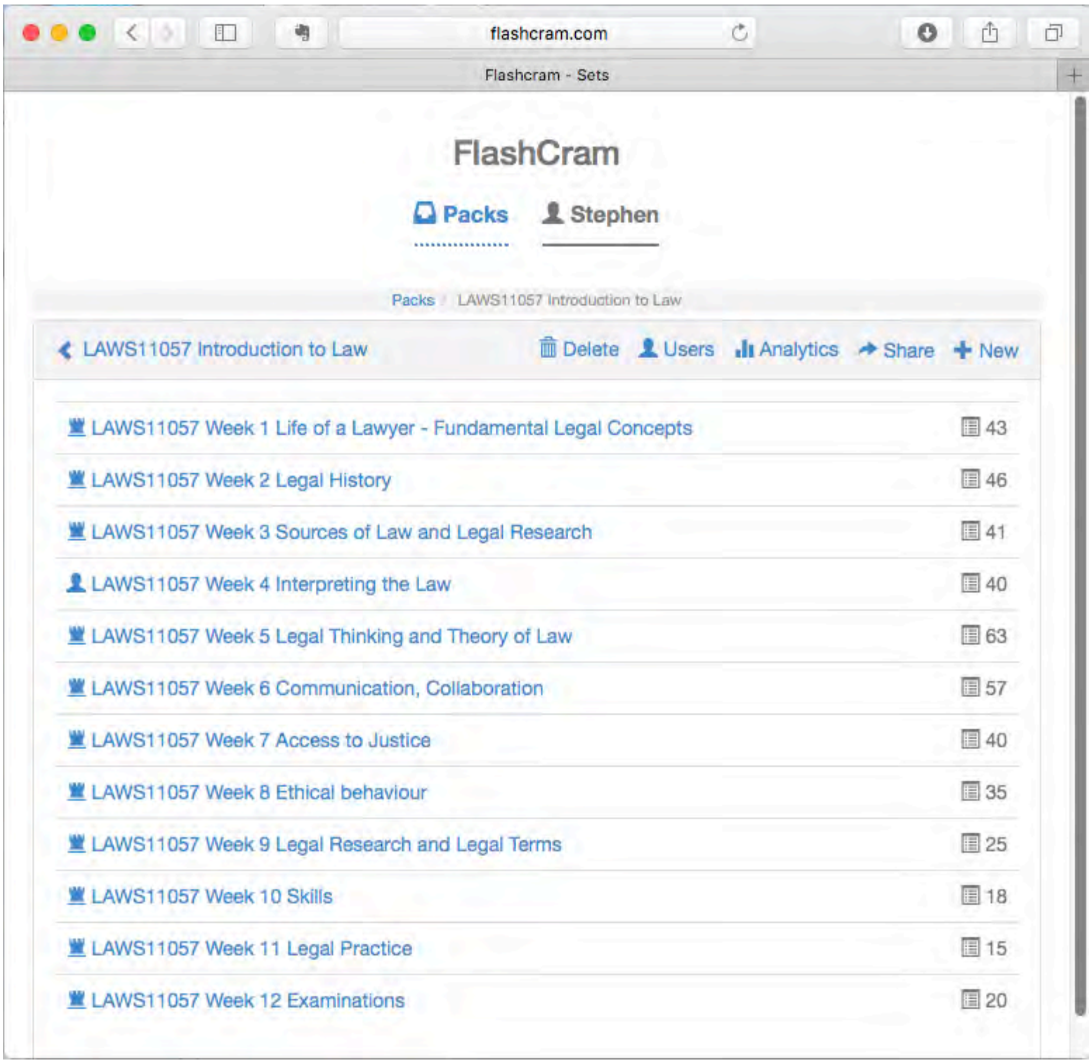

Figure 3: Topics and distribution of digital flashcards

The dependent variables were the four separate assessment items and total grade:

1. Assessment 1 (10.12.2015) 10% An exercise which required students to read one or more court cases supplied by the lecturer and then undertake some basic research to locate and read related material including the Australian Solicitors Conduct Rules and the university's policies and procedures on plagiarism. Students were then required to answer questions about the case(s) and the related materials in order to demonstrate understanding; at the same time commenting on the rationale for the court decision(s) and for the rules and procedures around plagiarism.
2. Assessment 2 (07.01.2016) 10% This exercise required students to locate a new piece of legislation meeting the description given and then answer a series of questions about the new law in order to demonstrate comprehension and an understanding of the process of law making within Australia. This exercise helped students begin to navigate around legislation sites online and forms the basis for subsequent work on statutory interpretation in Australia. Students were expected to research ancillary material including second reading speeches and explanatory memoranda to discover the purpose of the new legislation.
3. Assessment 3 (04.02.2016) 20% The third assessment task was a practical task. Students were asked to prepare a written document and also record and upload an audio-visual session that involved demonstrating legal research and referencing skills. They were required to prepare a short-written statement of up to 400 words explaining their process and the content of their video presentation. Grading focused on their technical work and communication skills.
4. Examination (15.02.2016) 60% - two-hour problem-based open book examination covering the entire unit content.
5. Unit total grade (100%) consisting of the addition of grades for all assessment items.

Results and discussion

A total of 47 students participated in the study (29 females and 18 males). The Leitner system was used by 19 students (11 females, 8 males). The SM2 system was used by 28 students (18 females, 10 males).

Pearson correlation coefficients were calculated for the variables. Type of spaced repetition system was significantly positively correlated with the final exam $r(45) = .337$, $p = .021$ and unit total $r(45) = .289$, $p = .049$. The SM2 algorithm was associated with better outcomes on the final exam and unit total than the Leitner system.

Gender was significantly negatively correlated with the final exam $r(45) = -.414$, $p = .004$ and unit total $r(45) = -.388$, $p = .007$. Males were associated with worse outcomes on both the final exam and unit total compared with females.

Assignment 1 was significantly positively correlated with assignment 2 $r(45) = .493$, $p = .000$, assignment 3 $r(45) = .671$, $p = .000$, the final exam $r(45) = .633$, $p = .000$ and unit total $r(45) = .713$, $p = .000$. People who did well on assignment 1 tended to do well on later assessment and overall unit result. The same was evident for assignments 2 and 3. Assignment 2 was significantly positively correlated with assignment 1 $r(45) = .493$, $p = .000$, assignment 3 $r(45) = .631$, $p = .000$, the final exam $r(45) = .509$, $p = .000$ and unit total $r(45) = .624$, $p = .000$. Assignment 3 was significantly positively correlated with assignment 1 $r(45) = .671$, $p = .000$, assignment 2 $r(45) = .631$, $p = .000$, the final exam $r(45) = .803$, $p = .000$ and unit total $r(45) = .896$, $p = .000$.

Exam results were positively correlated with type of spaced repetition system $r(45) = .337$, $p = .021$, assignment 1 $r(45) = .633$, $p = .000$, assignment 2 $r(45) = .509$, $p = .000$, assignment 3 $r(45) = .803$, $p = .000$ and unit total $r(45) = .979$, $p = .000$, but were negatively correlated with gender $r(45) = -.388$, $p = .007$. Final unit correlations were similar. Final unit results were positively correlated with type of spaced repetition system $r(45) = .289$, $p = .049$, assignment 1 $r(45) = .713$, $p = .000$, assignment 2 $r(45) = .624$, $p = .000$, assignment 3 $r(45) = .896$, $p = .000$ and final exam $r(45) = .979$, $p = .000$, but were negatively correlated with gender $r(45) = -.388$, $p = .007$.

The box plot of Exam by Type (see Figure 4) and an ANOVA (Sig = .021) (see Table 2) confirmed superior results for the SM2 algorithm (x = 38.11) over the Leitner algorithm (x = 28.0). The difference was 10.11% on average for the final examination.

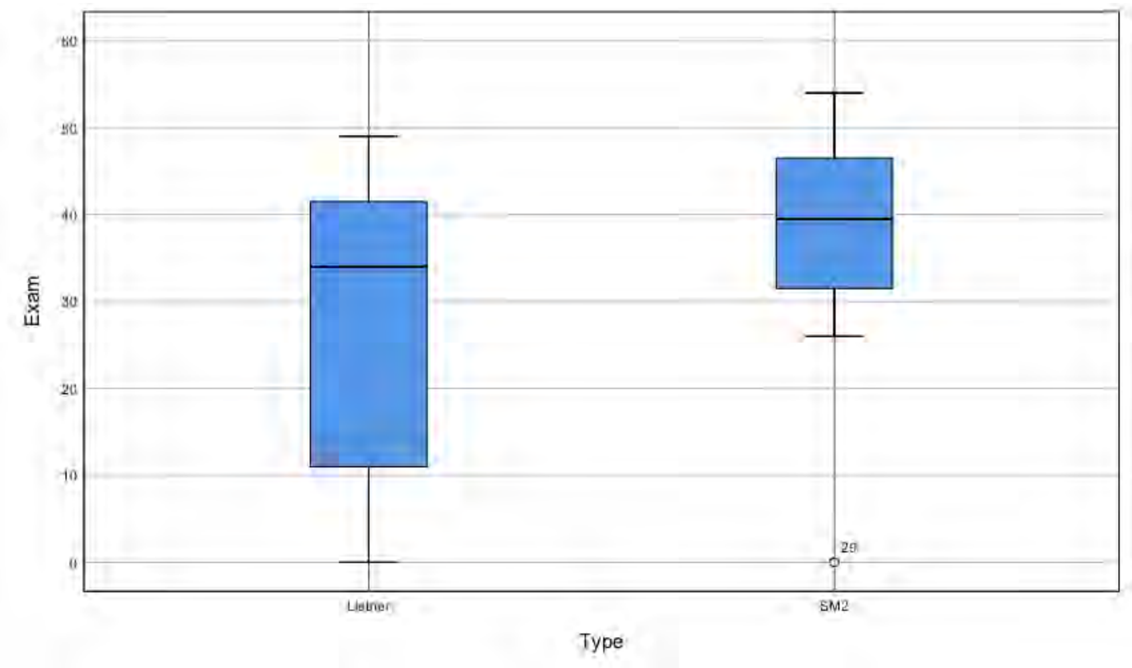

Figure 4: Exam and Type of Spaced Repetition Box plot

Table 2
Assessment and Type of Spaced Repetition ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Assignment 1	Between Groups	4.979	1	4.979	2.354	.132
	Within Groups	95.159	45	2.115		
	Total	100.138	46			
Assignment 2	Between Groups	7.677	1	7.677	2.412	.127
	Within Groups	143.238	45	3.183		
	Total	150.915	46			
Assignment 3	Between Groups	69.734	1	69.734	3.317	.075
	Within Groups	946.138	45	21.025		
	Total	1015.872	46			
Exam	Between Groups	1749.230	1	1749.230	9.302	.004
	Within Groups	8461.746	45	188.039		
	Total	10210.979	46			
Unit total	Between Groups	3044.461	1	3044.461	7.969	.007
	Within Groups	17192.018	45	382.045		
	Total	20236.479	46			

These results partially confirm the research hypothesis is that the SuperMemo 2 (SM2) algorithm will produce better outcomes for law student learning as measured by assessment results than the older Leitner system. This was only in relation to the final examination and unit total. Unit total being 60% comprised of the final examination results.

There were significant age effects as shown in the Assessment by Age ANOVA – see Table 3 - for all items of assessment apart from assignment 2. Participants in the age range 22-25 achieved relatively poor results on all assessments.

Table 3
Assessment and Age ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Assignment 1	Between Groups	72.701	22	3.305	2.891	.006
	Within Groups	27.438	24	1.143		
	Total	100.138	46			
Assignment 2	Between Groups	88.227	22	4.010	1.535	.154
	Within Groups	62.688	24	2.612		
	Total	150.915	46			
Assignment 3	Between Groups	788.122	22	35.824	3.775	.001
	Within Groups	227.750	24	9.490		
	Total	1015.872	46			
Exam	Between Groups	6921.312	22	314.605	2.295	.025
	Within Groups	3289.667	24	137.069		
	Total	10210.979	46			
Unit total	Between Groups	14704.645	22	668.393	2.900	.006
	Within Groups	5531.833	24	230.493		
	Total	20236.479	46			

The box plot of Exam by Gender (see Figure 5) plus an ANOVA $F(1, 45) = 9.3$, $p = .004$ (see Table 4) confirmed superior results for females (x = 38.83) over males (x = 26.28) in the exam. The difference was 12.55% on average. There was no significant difference on assignments 1, 2 and 3 between genders.

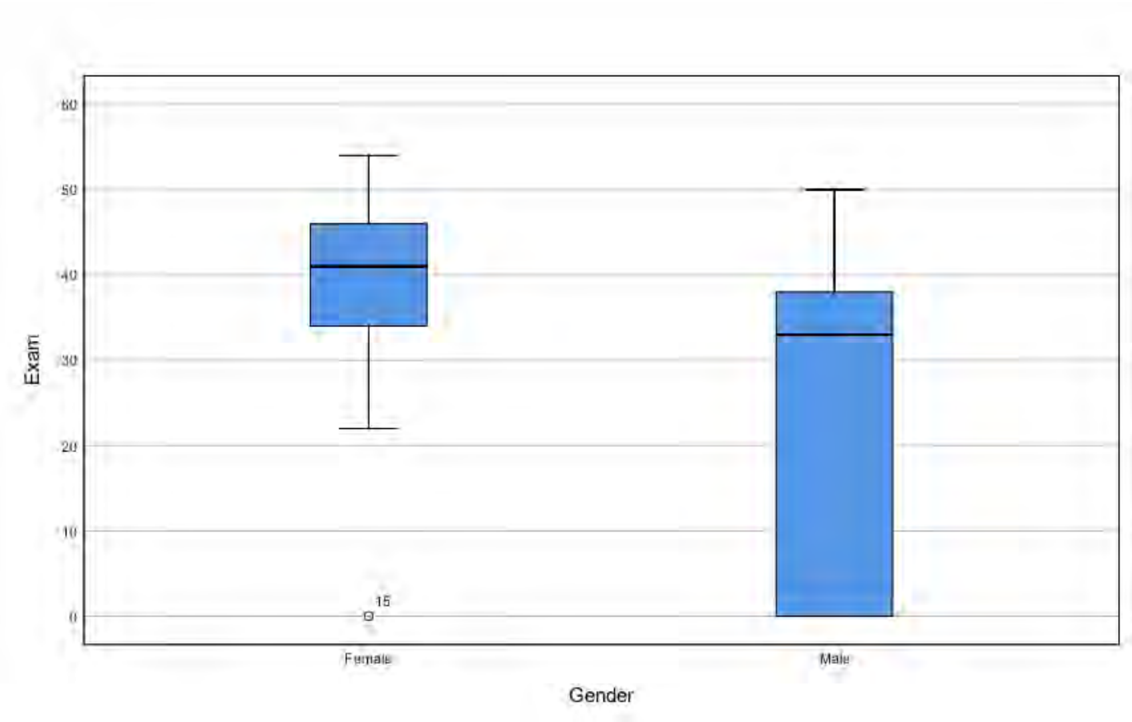

Figure 5: Exam and Gender Box Plot

Table 4
Assessment and Gender ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Assignment 1	Between Groups	4.979	1	4.979	2.354	.132
	Within Groups	95.159	45	2.115		
	Total	100.138	46			
Assignment 2	Between Groups	7.677	1	7.677	2.412	.127
	Within Groups	143.238	45	3.183		
	Total	150.915	46			
Assignment 3	Between Groups	69.734	1	69.734	3.317	.075
	Within Groups	946.138	45	21.025		
	Total	1015.872	46			
Exam	Between Groups	1749.230	1	1749.230	9.302	.004
	Within Groups	8461.749	45	188.039		
	Total	10210.979	46			
Unit total	Between Groups	3044.461	1	3044.461	7.969	.007
	Within Groups	17192.018	45	382.045		
	Total	20236.479	46			

Another way to consider the data is via linear regression – see Table 5. The previous results are confirmed.

Table 5
Table of regression coefficients

Variables	B	*t*	*p*	Beta	*F*	*df*	*p*	*adj.* R^2
Assignment 1					1.785	3, 43	.164	.049
Gender	-.662	-1.524	.135	-.221				
Age	.022	.824	.414	.119				
Type	.628	1.464	.151	.211				
Assignment 2					1.206	3, 43	.319	.013
Gender	-.866	-1.593	.118	-.235				

Age	.033	.992	.327	.146				
Type	.247	.461	.647	.068				
Assignment 3					1.263	3, 43	.299	.017
Gender	-2.399	-1.704	.096	-.251				
Age	-.028	-.326	.746	-.048				
Type	.975	.701	.487	.103				
Examination					8.008	4, 42	.000	.379
Gender	-9.342	-2.558	.014*	-9.342				
Age	.085	.386	.701	.085				
Type	8.354	2.379	.022*	8.354				
Unit total					4.225	3, 43	.011*	.174
Gender	-16.181	-2.809	.007*	-.379				
Age	.222	.631	.531	.085				
Type	11.035	1.941	.059	.261				

Note.*p < .05

Conclusion

The null hypothesis that there was no significant difference between the two spaced repetition flashcard algorithms was confirmed, except in relation to the examination and overall unit results.

The research hypothesis that the SuperMemo (SM2) algorithm will produce better outcomes for student learning as measured by assessment results than the older Leitner system was confirmed in relation to the examination and overall unit results. The overall unit results were highly influenced by the final examination which constituted 60% of the overall grade.

The three earlier forms of assignment undertaken by students were practical skill-based tasks which relied less on retained memory than the final exam. It appears that memory enhancement techniques such as spaced repetition digital flashcard systems are more useful for examination scenarios requiring memory recall rather than assessments not subject to the same short time constraints and which are of a practical applied nature. It may be that spaced repetition flashcards systems assist in retaining what has been learned, rather than helping students learn the materials in the first place (Branwen, 2018). Hence flashcards can be more appropriately positioned and used in the law curriculum to ensure basic knowledge is remembered. This would be particularly important in early core units in a program of study where students need to acquire a basic stock of discipline knowledge. As part of initial teaching pedagogy students should be shown the benefits of using flashcards and how this relates to their current and future studies of law. As pointed out by Cepeda (2006, p 370) ‘A primary goal of almost all education is to teach material so that it will be remembered for an extended period of time, on the order of at least months and, more often, years.’ It is after all difficult to apply higher order legal analysis skills where students do not remember basic knowledge or remember basic research skills and procedures enabling them to locate such knowledge. Using spaced repetition with flashcards is a more viable option than spaced repetition through repeated assessment, which is expensive in terms of time and effort and unlikely to be implemented in a modern curriculum. Dempster (1989, p. 326) correctly notes that ‘Spaced reviews and tests are underutilized in the classroom in terms of their potential for improving learning. That potential appears to be vast, although it is unlikely to be realized until those familiar with the research on spaced repetitions are willing to relate it explicitly to educational issues.’

Carpenter (2012, p. 5) again notes that ‘spacing has yet to be systematically implemented in educational curricula’ and this may be due to the research having ‘not produced a clear set of recommendations for how it can be used in everyday instruction.’ … ‘[I]n order to promote long-term retention of knowledge, students should receive spaced re-exposure to previously-learned information.’ While this often does occur through review of concepts in subsequent instruction, tutorial problems, exams and quizzes it can also occur using flashcards combined with a spaced repetition system. This latter approach may in fact be more efficient for long term memory formation in a crowed curriculum, with textbooks wedded to a linear not spiral approach to education.

It is significant that a 10.11% improvement in examination results is apparent when the SM2 algorithm rather than the Leitner algorithm is used. This can represent a whole grade level for students, which is important for honours and competitive employment opportunities in the legal profession. The literature on spaced repetition would also suggest that such memories will be retained for the long term. In disciplines where basic retention of knowledge is important, such as in law the SM2 algorithm has much to offer.

There are obvious limitations associated with this research. Spaced repetition flashcard systems may have different effects associated with different types of assessment. In considering intellectual skills, it may be important to distinguish between tasks involving practical skills compared with theoretical examinations, whether the examination is open or closed book, students at different stages of their law degree, as well as the influence of time pressure. Similarly, future research can compare more recent versions of SuperMemo which include more advanced algorithms, and include a control group of participants with or without digital flashcards, but no spaced repetition system. Future research could also use more sophisticated regression-based analysis to explore whether the SuperMemo 2 algorithm can predict performance in specific forms of assessment. Finally, the research could be extended to determining whether the positive effect of spaced repetition flashcard systems on examination outcomes also extends to improved performance after different retention periods. In other words, will second and third year students remember the content from their first-year introduction to law unit? And if so over what period of time?

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Digital Literacy Expectations in Higher Education

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Despite the widespread use of the term digital literacy, there is no common understanding of what it means or what skills and capabilities should be captured within it. The impact for higher education is that the term is misunderstood and significant assumptions are made regarding students' digital literacy capabilities. The study reported in this paper explores the mismatch between academic expectations and perceptions of students' digital literacy capabilities. Data was collected via a survey distributed to all Australian higher education institutions. Outcomes indicate that academics expectations are far higher than what they observe of students' digital literacy capabilities and that digital literacy skills are not being adequately scaffolded and extended through the curriculum. Improving digital literacy outcomes will not occur until responsibility for teaching these capabilities is explicitly expressed and actioned in the context of disciplines and that opportunities are included throughout students' educational experiences to scaffold digital literacy learning.

Keywords: digital literacy, higher education, digital curriculum

Introduction

Students are entering higher education (HE) institutions with a range of skills and expertise gained through previous education, work and life experiences. When minimum standards are expected to enable satisfactory progression through their university studies these are often articulated in terms of prior education. For example, completion of year 12 or equivalent is required to pursue undergraduate studies, or tertiary qualifications for postgraduate studies. English language is the main competency for which we have specific standards including minimum level of achievement at year 12 for domestic students, or The International English Language Testing System (IELTS) for international students for example. These provide the benchmark for students to understand what is expected of them on entry into university and are the basis from which their tertiary education will be developed. Similarly, academics and course designers can anticipate that students will have achieved the benchmark when they commence their studies and can design curricula and learning activities with this in mind. There are other competencies expected of students, which would normally be articulated as entry requirements, for example minimum standards of mathematics for engineering degrees.

One skill that is expected, but usually not articulated to students well, is digital literacy (Coldwell-Neilson, 2017). Students require this skill to enable them to negotiate online enrolments, course selections, timetable selections and the digitally enhanced learning environments that most universities in Australia now utilize. Many learning activities are facilitated through digital technology regardless of whether a student is studying on-campus or at a distance, ranging from accessing resources through a learning management system, communicating and collaborating through online discussion boards, to creating content in wikis and blogs. Further, graduates are expected to have the skills required to negotiate a digitally enhanced workplace.

Academics often assume that incoming students have the skills needed to negotiate these digitally enhanced learning environments. After all they are digital natives who use digital technologies all the time, aren't they? Due to the pervasive nature of digital technology in everyday life, students from the digital generation are assumed to be sufficiently savvy to improve their digital literacy skills and learn new skills on the fly, with little or no intervention through the curriculum. Reinforcing the perception that our students are digitally literate is the fact that they do manage to negotiate the digital systems to enrol in courses and make class selections. It is acknowledged, however, that the types of skills required in this situation may be different from those required to negotiate learning activities. But are assumptions of students' digital capabilities well founded?

The project being reported in this paper is part of a multi-stage program, aiming to develop a digital literacy benchmark for students entering and graduating from Australian HE, which will provide the foundation to extend and enhance digital competencies within the context of a discipline, align graduate capabilities with government recommendations, and improve student employability. An understanding of the required elements of a digital literacy framework to support development through the curriculum is currently being developed, but needs to be informed by the current expectations of HE institutions in general, and by the expectations of teaching academics in particular. Creating a framework which underpins an understanding of digital literacy, and which identifies the core digital literacy skills and competencies that institutions and academics expect students to have when they commence their studies, will allow institutions to articulate to students what digital skills and capabilities they need when they start their studies. This will provide a foundation from which digital capabilities can be developed and scaffolded through the curriculum allowing graduates to be better prepared for a digitally enhanced workplace. A working understanding of digital literacy has been derived from the JISC (2014) definition and captures the key elements of the 8 elements of digital literacies (Belshaw, 2011). It states that:

> … digital literacy is the ability to identify and use technology confidently, creatively and critically to effectively meet the demands and challenges of living, learning and working in a digital society.

Unlike the JISC and Belshaw's definitions, this working understanding refers to digital literacy in the singular. This concept will be underpinned by a framework which identifies the essential elements of digital literacy in the 21st century which can be contextualized to specific settings such as higher education or a discipline for example. The framework, which is currently under construction, will capture the pluralistic nature of the skills and capabilities underlying digital literacy.

The aim of this project is to explore academics digital capabilities and their expectations and observations of students' skills. This paper focuses on the latter aim, exploring academics perceptions of students' skills.

Background

There is a general understanding that students are digitally literate since they use technology extensively; this is not unreasonable given the widespread use of smartphones, tablets and other devices in our communities. But is this sufficient to prepare students for the demands of a university education and graduate employment? Although some universities provide prospective students with information regarding minimum requirements for *access* to computer technology there are limited statements regarding ability to *use* the technology (Coldwell-Neilson, 2017). Further, there is an assumption that because those born or brought up during the digital technology age, nominally from 1980 (identified as digital natives, a concept developed by Prensky in 2001), and use technology extensively, they are digitally literate. This is not the case (Ng, 2012; Denial, 2017). There is growing recognition that technology use does not necessarily equate to technology proficiency and may not contribute to transferable digital literacy expertise (Burton, Summers, Lawrence, Noble and Gibbings, 2015).

The 2014 National Assessment Program (NAP) ICT literacy report reinforces the fact that our young people *do* lack digital literacy skills. This test assesses "student ICT knowledge, understanding and skills, as well as students' ability to use ICT creatively, critically and responsibly" at school years 6 and 10. The report shows a significant decline in the mean performance of students in the 2014 test compared to previous assessments (ACARA, 2015). There is little indication that digital literacy skills grow beyond Year 10 of secondary school (King, 2018), which does not bode well for university entrants' digital literacy capabilities. A study conducted in Europe (ECDL, 2014) indicates that most people over-estimate their digital skills capabilities significantly. One example cited was of the respondents in the 15-29 age group who claimed they had 'good' or 'very good' knowledge of the internet, half of them scored at least 'bad' in a practical test.

There is growing recognition that graduates need to develop sound digital literacy skills – transferable skills which transcend disciplinary boundaries – allowing them to thrive and lead in a digitally enhanced work environment (Ferrari, 2013, Australian Government, 2015). Prospective employers have expectations of the capabilities of graduates, which have been the subject of many investigations and are routinely reported, for example, by the annual Graduate Outlook report (GCA, 2014). University curricula are normally informed by university-level statements of graduate outcomes in conjunction with requirements of specific professions through accreditation bodies and advice provided by industry advisory boards. Despite the plethora of information, the evidence is of a mismatch between employer perceptions of graduate outcomes and HE expectations of graduate employability (for example Prinsley and Baranyai, 2015). This gap extends to foundation literacies such as digital literacy which are not well-defined. Graduates need to be able to tailor their skills to meet the competency expectations of prospective employers but to do so, these must be defined and articulated.

'Australia's future workforce?' published by the Committee for Economic Development of Australia (CEDA, 2015) presents a very strong case for an increased focus on digital literacy skills. The contributors critically reviewed the requirements of today's workforce and predict future requirements, resulting in recommendations for policy, employment and education. The report suggests that "there are significant shortages in digital skills, which will become a new basic skillset in the way reading and writing are today" (p.12) and that "digital competency will be a basic competency for all workers" (p.15). The report further suggests that

> digital literacy needs to be included as a core component of school education … [and] … must continue into tertiary education and be a core component of ongoing workplace skills development (p.162).

It is estimated that over half of Australian workers will need to be able to use, configure or build digital systems in the next 2-3 years (FYA, 2015). CEDA further suggests that "[c]hanging demands … means that … qualifications and degrees need to deliver more general and also specific digital capabilities" (p.163) and that

> … technology-enabled HE requires a mindset change for which universities must focus more strongly on what their students want and what employers are looking for in graduates (Gallagher and Garrett as cited in CEDA p. 229).

The Australian Government's National Innovation and Science Agenda strongly supports improvement of digital literacy skills amongst others, which is reflected in the substantial investment in programs to boost digital literacy and STEM amongst young Australians. In parallel, the Higher Education Standards Framework requires explicit definition of course learning outcomes as well as effective scaffolding and support for student learning. In particular TEQSA's commentary on admissions clearly states that students need to be "equipped to succeed in their chosen course of study" which includes academic preparation as well as language and learning skills.

But what digital literacy skills are students expected to bring to their studies and is digital literacy being developed through the curriculum? In order to gain an understanding of what academics expect of students as far as digital literacy skills are concerned the following research questions are posed:

RQ1: How do staff perceive their digital literacy capacity?
RQ2: How do staff perceive their preparedness to teach in a technology enhanced environment? and
RQ3: What are staff perceptions of students' preparedness to learn in a technology enhanced environment?

The focus of this paper is on research question RQ3: staff perceptions of students' preparedness to learn in a technology enhanced environment.

Method

An online survey was developed using Qualtrics. Prior to deployment, the survey was validated by experts in digital literacy and survey design within the author's university. The survey was deployed for a period of 4 weeks, in the latter part of 2017, with the intention of reaching all Australian universities. Academics who are involved in teaching students (undergraduate or postgraduate) were invited to participate by completing the survey. A snowball sampling technique was used by requesting academics who received the invitation to distribute the survey amongst their own networks. The aim was to disseminate the survey as widely as possible so that the data gathered was representative, both institutionally and disciplinarily, of the Australian HE environment. The invitation to participate was sent to academics: who were known to the researcher: via networks that the researcher belonged to, such as the Australian Learning and Teaching Fellows network, HERDSA etc.; and via various Councils of Deans including Information and Communication Technology, Information Systems, Education, Science, and Business and other discipline-based forums.

Beetham and Sharpe's (2011) framework was used as the theoretical foundation of the survey. The framework is in the form of a pyramid consisting of 4 levels, commencing with access and awareness ("I have …"), followed by skills ("I can…"), practices ("I do …"), and culminating in identity ("I am …"). The survey was organized into 4 sections: respondents' self-assessment of their digital literacy skills, respondents' perceptions of students' skills, their institution's approach to digital literacy, and demographics and discipline information. All questions in the survey were optional.

A total of 471 responses were received. Of these, 55 respondents did not respond to any questions, and a further 99 respondents only answered questions in the first section. This left 317 usable responses in the section relating to staff perceptions of students' skills which is the focus of this paper. This data have been analyzed using descriptive statistics, which was deemed the most appropriate given the relatively low response rate and the number of respondents who did not answer all questions.

Results

The respondents consisted of 91 males and 194 females with 32 preferring not to indicate their gender. The age distribution of respondents is shown in table 1. Approximately 65% of respondents are 50 and under and the remaining 45% are over 51 covering a wide range of generational experience.

Table 1 – Age range of respondents

Age range	No. of respondents	%
21-25	4	1.3
26-30	14	4.4
31-40	67	21.1
41-50	84	26.5
51-60	94	29.7
61+	46	14.5
Did not indicate	8	2.5
Total	**317**	**100.0**

Table 2 shows the number of respondents within each Faculty. Respondents were from 29 Australian universities from a wide range of backgrounds and disciplines.

Respondents were asked a number of questions relating to their expectations and perceptions of their students' digital literacy skills and capabilities. Respondents were requested to answer the questions in the context of a particular unit or subject that they taught and indicate if the unit/subject they were thinking of was likely to be undertaken by students in their first semester/trimester of study at their institution; 148 respondents indicated that this was the case. Respondents were asked to respond to the statements "In week 1 of my unit/subject … I expect my students to be able to …" undertake a range of activities listed in table 3 (ie their expectations of students) and "in week 1 of my unit/subject all/some/none of my students can …" undertake these activities (ie their perceptions of students' capabilities).

Table 2 – Disciplines of respondents

Faculty	No. of respondents	%
Arts	29	9.2
Built Environment	5	1.6
Business, Economics, and related	33	10.4
Did not indicate	8	2.5
Education	71	22.4
Engineering	12	3.8
Fine Arts	2	0.6
Health and Health related	74	23.3
Humanities	2	0.6
IT and IT related	28	8.8
Law	2	0.6
Other	16	5.1
Science	27	8.5
Social Sciences	8	2.5
Total	**317**	**99.9**

Tables 3 and 4 show the number of respondents who expect students to be able to complete these activities as well as their perceptions of the capabilities of their students (categorized as all/some/none).
Table 3 refers to those respondents who indicated that their subject/unit was likely to be taken by students in their first trimester of study (referred to as junior students here) and table 4 to those respondents who indicated that their subject/unit was likely to be taken by returning students (referred as senior students here).

Table 3 – Perceived capabilities of JUNIOR students by respondents (N=148)

	I expect my students to be able to … (expectation)	**… of my students can … (observation)**		
		All	**some**	**none**
	# (%)	# (%)	# (%)	# (%)
Send me an email	143 (96)	130 (88)	15 (10)	3 (2)
Attach a document to an email	140 (94)	116 (78)	27 (18)	5 (3)
Locate unit resources online	131 (89)	53 (35)	90 (61)	5 (3)
Submit an assignment online	92 (62)	60 (40)	77 (52)	11 (7)
Manage their online storage	105 (71)	43 (29)	93 (63)	12 (8)
Word-process a document	141 (95)	115 (78)	31 (21)	2 (1)
Understand file types	115 (78)	54 (36)	87 (59)	7 (5)
Locate resources online in the library	107 (72)	31 (21)	110 (74)	7 (5)
Use search engines effectively	117 (79)	45 (30)	96 (65)	7 (5)
Understand data privacy and security	99 (67)	24 (16)	117 (79)	7 (5)
Understand digital copyright	85 (57)	24 (16)	96 (65)	28 (19)
Be able to use a discussion board	117 (79)	49 (33)	92 (62)	7 (5)
Manage their online identity	119 (80)	38 (26)	106 (72)	4 (3)
Have proficient keyboarding skills	117 (79)	59 (40)	86 (58)	3 (2)
Use social media to support their learning	74 (50)	40 (27)	93 (63)	15 (10)

Overall, respondents have very high expectations of their junior students with at least half the respondents expecting students to be able to undertake all of the activities listed. However, the only activities where respondents' expectations are almost met (i.e. where the perceived "All" is close to the expected) are "send me an email", "attach a document to an email" and "word process a document". The discrepancy between expectations and perceptions for the majority of activities is at least 60%, with some expectations hardly being met at all, most notably understanding data privacy and security and understanding digital copyright.

Bearing in mind that almost half of the respondents (n=148) indicated that the students they were thinking about were likely to be new to the institution, we need to determine if the mismatch in expected and perceived skills may have been influenced by lack of experience of the digital infrastructure in that institution. The data in table 4 shows the expectations and observations by respondents (n=169) who taught returning, or senior, students.

Table 4 – Perceived capabilities of SENIOR students by respondents (N=169)

	I expect my students to be able to … (expectation)	**… of my students can … (observation)**		
		All	**some**	**none**
	# (%)	**# (%)**	**# (%)**	**# (%)**
Send me an email	161 (95)	152 (90)	16 (9)	1 (1)
Attach a document to an email	157 (93)	143 (85)	23 (14)	3 (2)
Locate unit resources online	169 (100)	95 (56)	74 (44)	0 (0)
Submit an assignment online	149 (88)	127 (75)	36 (21)	6 (4)
Manage their online storage	136 (80)	63 (37)	101 (60)	5 (3)
Word-process a document	164 (97)	146 (86)	23 (14)	0 (0)
Understand file types	152 (90)	76 (45)	91 (54)	2 (1)

Locate resources online in the library	156 (92)	58 (34)	108 (64)	3 (2)
Use search engines effectively	158 (93)	57 (34)	110 (65)	2 (1)
Understand data privacy and security	137 (81)	31 (18)	131 (78)	7 (4)
Understand digital copyright	124 (73)	21 (12)	133 (79)	15 (9)
Be able to use a discussion board	154 (91)	86 (51)	79 (47)	4 (2)
Manage their online identity	137 (81)	51 (30)	115 (68)	3 (2)
Have proficient keyboarding skills	139 (82)	71 (42)	95 (56)	3 (2)
Use social media to support their learning	86 (51)	55 (33)	107 (63)	7 (4)

It seems that academics expectations of senior students is also very high across all categories except for using social media to support learning. Of the remaining learning activities, understanding digital copyright is the least expected with 73% of academics expecting students to be able to understand this concept. Again, the only activities where academics expectations were almost met are sending an email, attaching a document to an email and word-processing a document. Surprisingly, only 75% of academics observed that their senior students could submit an assignment online.

Respondents expectations of new students' capabilities are generally a little lower than for senior students, particularly where the activity is most likely to be facilitated through institutional infrastructure, for example submitting an assignment or using a discussion board. However, expectations are still quite high with more than 75% of respondents expecting students to be able to do nearly all these learning activities. It is concerning that senior students also do not meet respondents' expectations, with the disjoint almost mirroring that of junior students, the only exceptions being locating unit resources and submitting assignments online, both of which show substantial growth. Understanding digital copyright on the other hand has gone backwards (12% for seniors compared to 16% for juniors)! A possible explanation of this could be that respondents' expectations of senior students are higher and stricter.

A further question asked of respondents was to indicate whether or not they thought that their students entered their studies with the digital skills required to be successful learners in a digital environment. Surprisingly (or perhaps not given the expectations detailed in tables 3 and 4) 187 (59%) indicated that their students did have the necessary skills and the remaining 130 (41%) indicated that they did not.

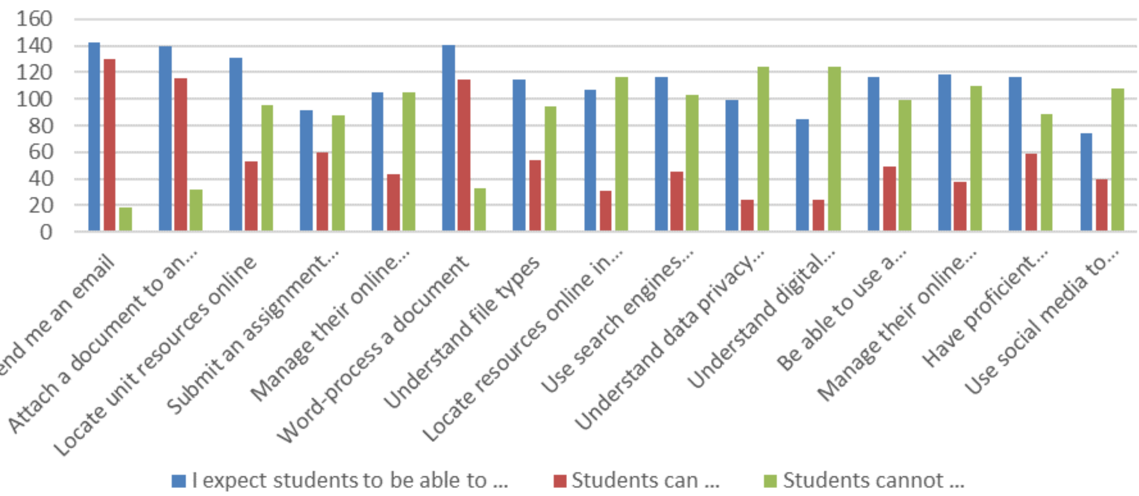

Figure 2: Expectations vs observations of SENIOR students' capabilities

Figures 1 and 2 show the data collated in tables 3 and 4 respectively as bar charts. The blue bar is the number of respondents who expect their students to be able to …, the green bar is the number of respondents who consider that their students can do …, and the red bar is the number of respondents who consider that either some or none of their students can do …. Figure 1 relates to expectations of junior students and figure 2 to expectations of senior students. These figures are a very graphic representation of the mismatch between expectations and perceptions. Implications of these results are discussed in the following section.

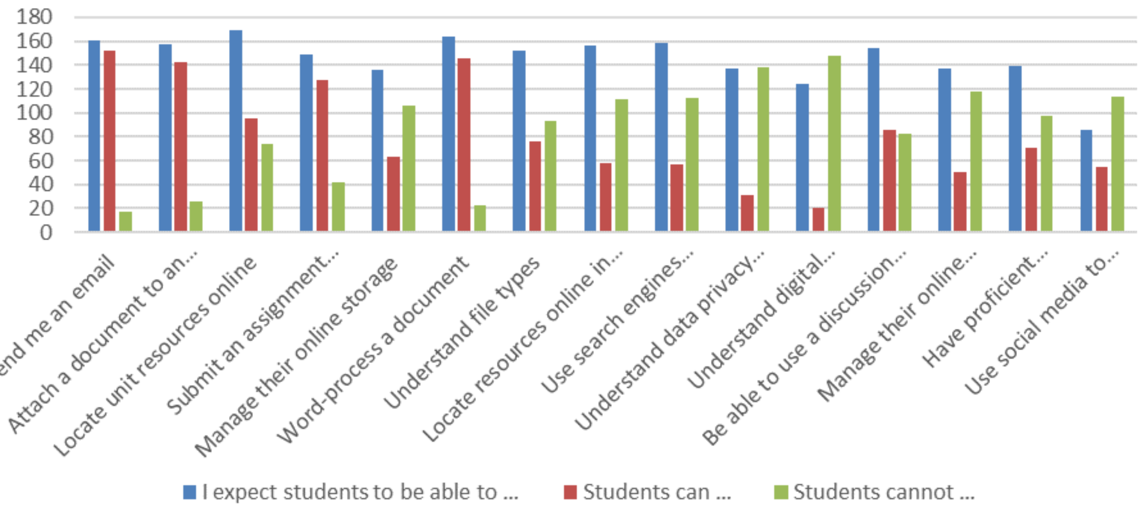

Figure 1: Expectations vs observations of JUNIOR students' capabilities

Discussion

It is clear from both figure 1 and 2 that academics perceptions of students' digital literacy capabilities are generally not meeting their expectations. Of particular concern is the ongoing lack of development that the mismatch of senior students' capabilities suggests. It seems academics expectations far outstrip what is observed in their students and it seems that digital literacy skills are not perceived to develop adequately from entry to senior years! Exploration of academics' commentary provided with the questions analysed here suggests that most academics are confident that their students pick-up the necessary digital skills required for their course throughout its duration, noting that they see improvements in their students as they progress (even if at varying paces). This confidence does seem misplaced given the strong evidence to the contrary, as indicated by Burton et al (2015) for example. However, some academics did express that they based their assumptions on the fact that they did not receive complaints or queries from students if they are having trouble. Some also noted that students who lacked in digital literacy also lacked in general literacy suggesting that they would fail the unit and hence were not of concerned. The guidelines articulated by TEQSA would suggest that this is probably not a sustainable approach to deal with lack of any literacy!

Respondents who teach at the undergraduate level commented that they expect their students to have acquired digital literacy skills through their secondary education, or expect students to self-identify weaknesses and learn in their own time. Again, this is not supported in reality given the outcomes reported by ACARA (2015) and King (2018). Those teaching at the postgraduate level had very high confidence in their students' digital literacy skills. They also expressed that they expected their students to have the specialized digital skills required from the day they commenced their postgraduate studies which they would have gained during undergraduate studies. As one respondent commented, "I generally expect that most people embarking on study at tertiary level now have proficiency in computer skills".

A number of themes appeared regularly throughout the commentary related to concerns regarding students' lack of digital literacy skills. These included:

- Ethical concerns regarding student plagiarism and not understanding copyright law.
- Students not using technology responsibly,
- Students not being able to assess the quality of information they source from the internet.
- Students do not know how to use their university's learning management system.
- Lack of time and/or space in the curriculum to teach digital literacy skills.
- Difficulty engaging and motivating students with digital literacy as students think they already know enough and do not value these skills as requirements necessary for joining the workforce.

Respondents' perceptions of students' levels of digital literacy skills on commencement of their studies yielded thoughtful and interesting comments. The main themes are summarized below:

- There is too big a gap between high school and university expectations of digital skills.
- Students have learned how to operate computers and smart devices, but not cultural/critical literacies or

to use digital tools and devices in an academic context.
- Students have learned digital skills through trial and error which does not necessarily equate to being good at learning digital skills that are beneficial in an academic environment.
- There is too much content online, and students do not have the skills to find or discriminate valuable resources.
- Students need to be taught the digital skills that apply to the learning environment to ensure they have the skills for employment
- Students (and teachers) need to be thoroughly taught how to use learning and teaching digital infrastructure, and some respondents expressed that their learning management system needs to be much simpler or of better quality.

The digital native myth equating to being digitally literate was quite persistent in the comments, leading to respondents having high expectations which are not reflected in the reality of students' digital capabilities. For example, "they are digital natives and are online all the time especially their phones" and "most are digital natives and can navigate the digital world fairly easily". One respondent simply stated that "it is expected" and another commented that "they are told they need to be able to do this", the assumption being that students will be able to learn the necessary skills without being taught or guided. Respondents also pointed out that students are unwilling to engage in online learning because they are only interested in digital tools for personal use or that "transferring their digital skills to the more complex independent learning environment of a university can be challenging". The lack of a common understanding of digital literacy was also a limiting factor with students believing that use of mainstream software and social media makes them digitally literate or that the only skill they need is the "ability to point a browser to Google".

Some respondents expressed feeling inadequate in terms of their own digital literacy capabilities when comparing themselves to their so-called digital native students. A lot of "students are better than their teachers" and students are "consumers of technology, not creators – just like me". Respondents were also conscious of limitations in their students' prior digital experiences and other factors which could inhibit their abilities. Mature age students for example, and those of low socio-economic status or students from rural and remote backgrounds may not have had the same opportunities to develop digital literacy skills as school-leavers are expected to have had. International students have the added barrier of being in an environment where English is not their first language.

Although academics appear confident in their students' digital literacy capabilities, the level of confidence is not supported in the data presented here. Of particular concern is the fact that the discrepancy appears to be ongoing throughout students' studies. One would hope that course reviews and similar quality assurance processes would highlight such a discrepancy and action would be taken to resolve it. This does not appear to be happening in the case of digital literacy. The disjoint between expected and observed levels of digital skills suggests that respondents have not revised their expectations based on their observations. Several reasons suggest themselves for this situation. One possibility is that respondents believe that students can acquire digital skills through necessity. It is also possible that respondents are not prepared to acknowledge that students' digital literacy skills are not up to standard as this would require them to address the gaps in knowledge in their teaching. Alternatively, respondents own digital literacy skills (or lack thereof) is a limiting factor in their ability to help students improve or that they believe that university interventions will resolve the issue. It will not be until CEDA's (2015) recommendation that digital literacy is scaffolded throughout students' education experiences are adopted systematically throughout courses will we see significant improvement in graduates' digital capabilities.

Conclusions and future work

Many institutions have varied cohorts of students including school leavers, mature age returning to tertiary studies, mature age undertaking tertiary studies for the first time, international students, and low socio-economic status students for example. Further it is now understood that extensive technology use does not necessarily equate to good digital practices. Unfortunately, it would seem that the digital native myth is still common in academia and there is an assumption that students will just 'pick up' the necessary digital skills in order to survive to the end of their course. Further, academics perceive it as not their role to incorporate digital literacy into the curriculum or that there is no room in the curriculum (teaching period) to include additional learnings.

It seems that we cannot make assumptions regarding prior digital literacy experiences providing appropriate skill levels to support tertiary learning and as one respondent put it

> I guess I have assumed that most of the young students are digitally savvy. In writing this I do wonder however whether I assume far too much.

Course curricula often do not recognize digital skills that are discipline specific or differentiate digital skills that are transferable between disciplines, perpetuating the mismatch between the skills students are expected to have and the reality of their capabilities. Responsibility for teaching digital literacy must be explicitly expressed and actioned in the context of disciplines. Digital literacy needs to be systematically scaffolded and extended throughout the curriculum, as any other skill would be, to provide opportunities for students to develop their digital skills to a level of fluency that will meet the demands of a digitally enhanced work environment. Academics must accept that digital literacy is not a skill that they can assume students have any more than language and literacy skills. Such learning skills have to be nurtured, supported and expanded if they are to grow. Since all evidence suggests that skill levels at entry to HE are not up to standard, universities have to take responsibility for assisting students to meet employer expectations.

Support to scaffold and extend digital capability, as with other skills, goes well beyond the learning skills students require. Academics also need support to extend their skills to levels where they are capable users of the digital technologies in their learning environments at least to a level of confidence to pass on to their students. As one respondent said "I teach university staff it astonishes me how digitally illiterate some of them are".

With a clear understanding of expectations of assumed knowledge and digital competencies that make up the graduate learning standard, disciplines can plan how digital competencies are developed, extended and enhanced through the curriculum – a future extension of the larger project which this study is part of, which has value at a number of levels: by informing student expectations of capability growth; informing staff expectations; advising students with credit for prior learning; identifying where remedial learning may be required; and further informs employer expectations.

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Technology-enabled feedback: It's time for a critical review of research and practice

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Globally, there are significant policy initiatives and commitment of resources towards technology-enabled feedback (TEF) adoption across the k-16 spectrum. TEF suffers from chronic problems, however. Sustained integration of TEF into curricula is infrequent; technology abandonment remains common. This paper explores the gap between TEF aspiration and adoption through a review of relevant literature. The literature review is treated as act of research; a sequential method of identifying, evaluating, and critically analysing sources was applied and is thoroughly explained. Findings are presented and discussed. These include a fundamental quality concern within the field of TEF research that may impact legitimacy of research to inform both further research and sustained adoption. Recommendations are made for addressing concerns and achieving progress.

Keywords: technology-enabled feedback, feedback, assessment, review

Introduction

For over half a century, technology has been promoted as enhancing feedback in formal testing. Increasing hardware and software sophistication have encouraged attempts to expand technology's role in enabling formal and informal processes of feedback and more generally, assessment. This in turn has led to policy initiatives and significant commitment of resources towards Technology-enabled feedback (TEF) adoption across the k-16 spectrum.

The potential of TEF is tempered by problems. Sustained integration of TEF into curricula is infrequent; technology abandonment remains common (Deneen, Brown, & Carless, 2017). What accounts for persistent gaps between aspiration and actuation? Some relevant answers lie within existing literature in terms of findings and characteristics of the literature on TEF, itself. This paper aims to address the gap between TEF aspiration and adoption through reporting findings from a systematic and critical review of relevant literature.

The objectives of the review were to:

1. Determine findings relevant to issues of TEF adoption
2. Evaluate relevant quality characteristics of literature on TEF, and
3. Present ways forward that may inform further research and approaches to TEF adoption.

Background and Perspectives

Technology-Enabled Assessment (TEA) may be understood as assessment of, for and as learning where technology is leveraged to benefit assessment experience or outcomes (Jordan, 2013). TEF then may be understood within that context, where leveraged benefit focuses on the experience or impact of feedback (Gomez et al, 2013). We draw on Hattie and Timperley's seminal work to define feedback as "information provided by an agent (e.g., teacher, peer, book, parent, self, experience) regarding aspects of one's performance or understanding (2007; p. 81).

As early as the 1960s, automated marking systems were promoted as saving time and resources in generating performance indicators, while reducing the drudgery associated with staff marking (Dikli, 2006; Warschauer & Ware, 2006). Developments in computer hardware and software led to the allowance of more varied inputs and the affordance of more than numerical scores, shifting TEF from a largely summative orientation toward provision of feedback for formative purposes (Warschauer & Ware, 2006).

The pervasiveness of the Internet during the early 2000s gave birth to a plethora of TEF applications such as web-portals, online discussion forums and learning management systems giving teachers the opportunity to directly interface with TEF, evaluating and delivering feedback more quickly to students (Warschauer & Ware, 2006). By the late 2000s, audio and video feedback, as well as screencasts of instructional feedback could be utilized through computers and the Internet. Through these developments, TEF evolved away from automated efficiency towards harnessing technology for providing richer, multimodal provision.

Recently, TEF has included development of computers as intelligent agents of feedback. Intelligent tutoring systems and adaptive testing engines are increasingly able to provide specific and directed feedback in response to learners' on-going interactions with computers. These systems are even capable of making data-informed recommendations on follow-up tasks intending to consolidate learning efforts.

Meta-analyses investigating the effects of computer feedback on student writing found significant positive effects on quality (Bangert-Drowns, 1993; Cochran- Smith, 1991; Goldberg, Russell, & Cook, 2003). Attali (2004) reported that through regularized TEF usage, students demonstrated enhanced capabilities in correcting errors and effectively improving their work in subsequent submissions.

There are significant causes for concern, however. Studies on TEF over the past few decades have been directed towards demonstrating high levels of agreement and correlations between computer-generated and human scores and feedback without evaluation of merits of the actual feedback message (Burstein et.al., 1998; Attali & Burstein, 2006; Warschauer & Ware, 2006). Warschauer and Ware (2006) expressed concern that much of TEF research is funded and even carried out by companies that produce commercial TEF products. They noted we are left with doubts regarding legitimacy of results.

Thus, an examination of problems in TEF must focus both on research results, and relevant quality characteristics of the research.

Methodology

Scoping this review requires clearly defined boundaries of what constitutes TEF. In enabling feedback, technology must be more than simply enacting feedback. As such, technology is said to enable feedback only when it presents an alternative that adds value beyond that presented by a "low-tech" solution. An extensive search involving multiple passes was then conducted. A first pass with Google Scholar revealed a vast body of TEF publications, which were diverse in quality. Many of these, despite being labelled as scholarship, were found to be lacking in methodological soundness and rigor.

The search was then enhanced with hand searches on a core group of relevant high-impact journals. The reference lists of identified high-impact publications were examined and compared to identify high-impact articles that appeared frequently. Further, consultation on sources was sought from two experts in educational technology and assessment. This led to an initial list of 35 articles that met the basic criteria of inclusion. The authors split the list of articles and engaged in a two-pass system for determining quality, relevance, and methodological soundness. As this is a critical review, several articles were intentionally included to demonstrate the wide range of methodological soundness.

A reliability exercise was then conducted between the two authors (Fink, 2005). Results were compared, discussed and adjusted. Once sufficient inter-reader reliability had been established, the articles were divided between the two authors and full systematic abstracting commenced. This involved identifying a priori categories pertaining to typology, context, methodology and findings (see Table 1). Such an approach falls within the realm of meta-synthesis. Emergent categories and codes were derived from within a priori categories established separately by each author. This process was accomplished in a multi-sage progress involving both authors and an external research assistant. The authors then came together to stabilize categories, codes and axial relationships between and among them.

We adopt the perspective that reviewing literature review is an act of research (Fink, 2005). Concomitant with this is the requirement that reporting review results must include a clear account of a defensible methodology (Smagorinsky, 2008). We use the term "critical review" as our intention is to go beyond reporting a research-derived narrative of best practices.

Table 1: Processes of enabling feedback in several TEF systems

TEF System	Reported by	Technology enables feedback by		
		Acquiring	Transforming	Conveying
Websites that Host Feedback	Harrison et.al.(2013)			✔
Audio Feedback	Cann (2014); Henderson & Phillips (2014); Hennessy & Forrester (2013); McCarthy (2015)	✔		✔
Video & Screencast Feedback	Barry (2012); Crook et.al. (2012); Henderson & Phillips (2014); Henderson & Phillips (2015); Marriott & Teoh (2012); McCarthy (2015); West & Turner (2015); Yuan & Kim (2015); Phillips, Henderson & Ryan (2016)	✔		✔
Discussion Forums	Coll et.al. (2013); Shroff & Deneen (2011); Huang & Hung (2013)	✔		✔
Messaging Systems & LMS	Horvadas et.al. (2013); Lai & Hwang (2015); Burrows & Shortis (2011)	✔		✔
Adaptive Grade Release	Hepplestone et.al. (2011); Irwin et.al. (2012); Parkin et.al. (2011)	✔		✔
e-Learning Applications	Shute & Towle (2003); Van der Kleij et.al.(2015); Timmers et.al.(2013)	✔	✔	✔
Automated Marking Systems	Jordan (2011); Jordan (2012); Jordan (2013); Jordan & Mitchell (2009); Dikli (2006); Warschauer & Ware (2006); Chowdorow et.al. (2010);	✔	✔	✔
Intelligent Tutoring Systems	Narciss (2014)	✔	✔	✔
Computer Games	Shute (2011); Shute & Ke (2012); Nino & Evans (2015)	✔	✔	✔

Scope

Key constructs and terms were identified, with the core term setting scope, 'technology-enabled feedback.' The search also focused on assessment (inclusive of assessment of, as and for learning) and more specifically, feedback (inclusive of feed forward). Technology was intentionally setting as inclusive of key areas such as smartphones and mobile technology. We consider technology as a continuum from "high tech" to "low tech." Anything using computer devices and/or the internet or a more sophisticated engagement with technology was considered.

Not surprisingly, there was a high concentration of relevant papers within technology-oriented education journals. The scope of sources was intentionally set beyond just these journals, as failing to do so might bias results.

Literature search & abstraction

Search strings were derived from the scope. An extensive search of the literature with multiple passes was conducted. A core group of relevant, high-impact journals were identified and hand searches were conducted within these journals. Reference lists of identified high-impact publications were examined. Finally, expert consultation on sources was sought from two scholars in educational technology and educational assessment. An initial list of 35 articles meeting the basic criteria of admission. This was reduced to 25 articles through a two-pass system for determining quality and eliminating unqualified articles (Fink, 2005). As this is a critical review, articles from high-impact journals were intentionally left in demonstrating a range of methodological soundness.

A reliability exercise was conducted between the two authors until a kappa score of .8 was achieved (Fink, 2005). Following this, article abstraction was conducted using a priori categories according to quality, typology, context, methodology and findings.

Analysis

Within a priori categories, emergent categories and codes were derived. This was accomplished in a multi-stage progress involving both authors and an eternal research assistant. Initial emergent categories and codes were established by each author, separately. Then, the authors came together to stabilize categories, codes and axial relationships between and among both. An approach was adopted similar to the multipass approach advocated by Saldaña (2015) for analysing qualitative data.

Results of the Review

The analysis surfaced three primary areas for exploration. These pertain to how feedback is enabled, how TEF systems are evaluated, and how they perform.

Enabling Feedback

Feedback provision involves the acquisition of information from learners, the transformation of the acquired information into feedback, and the transmission of feedback to the learner. Technology is said to enable feedback because it can perform at least one of these in ways that humans cannot. From this review, the majority of TEF systems use technology to only acquire and transmit information. This surfaces two categories of TEF systems – those where technology transforms information, and those where technology does not.

TEF systems that do not transform information tend to focus on acquisition and presentation of information. These typically use text and audio-visual modalities to capture, distribute, and store digital information. As technology is not involved in modifying information, some human action is necessary. Feedback processes are enabled as tutors are afforded the facility to self-record any feedback on learners' work and host them on online portals (Crook et.al., 2012; Marriott & Teoh, 2012; McCarthy, 2015; Phillips, Henderson & Ryan, 2016; West & Turner, 2015). A key concern of such TEF systems is the lack of design guidelines and principles that encourage learning and engagement. Several studies have recognized this concern and developed guidelines for implementation (Hennessy & Forrester, 2013; Cann, 2014; Barry, 2012; Yuan & Kim, 2015; Henderson & Phillips, 2014). With such TEF systems however, technology's purpose is to passively convey acquired information.

TEF systems where technology's role includes transforming information tend to focus on what technology can autonomously do with acquired information. Among these are adaptive e-Learning applications and automated scoring systems. Shute and Towle (2003) discussed the use of adaptive e-Learning applications and proposed a framework to guide their design. These systems operate by administering simple tasks and collecting information from learners. Feedback is then automatically generated or selected from a statement bank. These systems are then able to recommend appropriate follow-up tasks to check if they have internalized the feedback messages. A drawback of these systems, however, is that their operation is often limited to selected-response questions and numerical answers entered into a text field (Jordan, 2013). One approach to overcome this lies in the development of computational algorithms based on natural language processing techniques that enable computers to automatically assess free-text responses from learners (Chowdorow, Gamon & Tetreault, 2010; Jordan, 2011).

These two types of TEF systems emphasise different aspects of the feedback process and are thus evaluated differently. These approaches are discussed next.

Evaluating TEF Systems

Many of the reviewed studies assess the merits of TEF systems in consideration of their technological affordances. TEF systems where technology only acquires and transmits information are typically evaluated in terms of how conveniently these processes take place. These typically use interviews, focus group discussions, and questionnaires as their primary means of data collection.

TEF systems where technology transforms information tend to measure engagement using digitally acquired information from learner interactions, such as the amount of time spent on feedback messages (Timmers, Van

Den Broek, & Van Den Berg, 2013) and logs of activity (Chowdorow et.al., 2010; Hepplestone et.al., 2011; Parkin et.al., 2011; Irwin et.al., 2012; Narciss et.al., 2014). Some of these studies have also examined the effects of TEF systems on motivation, self-efficacy, goal-orientation, self-regulation, confidence (Harrison et.al., 2013) and achievement (Narciss et.al., 2014; Van der Kleij, Feskens & Eggen, 2015).

The various approaches discussed here reflect what these studies consider to be of merit for TEF systems. Interestingly, very few studies evaluate TEF systems based on how well they enact the principles of educational and assessment research. TEF systems are instead typically evaluated for their technological affordances and user satisfaction. Further, most of these evaluations are conducted using questionnaires and interviews conducted by researchers who are also the developers of these systems.

TEF Performance

Four different types of TEF systems have been identified for evaluation. These include audio-visual technologies, learning management systems, e-learning applications and automated scoring systems. It may be noted that only the latter two types of TEF systems involve the autonomous use of technology to transform information into feedback.

Audio-visual feedback has been reported to be largely popular for their clarity and usefulness and personalized nature (Henderson & Phillips 2014; Crook et.al., 2012; Barry, 2012; Cann, 2014). These alternative modalities of feedback provision correlate positively with improved student experience, leading to greater engagement (Phillips et.al., 2016; Barry, 2012; Crook et.al., 2012) and have led to savings in staff time (Henderson & Phillips, 2014). These modalities, however, are not without problems. Learners can suffer an initial feeling of anxiety when receiving video feedback, and some may encounter difficulties in matching video feedback to specific sections of their assignments (Henderson & Phillips, 2014).

Learning management systems allow for the convenient uploading and access of feedback information, and allow for the tracking of access statistics. Learners were found to be appreciative of the benefits offered by such systems (Parkin et.al., 2012). Further, higher performing students were found to have been more proactive in frequently accessing online feedback (Harrison et.al., 2013).

E-Learning applications have been reported to have positive effects on learner motivation, task-value beliefs, success expectancy, and academic achievement. These positively correlate to learners' efforts in seeking feedback from such systems (Timmers et.al., 2012; Narciss et.at., 2014). Moreover, the effects of such systems on learning have also been found to be largely positive.

Automated scoring systems have been evaluated based on how well they can engage learners and improve their academic performances. Chowdorow et.al. (2010) observed that learners became more selective among the corrections suggested by one such system, whereas Jordan and Mitchell (2009) noted that students do not always read computer-generated feedback, as they remain unconvinced that the system understood their responses. Moreover, automated marking systems has been found to improve academic achievement, and that suggested corrections to learner responses led to higher quality work (Chowdorow et.al., 2010).

Interestingly, most of the findings on learning and achievement were reported for TEF systems where technology is used in the transformation of information into feedback messages. Where technology functions as the enabler of information acquisition and transmission, the focus is substantially more on achieving efficiency and less so on learning. Consequently, the design of these TEF systems tends to be influenced more significantly by these outcomes, rather than by how well they enact some of the principles in education research. In the next section, we discuss the some of the implications of these findings.

Discussion

Despite the reported benefits of TEF systems, the lack of sustained TEF adoption raises several questions over the legitimacy of research findings that have seem remarkably positive.

First, it must be noted that TEF research is largely conducted by researchers who are themselves the innovators of TEF systems. Any lack of objectivity in research can therefore result in claims that are skewed towards the merits of the innovation. These include overly generic conclusions such as "the majority of students liked it and found it useful". Very few studies reported on rigorous follow-up procedures that could have absolved themselves of any suspicion of bias. Consequently, the lack of rigor and soundness in TEF research procedures may have been the cause of unjustified claims that do little more than showcase potential.

Second, many of these studies were conducted by researchers whose primary focus lies in technological development, and not in education research. As the discourse in TEF development is driven and dominated by technologists, it is inevitable that there are extensive discussions on technological affordances, and not what educational institutions require. As these fundamental requirements are not met, sustained adoption is unlikely.

Third, as technologists are not responsible for theorizing the principles of assessment and feedback within the various disciplines, they may not appreciate the specific disciplinary variations when applying their innovations in different schooling contexts. It consequently becomes difficult for education researchers to critically examine and evaluate these innovations in relation to well-established feedback principles. In terms of practice, the absence of critical evaluation in specific contexts makes adoption difficult to justify. This is especially the case as very few of these TEF systems have been developed using any theoretically informed framework. The possibilities of dissemination of best practices for continued TEF development are thus limited.

Conclusion

This review has identified possible reasons for the lack of sustained adoption of TEF systems. While substantial effort has been made to showcase the affordances of TEF systems, some of the adopted research methods appear to lack rigor and may be subject to bias. Further, a disproportionate amount of effort has gone into illustrating what actually works in TEF, as opposed to explaining why they work and who they best work for. TEF research is overly focused on technological development, with only superficial consideration for principles in feedback and assessment. It thus remains that the focus "has not been on using technologies to address fundamental educational issues" as pointed out by Nicol and Milligan (2006, p.11) more than a decade ago, despite substantial technological advancement since. Until these issues are resolved, the promise of TEF is unlikely to be fulfilled.

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Do-it-yourself e-Exams

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This paper focuses on a small case study in which we developed and tested a set of spreadsheets as a 'do-it-yourself' e-examination delivery and marking environment. A trial was conducted in a first-year university level class during 2017 at Monash University, Australia. The approach enabled automatic marking for selected response questions and semi-automatic marking for short text responses. The system did not require a network or servers to operate therefore minimising the reliance on complex infrastructure. We paid particular attention to the integrity of the assessment process by ensuring separation of the answer key from the response composition environment. Students undertook a practice session followed by an invigilated exam. Student's perceptions of the process were collected using pre-post surveys (n = 16) comprising qualitative comments and Likert items. The data revealed that students were satisfied with the process (4 or above on 5-point scales). Comments revealed that their experience was in part influenced by their level of computer literacy with respect to enabling skills in the subject domain. Overall the approach was found to be successful with all students successfully completing the e-exam and administrative efficiencies realised in terms of marking time saved.

Keywords: computerised assessment system, e-exam, spreadsheets.

Introduction and Background

In this study we set out to answer the research questions of: a) could a spreadsheet be used as a small-scale, secure, do-it-yourself exam delivery system? And, b) would students accept this approach?

This small exploratory case study is about using a spreadsheet as a response collection medium for computerised exams. This represents an interim step within a wider effort (Fluck & Hillier, 2016; Hillier & Fluck, 2017). This case is informative in terms of what can be accomplished without access to a corporate e-Assessment infrastructure. In Australia, the authors are members of an Australian Government funded project "Transforming exams: a scalable examination platform for BYOD invigilated assessment" that is investigating approaches to the development of authentic high stakes computerised assessment in higher education. The lead author and colleagues have previously articulated a range of conditions for the deployment of an e-Exam approach (Hillier & Fluck, 2013) and potential benefits linked to deploying e-Exams (Fluck & Hillier, 2016) in terms of facilitating curriculum reform towards the use of more authentic (Mueller, 2016) and relevant assessment. Jamil, Tariq and Shami (2012) also agree that using computers for assessment can improve learning by testing skills, knowledge and capabilities relevant in the twenty-first century. Although the broad aim of our work points to authentic assessment, this paper is not about it per se. Rather we focus on one method for using spreadsheets as a delivery mechanism for exams and its acceptance by students.

The spreadsheet was deployed within the open source e-Exam delivery platform developed as part of the 'Transforming Exams' project. Although the platform is not required in order for the spreadsheet elements of the approach to function, the e-Exam system used in this study provides a secured and consistent operating environment when used to boot bring-your-own laptops or desktop computers. Hillier and Fluck (2017) explain that the e-Exam platform is a modified version of the open source Linux operating system and a full office suite (Libre Office) on board a 'live' USB stick. The spreadsheet-based testing approach in this paper adds to the stock of existing methods developed under the 'Transforming exams' project that has included the use of word processors, multimedia, software programming and maths tools.

We will next review the literature related to prior work done on the use of computers for exams with the aim of developing a set of requirements for a do-it-yourself e-exam delivery approach. An overview of the study design and then details of the procedure used to develop our solution is then presented. Results from a live trial of the approach are presented that includes surveys of the student's experience and a discussion of the implications of this work.

Literature

The use of computers for testing in education has been occurring since at least the 1960s with Swets and Feurzeig (1965) writing about formative uses in medical, mathematical and language teaching. In the intervening years little progress has been made in bringing technology into the mainstream exam halls of universities where pen-on-paper exams still dominate. However, over the last 10 years there has been a substantial increase in interest from educational institutions to move away from pen-on-paper testing towards the use of computers for exams.

The recent development of approaches to e-exams has been written about by a number of researchers. We focus on efforts where the aim of enabling authentic assessment has been apparent in the approach taken. Fluck, Pálsson, Coleman, Hillier, Schneider, Frankl and Uolia (2017) discussed several exam solutions being developed and used in Europe. At the University of Iceland local area network drives have been used for e-exams since 1998. At ETH Zurich the open source Safe Exam Browser (SEB) suite of software is used with Moodle and ILIAS and is now used by numerous educational institutions around the world. In Austria at the University of Alpen-Adria at Klagenfurt, the Secure Exam Environment (SEE) system was created in 2011 (Frankl, Schartner & Zebedin 2012). SEE uses student owned laptops that are started from a network-based Linux operating system image (net-boot) that then connect through to the university's Moodle LMS via Safe Exam Browser. In Finland all universities have access to use the "eXam" system, constructed by a consortium of Finnish universities in 2017. Students use a web browser on institution owned computers that are housed in specialised video monitored 'aquarium' rooms (Kuikka, Markus & Laakso, 2014).

Other reports of e-exam developments include those by Tamm, Lattu and Lavonen (2016) in Finland, Alfredsson (2014) in Iceland, Walsh and Keiller (2014) in South Africa and Bussières, Métras and Leclerc (2012) in Canada. However, such developments are not without their risks. In USA, ExamSoft is a commercial provider that offers as an option use a BYO laptop to students taking the state Bar (law) exam in most states. In July 2014 a major glitch caused problems for multiple state exams running at the time resulting in law suits from impacted students (Associated Press, 2014; Straumsheim, 2014). This highlights the delicate nature of high stakes assessment and the need to construct robust technology.

Students have also been asked their thoughts regarding the computerisation of exams. In the UK Dermo (2009) reported on a survey of student perceptions of using the QuestionMark perception test tool at the University of Bradford. In Australia, Hillier (2014) surveyed 488 students on their pre-conceptions of using computers for exams. In general students were cautiously positive, with differences emerging between disciplines, perhaps linked to the nature of assessment tasks typically used in those areas and their level of risk acceptance around the possibility for technology failures impacting their exam.

The many solutions outlined so far all have one thing in common – they require networking infrastructure and online servers to function. In most of the above cases a live network must be functional for the duration of the exam but a network outage, even if only brief, will interrupt student's work in the exam. The avoidance of a 'single point of failure' during critical times (as seen in the ExamSoft case) should be a priority in designing a high stakes e-exam delivery system.

Many existing exam delivery solutions are largely beyond the reach of individual teachers and small education organisations to deploy in contexts where networking may be unreliable, or where IT support may be limited. The ability for individual teachers to independently utilise technology to improve their work without the prerequisites of a large institutionally supported infrastructure democratises the benefits of technology. Common tools such as a software office suite and specifically spreadsheets are powerful 'mind tools' (Jonassen 1991) that can be deployed to enhance education. In this same light, software can serve as human capability multiplier. This has benefits in both efficacy and efficiency of education. Software applications are frequently 'tools of the trade' in many disciplines and workplaces. Using a spreadsheet as part of the learning and assessment environment can allow assessors to improve the authenticity (Mueller 2016) of the assessment tasks they set. Provided e-tools are designed with ease of use in mind and that teachers are equipped with the prerequisite knowledge, then efficiency in the education process itself can be realised. This is significant for many time poor educators. Arguably this allows teachers to spend less time on administration and instead focus their efforts on the creative endeavours of enhancing curriculum and teaching activity.

Education practitioners have already developed spreadsheets that can automate assessment activity. Freney, Wood, Ellwood, Lewis and Muller (2010) developed an online toolset for marking and feedback in the form of an online gradebook that also came with a basic spreadsheet file for off-line use. Hillier's (2012) 'Excel-e-mark' extended their work into a set of scripted Microsoft Excel workbooks that did not require an Internet connection to function. Brandriet and Thomas (2015) outlined a spreadsheet tool that can be used by teachers to analyse their student's responses to the American Chemical Society Examination. Hayes and Bee (2008) designed a spreadsheet to summarise and tally grades exported from an LMS. While these tools are useful once a student's work has been submitted, the spreadsheets were not designed as an assessment environment in which students could compose their responses.

The idea of using spreadsheets as an assessment environment has been explored by others. Bradley (2013) explains how to create a simple multiple-choice quiz using Excel, but this requires manual processing of each submitted file. Blamey and Freeman (2004) created a sophisticated spreadsheet for individualised problem-based learning in a financial accounting course that included self-assessment and summative assessment of submitted student files. However, both these techniques entail hiding correct answers within the spreadsheet file that is in the hands of the student. This idea equates to 'security by obscurity' which is not well regarded (Scarfone, Jansen & Tracy, 2008). While this may be satisfactory for formative assessment, this raises the risk of cheating by copying or hacking when used for summative assessment. Therefore, if the components that determine the grade can be removed from the response composition environment then a greater level of security can be achieved.

Based on the review of the literature it would appear the use of spreadsheets that combined both an assessment environment and a marking gradebook into a single solution were scarce. The review also bought to the fore some concerns that we were motivated to address in our solution. These form sets of guiding requirements:

- Utilise standard and common spreadsheet software (leverage existing tools, minimising barriers for use by teachers and students)
- Enable automated or semi-automated marking of selected response style questions and short text responses minimising manual data entry (to realise work efficiencies of technology and minimise errors)
- Not rely on a live network during the exam (to minimise the chance of disruption and enhance teacher autonomy)
- To avoid hiding the answer key in the student portion of the system (to remove the chance a student could hack their way to the answers).

Method and Development Approach

In our development effort we focused on how we could adapt common office software, specifically a spreadsheet, for use in supervised summative assessment. The aim was to produce both an assessment response environment and an automated grading tool that would be robust and secure.

We drew on lessons learnt so far with respect to the logistics of running prior bring-your-own laptop-based e-exam sessions using the previously developed Linux bootable USB e-Exam system (Hillier & Fluck, 2017, and transformingexams.com). The e-Exam system has previously been used for offline word processor based exams (Hillier, 2015; Hillier & Lyon, 2018a,b). The procedure we followed to develop, test and refine the spreadsheet tool set is outlined below. The study was covered by the ethics approval previously gained for the e-exams trials already being conducted as part of the broader Transforming Exams project.

1. We called for expressions of interest from students enrolled in a first-year introductory Chinese language class. This class was selected because existing assessment comprised a mix of selected response and text based constructed responses.
2. A prototype of the spreadsheet toolset was created with three components:
    a. The question and response spreadsheet which did not contain any grading functionality. Each student used their own copy of this file during the exam (within Libre Office Calc, loaded onto an e-Exam USB flash drive). See Figure 3 for an example.
    b. The 'gradebook' spreadsheet containing the response and answer keys used to assign grades for each question (used with Microsoft Excel). See Figure 2 for details.
    c. The 'combine' spreadsheet file that used the 3rd party RDBmerge 'add-in' (de Bruin, 2013) for Microsoft Excel. This was used to merge data sets from individual student response files into the gradebook spreadsheet.
3. A 'practice exam' was conducted with the group of students who had expressed interest in typing their examination. The session was conducted in a collaborative learning computer suite quipped with group tables, electricity supply points and several desktop computers. Students used their own laptops in the first

instance with back-up provided by institution owned laptops and in-situ desktop computers. This session served multiple purposes:
   a. To test the proposed exam format and configuration of the student facing spreadsheet software.
   b. To ensure student's laptops would work with the Linux Bootable USB e-Exam system. If not, a back-up laptop was lent to the student.
   c. To provide students with an opportunity to practice the software start up process, to preview the working environment and try the question formats.
   d. To provide the researchers with the student's initial impressions of the process and software.
4. We collected data during the practice exam session via a pre-exam survey completed by the students (see Table 1), by observation and by system logging features of the USB e-Exam system.
5. Following the practice session, the academic tested the process to be used for merging and marking the responses based on the practice exam data responses.
6. We then adjusted the spreadsheet software. Improvements were:
   a. Changes to the layout of the exam on the screen to ensure it would fit horizontally on one screen.
   b. Setting all non-editing cells to 'protected'. This prevented accidental damage to question content, prevent copying of question text and allowed students press 'tab' to move to the next answer box.
   c. The gradebook spreadsheet was updated to include a wider range of alternative responses using wild cards and different response patterns along with partial marks for each.
7. The exam was prepared using the updated spreadsheets. The gradebook spreadsheet used one column for each question. Sets of expected responses and corresponding marks were entered.
8. The exam event was conducted in the same room as the practice session. Students were lent an institution owned laptop only where their own did not work. The procedure in the exam room was:
   a. Upon entering the exam room each student received an instruction sheet, the post-exam survey and an e-Exam system USB containing the exam spreadsheet.
   b. Each student then booted their laptop using the e-Exam system USB. A technical helper was on hand if required. All students then waited for everyone to be ready.
   c. At the 'e-exam starter' screen students entered their student ID and name.
   d. At the appointed start time the invigilator asked students to begin.
   e. The system then opened the spreadsheet containing the questions and spaces to write responses.
   f. Students typed responses into the spreadsheet. The file was automatically saved every 2 minutes.
   g. When complete, students saved their file, shut down their laptop and handed back the USB that now contained their responses.
   h. Students then completed the post-exam survey prior to leaving the room.
9. Following the exam, response files were retrieved from USB sticks via a large USB Hub. The files were then processed using the 'combine' spreadsheet via the RDBMerge Add-in within Excel. The table of collated student responses were then copied into the prepared gradebook ready for marking.
10. Marking then occurs via embedded formulae (see figure 2) in the 'results table' sheet within the gradebook spreadsheet. Marking took place automatically for selected response questions. Short text responses were iteratively marked. A new correct or partially correct response could be added to the answer key on-the-fly. Wild card characters or alternate wordings were possible. Corresponding mark allocations were then added to the key. The formulae embedded in the gradebook then evaluated responses for that question from all students against the updated marking key. This process continued until all correct variations were included. Any remaining responses not found in the answer key were allocated a mark of zero. It was also possible to add incorrect responses to specify negative or zero marks. As marking progressed efficiencies accrued with each possible response added to the key.

The steps above are broadly representative of a typical cycle for use of the e-Exam system when using spreadsheets without a live network. This workflow is depicted in figure 1.

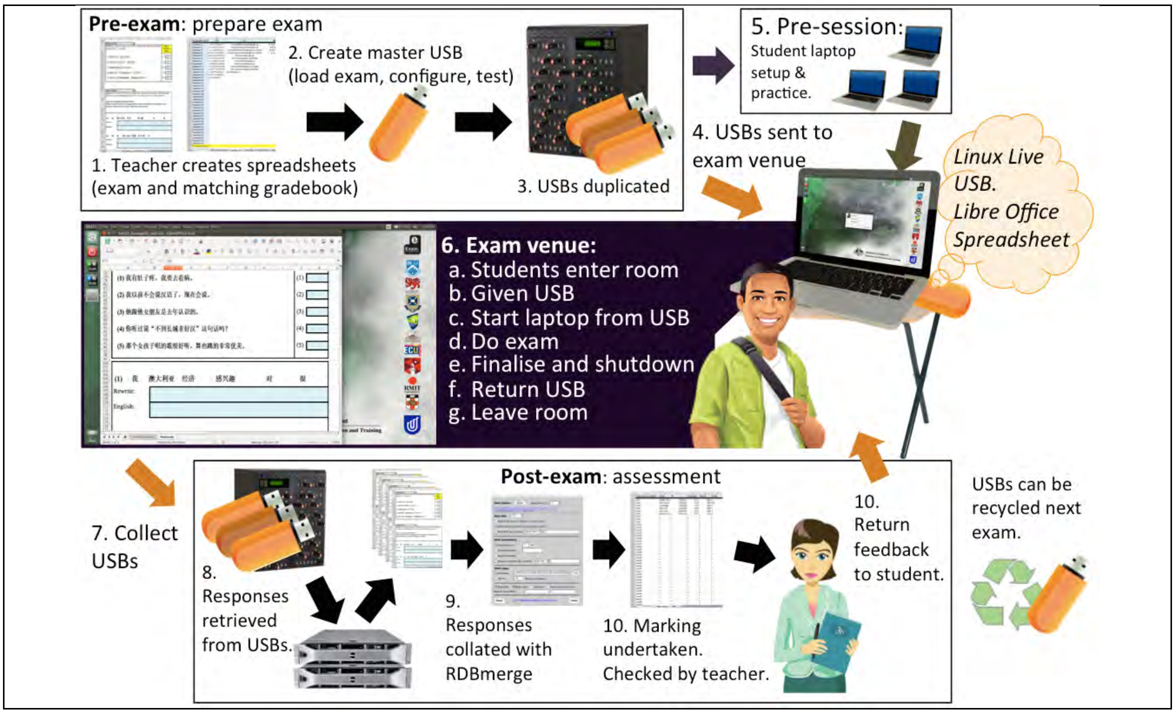

Figure 1: Offline e-Exam workflow using spreadsheets

Figure 2: Marking process in the gradebook spreadsheet

Data Analysis

Following the trial, we analysed the pre and post survey responses (n = 16) shown in table 1 using SPSS v24. Likert item data were considered to be non-parametric (Jamieson, 2004) with Mann & Whitney's (1947) U test used to check the variance of two groups (males and females). The study by Dermo (2009) supports the choice of using non-parametric tests when analysing students' perceptions of e-assessment systems. In terms of the pre-post paired Likert items, we used the 'Sign Test' to check for differences (Roberson, Shema, Mundfrom, & Holmes, 1995). Note; the requirement of a Wilcoxon Signed Ranks Test (Wilcoxon, 1965) of normal distribution of differences was not met with Shapiro & Wilk (1965) test (p = .001). It is also noted that the small sample could have impacted the accuracy of the results due to the dropping of 'ties' in the analysis (Mendenhall, Wackerly & Scheaffer, 1989). However, like Demo (2009) we do not consider the data to represent an objective truth but rather are indicative of the strength of the opinions of this particular group of students. As such we applied the statistical techniques to Likert items as one means of sense making the body of opinion in conjunction with analysis of open comment questions and observation.

Findings and Discussion

The group of first year undergraduates comprised 17 individuals at the practice session. One student did not type the exam so was excluded (n = 16). This small sample means that the statistical findings cannot be generalised beyond this group.

Students reported a positive experience of using the spreadsheet-based e-exam with most questions ranking above 4 on a 5-point scale (where 5 is most positive) on both pre and post surveys (see Table 1). When we compared their pre and post opinions using the 'Sign test', there was very little change (note missing values were dropped based in pairs). Only one item "It was easy to start my computer using the e-Exam USB stick" saw a significant drop in agreement from 4.7 to 4.1 in the post ($p = .03$) perhaps due to stress at the start of the exam. However, our anecdotal observation was that the start-up time was considerably less in the exam compared to the practice session.

Table 1: Survey items

Likert items	Pre survey			Post survey			*M*	Sign test
(Strongly Agree 5, Neutral 3, Strongly disagree 1)	*n*	*M*	*SD*	*n*	*M*	*SD*	Diff.	*p.*
The written instructions were easy to follow	15	4.3	0.60	16	4.3	0.58	0.0	n/s
It was easy to start my computer using the e-Exam USB stick	16	4.8	0.45	16	4.2	0.83	-0.6	0.03
I can use the e-Exam system just as well as my own laptop	16	4.0	0.97	16	4.2	0.54	0.2	n/s
It was easy to use the office suite (word processor / spreadsheet)	17	4.0	0.80	16	4.0	0.73	0.0	n/s
It was easy to save my response files into the correct place	10	4.5	0.71	12	4.2	0.39	-0.3	n/s
It was easy to answer the multiple-choice questions *	7	4.6	0.79	9	4.0	0.71	-0.6	n/s
I felt the e-Exam system was easy to use	17	4.3	0.47	16	4.2	0.66	-0.1	n/s
I felt the e-Exam system was reliable against technical failures	17	3.8	0.73	16	4.0	0.82	0.2	n/s
I felt the e-Exam system was secure against cheating	17	4.0	0.71	16	4.3	0.58	0.3	n/s
I now feel relaxed about using the e-Exam system for exams	16	4.1	0.62	16	4.2	0.66	0.1	n/s
I would recommend the e-Exam system to others	17	4.1	0.70	16	4.2	0.66	0.1	n/s

* This question was labelled with 'skip if not applicable'.

Each of the survey items (as listed in Table 1) were also examined for differences due to gender using a Mann-Whitney U test, however no significant differences were found (test results are not shown). The group comprised 7 females and 9 males.

In terms of logistics, while we did conduct our study in a room equipped with institution owned computers, we focused on a bring-your-own (BYO) laptop strategy in the first instance. Fluck & Hillier (2018) have argued that BYO is realistically the only financially viable approach if we wish to scale to a large number of simultaneous candidates. The combination of BYO laptops and institution computers did serve to increase the number of students that could participate. Both were booted from the live USB to provide a consistent software environment for all candidates. It is worth noting that should it be required, the spreadsheet elements of our work could also be deployed on institutional computer labs running Microsoft Windows or Apple OSX/MacOS, suitably configured for exams. However, this adds a dependency on IT support and networking.

The security feature of not including any 'answers' in the spreadsheet files used by students meant that there was zero risk of students being able to 'hack' their way to the answers. We did not find any instances of cheating in the exam and students rated it 4.3 out of 5 in terms of their agreement that "system was secure against cheating".

Relatively simple exam question types were used (multiple-choice, fill in the blank, True/False) along with short answer questions (see figure 2 for an example). The sophisticated features of the e-Exam software, such as multimedia or application based constructed responses were not in-play for this exam. This meant that the differences between doing the exam on paper and on a computer were less stark. However, students commented on the functional differences between paper and computer that pertained to the discipline context. Students contrasted the ability to hand-copy Chinese characters by visual recognition when using pen-on-paper and noted this was not possible when using the computer. A student commented:

> "Unable to copy and paste characters (like copying out characters by hand)."

Instead respondents needed to use one of the provided keyboard-based input methods (e.g. PinYin – see figure 2). Some students noted this as a reason for choosing to type the exam:

> "It's easier to type characters than to handwrite them. It is also neater." And "No requirement to learn how to write characters".

This may have implications for curriculum design and for student's approaches to assessment items in that a greater emphasis on Chinese typing and knowledge of PinYin will be required.

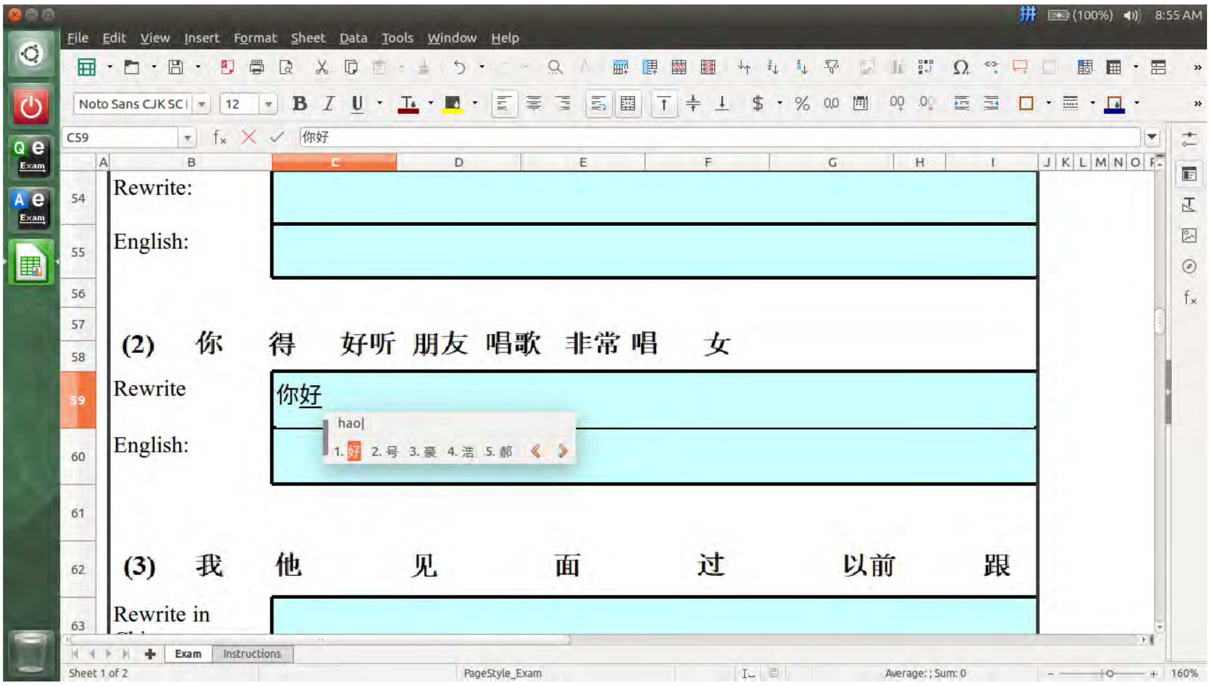

Figure 3: PinYin input within the e-exam spreadsheet

Chinese typing techniques may not be routinely taught to beginning learners and so this may need to be introduced earlier in courses where computerised exams are used. Similarly, a reduced focus on hand-writing due to e-exams may impact the value placed on it as a practice, such as for learning the stroke order for writing characters.

Conclusion

The spreadsheet approach outlined in this paper may suit use by individual teachers and smaller schools because there is no requirement for networks or servers. We argue that the barriers to getting started with e-exams are reduced by using common office software, everyday laptops, commodity USB sticks and where possible, free, open source software. Using off-the-self and open source components means it carries very little legal or financial overheads and only minimal infrastructure is required to run the e-testing approach. The approach is also flexible in that the spreadsheet components could be used in existing campus computer labs. For teachers with the knowledge of spreadsheet software the approach provides a degree of independence and flexibility without the need to coordinate with or rely in IT support services. However, at the current stage of maturity the approach does require some technology skills to administer, in particular the need to set-up the spreadsheet for each exam and to retrieve responses from individual spreadsheets following the exam. On a continuum from the least efficient manual pen-on-paper exams to a fully networked e-testing system, then this spreadsheet approach comes somewhere in the middle in terms of efficiency gains. In this case the administrative benefits were realised in terms of an electronic reticulation of questions, responses and marking. The marker estimated that using the spreadsheet saved about 30% of time it would have taken to manually perform all marking. This was due to the automatic assessment of some questions and the ability to iteratively add to the marking key in the case of text response items. The fact that text responses were easily legible in contrast to handwritten responses also saved time.

In terms of leveraging technology affordances, it was also recognised by us that we did not take advantage of the affordances of the spreadsheet software beyond using it as a digital data collection form. This was reasonable in piloting a proof of concept. The next phase of work should be to take advantage of the technological affordances of the spreadsheet for assessment design. Using simulation, data analysis and the mathematical functionality of a spreadsheet will be useful in disciplines such as maths, commerce and engineering. There were some hints in this study of the implications such a move could have on curriculum design. We noted that the move from a hand-written medium into a typed medium had implications for student's knowledge of Chinese typing input methods. In terms of beginners learning Chinese, this meant that there is now a greater reliance on knowledge of Pin Yin rather than being able to rely on direct visual reproduction of Chinese characters in order to produce a response. This brings assessment into alignment with authentic practice given the typed medium is now dominant in the work and social spheres.

However, our focus in this paper was on the viability of using a spreadsheet for exam delivery. Our experience was that it was successful with students providing positive feedback. Further technical work will be needed to refine the toolset in terms of usability, further automation and in demonstrating its use in other discipline areas. Providing user instructions, examples and training will also help other teachers to use the system proficiently and to help them develop more sophisticated assessments within the spreadsheet environment.

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Towards authentic e-Exams at scale: robust networked Moodle

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In this paper we present the design and user evaluation of a resilient online e-Exam platform that is capable of working without a network for most of the exam session, including the conclusion of an exam, without loss of data. We draw upon the education and technology acceptance literature as a basis for evaluation. The technology approach takes advantage of the Moodle learning management system quiz module as a means to provide an electronic workflow for assessments and builds on a range of open source components to construct the robust solution. The approach also enables rich, constructed assessment tasks by providing authentic 'e-tools of the trade' software applications and a consistent operating system on each student's BYO laptop. The robust Moodle exam deployment was trialled in two undergraduate units (subjects) at an Australian university. Students undertook a sequence of practice, mid-term and a final examination using the platform. Additional software and audio files were utilised as part of the exams. Student feedback on their experience was collected using pre and post surveys covering a range of issues related to technology acceptance.

Keywords: Keywords. e-Exams, networking, resilience, offline, authentic assessment.

Background

This paper focuses on the design and evaluation of a 'robust' online edition of the e-Exam platform developed in the third phase of work being carried out under an Australian Government funded project (TEAA, 2015; Fluck & Hillier, 2016). The project is looking at ways to modernise supervised examinations within the Australian higher education context where the primary aim has been to enable authentic assessment. We use the term 'e-Exam' (eExam) to specifically refer to a "timed, supervised, summative assessment conducted using each candidate's own computer running a standardised operating system" (Fluck & Hillier, 2017). This definition is in contrast to many existing computerised testing systems (QuestionMark, Examsoft, TCExam etc) that use single applications or web pages that provide a limited 'form' based environment for questions and responses. Such approaches add little to the design of exam-based assessments because the rich affordances of complex software as mind tools (Jonassen, 1991) for problem solving is not available to task designers or students.

We have previously discussed a set of requirements for an approach to e-Exams (Hillier & Fluck 2013) that has included enabling authentic assessment using e-tools of the trade, integrity, reliability and scalability that would ethically use student's bring-your-own laptop.

A primary aim of our work has been to allow technology to be a tool that enables the redefinition (Puentedura 2003, 2006) of assessment tasks, targeting higher order thinking (Krathwhol, 2002), rather then just replicate paper-based question formats in a digital form. We are working towards providing a holistic digital 'authentic assessment' (Crisp, 2009). By providing sophisticated software applications we can open up the pedagogical landscape of the exam room enabling assessment designers to set complex tasks that are better reflective of the employability needs of 21st century graduates, requiring a higher degree application, analysis, synthesis and evaluation.

Work carried out under the first two phases of the project focused on providing a transition between paper and digital exam scripts. In phase one, students were given a choice of handwriting or typing their responses using a word processor. Phase two saw the use of a range of 'e-tools of the trade' where constructed responses were enabled through the provision of multimedia, software development, diagramming and language translation tools. Responses were returned as a word processor document, program script or similar digital artefact.

The first two phases of our e-exam work did not utilise a network during the exam session itself. This minimised the requirements for complex infrastructure in the exam room and minimised risks associated with relying on networked servers for the duration of the e-exam event. However, this came at the cost of administrative efficiency because data had to be loaded and retrieved from USB sticks for each exam.

The key stakeholder group that will be most impacted by the adoption of computers for exams is the students. As the primary users of the system we asked their opinions regarding ease of use, reliability, security and suitability of the e-Exam system via surveys and focus groups. Responses previous trials have been positive with students rating their experience above 4 on a 5-point scale across most measures. Full results of the earlier phases are reported elsewhere (Hillier, 2015b; Hillier & Lyon, 2018a,b).

What has become apparent from our trials of e-exams is that students were far more conservative in their views when faced with the idea of e-exams. Their level of enthusiasm was found to vary by discipline area (Hillier, 2014). This was unexpected given the high rate of use and ownership of computers amongst university students (McManus 2012). When given the opt-in choice of typing or handwriting the actual rates of adoption by students varied greatly with low figures ranging from 5% to 36% in some early e-exam trials (Hillier 2015b). In the UK, Purcell, Paterson & Mogey (2012) noted a 10% uptake in their e-Exam trials. Refinement of induction strategies saw this rise to around 50% in more recent opt-in Australian trials (Hillier & Lyon, 2018a). The most prevalent concern reported by students was the reliability of using computer technology in a time constrained, stressful, high stakes exam environment (Hillier 2014). This means that reliability needs to be demonstrably high to lessen unnecessary stress. The ideas of 'graceful degradation' and 'progressive enhancement' (W3C 2015) of capabilities and logistical continuity strategies (procedures) led us to implement multi-layered technical fall-backs. This is important so that if things go wrong it doesn't result in a catastrophic failure. Using technology such as a networked learning management system (LMS), online web application (e.g. TCExam, QuestionMark Perception), or online remote desktop style environments (e.g. Citrix virtual desktop) typically have acceptable reliability levels when used for non-time critical activities (i.e. formative learning, out-of-class study, self-check quizzes or long duration project work). A key feature of these systems is the use of live networks for the entire assessment workflow or session. This is great for administrative efficiently and the provision of a unified toolset, but reliance on an active network connection to a server for the duration of the exam is also their "Achilles heel" that represents a single point of failure for the whole cohort of students. Recent examples of failures in networked computerised exams attest to this risk (Donovan, 2014; Peregoodoff, 2015; Strauss, 2016; Aubusson & Noyes 2018a, b). During the time-limited exam session any failures that impact the whole cohort are magnified. This can include the failure to start an exam, significant interruptions to working time during an exam, or aborted exam sessions. This leads to increased stress for already stressed students and disruptions to tight exam schedules.

These tales of trouble prompted us to consider how we can leverage the utility of a networked assessment system whilst minimising the risk of technical failure.

Research Questions

We have seen success in the first two phases of the project on the primary goal of our project - enabling a greater degree of authentic assessment within supervised exam spaces. However, with Universities in Australasia each regularly running 100,000 to 300,000 exam sittings annually (Roach 2017), to be 'doable' in this context, the technical and procedural approaches also need to be efficient. Therefore, a key guiding research question for the third phase of our work was:

"How can we maintain and extend a capability for higher order, rich, authentic, e-tools of the trade assessment tasks, while taking advantage of the administrative efficiencies of a network server but ensuring that the system was robust during the critical period of the exam event?"

Within a context where Learning Management Systems (LMS) still dominate learning environment and while striving for more authentic assessment, two specific questions were posed:
1) "How can we leverage the administrative efficiencies of a networked LMS for use in e-exams?"

And, at the same time:
2) "How can we minimise the risks associated with the reliance on a live network during the exam?".

Finally, we need to ensure that the primary users of the system, that is the students, accept the system for use under exam conditions:
3) "Do students accept the networked edition of the e-exam system as fit for purpose for undertaking supervised time limited exams?

Technical development approach

Our technical development approach has been component-based software development (CBSD). This is increasingly being used to deliver solutions that involve the re-use and adaption of what equate to 'virtual Lego bricks'. This includes both open-source software (Capiluppi, Boldyreff & Stol, 2011) and commercial off-the-shelf (COTS) products. The third phase of our work on the 'robust' networked approach to e-exams drew upon a range of open-source software such as Linux, Moodle and Safe Exam Browser (SEB) that we built upon, combined and configured. A small percentage of the overall code was custom developed but this was critical in ensuring the solution met our design goals. COTS hardware components such as laptops, servers, networking, USB storage devices and large USB hubs were also used. The rationale for using open source development for e-exams has previously been articulated in (Hillier & Fluck, 2013) while the use of COTS hardware was a practical and financial decision.

While there are many approaches and software systems used for computerised exams (Hörnblad & Brenner, 2015) none have combined the separate parts and concepts to create the set of features and capabilities that we present in this paper. Here we focus on the prior work that had a direct influence on our solution. The first of these is the open source Linux operating system. Using a 'Live' Linux approach to boot laptops means that laptops from Apple and those that normally run 'Windows' will instead run an identical software tool set. Its open source status provides a testing authority with the means to provide a known, consistent software environment to all exam candidates regardless of the native operating system on the laptop. A Live Linux system has also been used as an exam environment by others (Frankl, Schartner & Zebedin, 2012; Alfreosson, 2014; Britschgi, 2015), some of which we have previously reviewed (Fluck et al 2017). In a number of other cases Live Linux has been used in conjunction with BYO laptops to provide a controlled software environment, either by starting the laptop from a CD-ROM (Fluck, Pullen & Harper, 2009), then USB stick (Alfreosson, 2014; Lattu, 2014; Britschgi, 2015; Hillier & Fluck, 2017; Yioppilastutkinto, 2018) or a from network source (Frankl, Schartner & Zebedin, 2012). Several feature the use of a lock-down browser to serve as a gateway to a networked quiz or LMS server (Adesemowo, Johannes, Goldstone & Terblanche, 2016). The open source Safe Exam Browser (SEB) has proven successful in deploying computer lab based e-exams (Al Nadabi, 2015) and when used with BYO laptops, although instances of the latter are less common. SEB also has the ability to allow third party applications during an exam when specified, although this relies on separate provision of such applications by the owner of the equipment. In at least one case SEB, Moodle and Linux have been combined however the proponents of the approach admit that they are still reliant on a live connection for the duration of the exam (Frankl, Schartner & Jost, 2017). Few existing solutions allow for 'offline' use. One that does is the commercial closed source Examsoft product. However, Examsoft does not allow regular software applications to be used alongside quiz centric tools and therefore this limits the 'authenticity' of the assessment.

Moodle is a popular LMS used around the world and is open source allowing for easy inclusion. Moodle already has a very comprehensive question engine, a variety of question types and the ability to assess short text responses by pattern matching. Moodle can also allow the submission of files within the quiz itself which means that a wide range of software applications can be deployed as problem solving tools within the same system. This provides the opportunity for a mixed mode exam that includes selected response, convergent response and complex constructed responses. We also drew upon the large library of contributed code components including by Ward and Pinna (2018) for streamlined course enrolment, Hunt (2015) for offline capabilities and Hunt (2018) for Safe Exam Browser key pairing integration. We subsequently made modifications to these components to make them work more transparently with Safe Exam Browser and within the Live Linux environment. All of these factors meant that Moodle was an attractive for use as part of an e-Exam environment from the point of view of enabling authentic assessment within a robust e-workflow.

e-Exam platform capabilities

The e-Exam platform uses a combination of techniques and technologies. Detailed technical features of the customised Live Linux based e-Exam platform are explained further elsewhere (Hillier & Fluck, 2017). But briefly, we have deployed a customised Live Linux distribution loaded on multi-partition USB flash storage devices to boot a variety of student bring-your-own laptops. Customisations to the Linux OS includes restrictions on what the user can do and access within the system. Host drive access and third-party device access is prohibited as is access to a number of communications channels. Networking can be enabled and used in a controlled manner. A range of authentic software applications can be provided within the exam environment, including a full office suite, multimedia players, drawing tools and discipline specific tools, for example, Mathematics software (Maxima, R, Scilab, GeoGebra, Gummi LaTeX editor and NetLogo). In this phase of our work we have extended the ability of the platform to allow these tools to be used alongside a LMS quiz. This creates a comprehensive mixed mode e-assessment platform. A variety of configurations are possible:

a) **Fully offline**: No network was used during the exam and all material is pre-loaded on the USB stick prior to the exam session. A suite of applications is made available on the USB with all work conducted and saved to USB storage. An office suite is used as the response composition environment and has a fully automatic document save feature. Over 20 trials have been conducted using this mode of operation. In phase one, paper-equivalent, student choice exams were run. Phase two saw post-paper trials where all students used a computer to complete tasks (e.g. computer programming, spread sheet, multimedia).
b) **Fully online**: The USB acts as a thin client secure gateway to a learning management system server or virtual desktop environment. A full suite of applications can be optionally provided via the USB as local working space. A highly reliable network and server infrastructure is required. The trade-off between administrative convenience and in-room reliability is that a network outage will result in a halt to the exam.
c) **Cached online**: The e-Exam USB provides a secure client that connects to a LMS, in this case a Moodle server using a key pair with SEB (the key prevents unauthorised access). Exam content is cached (from a Moodle quiz) at the start of the exam. The network is then optional and serves as an administrative convenience from then onwards. Auto synchronisation of student responses to the server and automatic fall-back to encrypted local storage make this approach more robust than standard online exams. A full suite of applications can be provided via the USB as local working space. Any files produced by a student can be submitted via Moodle or saved to the USB stick.

Detail of the process used to run a cached online e-exam is represented in Figure 1 and described below. It is worth noting that both the server and the client are fault tolerant and flexible. The e-Exam client USB hold a cache of the exam content and auto save or back-up the student's responses according to network conditions. The server can be run on common web infrastructure or from a Live USB stick (e.g. booted from a laptop in the exam room). In the latter case additional internal backup and automatic recovery for the server have been implemented in case of a server crash. Should this occur during an exam the clients continue to operate in off-line mode. When the server resumes operation, clients will automatically reconnect to the server and resume synchronisation of response data without loss of the user session.

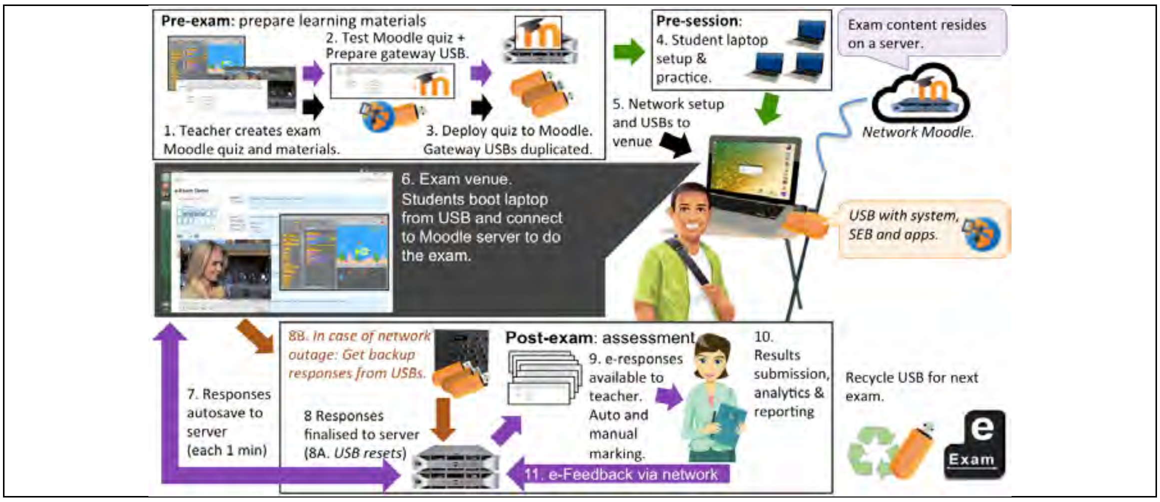

Figure 1: workflow for cached online e-exams with robust Moodle

The process for conducting an online e-Exam using the 'cached online' mode is outlined below:

1. Exam materials are prepared as a Moodle quiz including any file attachments.
2. Each set of exam materials is checked. The e-Exam USB sticks are configured and can be generic or customised for an exam or used to pre-load large resource files such as a long video. Under most common use the USBs would be configured with a generic set of applications and will be reusable.
3. Each set of exam materials is deployed to Moodle server. The e-Exam USB sticks are duplicated (or reused from previous sessions).
4. Students attend a practice session to check laptop compatibility and familiarise with the system.
5. Exam rooms are set up a 'quick start' instruction card and e-Exam USB sticks placed on desks instead of paper exam scripts. Power sockets were provided for each student. Spare laptops and USB WiFi dongles are on hand should they be required.
6. The exam session runs:
   a. After students enter the exam room they boot their laptop using the USB stick.
   b. Upon reaching the e-Exam system desktop a unique background image is displayed (serving as a visual

check for exam invigilators) along with the first user prompt.
   c. The system requests the user to provide their information: student id and name.
   d. The system then requests their network login (or automatically connects) to the network.
   e. Upon connection, the e-Exam system launches SEB to the preconfigured Moodle server.
   f. The student logs into Moodle.
   g. A link to the exam for this student (Moodle quiz) will be shown.
   h. If the SEB client and Moodle server keys match then the 'Attempt quiz now' button is displayed.
   i. Upon starting the quiz, the question content is cached to the client including images and multi-page quiz.
   j. A full suite of applications can be made available on the USB stick with complex constructed responses possible using the USB as local working space. Such responses can then be submitted via the Moodle file upload question type or saved to the 'answers' partition of the e-Exam USB.
   k. At the conclusion of the exam. The 'submit all and finish' button is used as per standard Moodle quiz submission. The student's responses are finalised and stored on the Moodle server.
   l. If a network connection is absent then an onscreen notice is shown and the attempt data submission action is redirected to local storage as an encrypted file (on the e-Exam USB).
   m. Student closes the software and shuts down the computer.
   n. The e-Exam client USBs are collected, counted and then students can leave the exam room.
7. Note: During the exam the client autosaves in-progress attempt data to the server every minute. However,
   a. If the network is absent, then each attempt data autosave action is redirected to local storage as an encrypted file (to e-Exam USB). The cached quiz allows the student to continue working.
   b. Upon network reconnection the client will re-sync attempt data to the Moodle server.
8. Responses are finalized to the server.
   a. If the student's responses were successfully submitted to the server then USB sticks are cleaned.
   b. If the student's responses could not be submitted online to the server then staff must undertake a data retrieval process via a large hub. The e-Exam admin tool is used to bulk retrieve attempt data files from USBs. The attempt files are then uploaded to the Moodle server.
9. The normal e-workflow for assessment within Moodle resumes with responses made available to the teacher for automatic and/or manual grading.
10. Standard Moodle features can be used to manage evaluation, analytics, reporting and feedback.

The focus in the remainder of this paper is on the evaluation of the 'cached online' mode of operation.

Study context

A round of trials were conducted in two undergraduate Chinese studies units, one at first year and one at third year level, at an Australian university with a sequence of three exams in each unit. The students participated on a voluntary basis either typing or handwriting with the majority of typists trying an e-exam for the first time. We were primarily seeking findings related to system usability and acceptance where both unit groups (first year and third year) used the same technology with tests in similar circumstances and the same discipline area. A key difference in the exam conditions in the two units was two offline dictionary applications were made available for use in the e-Exam system for the third-year unit, but not in the first-year unit. In the first-year unit short listening items were included in exams two and three that utilised audio headsets. All exams were administered locally in-class rather than in centrally run exam halls. Power was provided at each desk and WiFi was used instead of wired connections. A separate Moodle server that included plugins and our modifications was used instead of the institutional Moodle server.

Research methods used for evaluation

In evaluating the robust networked e-Exam solution we draw upon information systems theories around technology acceptance (Davis, 1989; Farzin, 2017) and the work of prior researchers (Dermo, 2009) who have evaluated e-assessment systems. Drawing in our previously articulated requirements and work by Dermo provided the basis for the evaluation survey instruments (See table 1 for questions).

Evaluation procedure

Early in the semester a call for expression of interest was announced to students in each unit and informed consent collected according to the approved ethics protocol. The voluntary nature of the trial meant that students could withdraw or change their mind at any stage during the process.

A practice session was held two weeks prior to first exam. The aim was to check that student's laptops were compatible with the system and to provide a preview of the exam format, the boot processes and software environment. Observation notes were taken and a pre-exam survey was carried out that collected information on hardware that was used, issues encountered and student's perceptions of the system and processes. A preliminary analysis was done to capture any concerns and to address any technical issues.

Mid semester exams (exams one and two) were held using a Moodle quiz of constructed and selected response questions. Post surveys were completed to capture the student's experience of each session.

At the end of the semester a final exam (three) was held using a similar range of question types and software tools. The post survey was again used to collect student's perceptions of the experience.

In our analysis in this paper we focus on questions related to reliability and usability of the e-Exam system on the part of those that typed the exam.

Data analysis

Statistical analysis of Likert item survey questions (strongly agree 5, neutral 3 and strongly disagree 1) as shown in Tables 1 to 4 was done using SPSS v24 using alpha level of .05. Likert data pertaining to student's opinions were analysed item by item (not as a scale) and as such were treated as non-parametric (Jamieson, 2004). The statistical techniques we used included Mann & Whitney's (1947) U test to check the variance of two groups by study unit and by gender. The study by Dermo (2009) supports the choice non-parametric tests such as Mann & Whitney's test in analysing students' perceptions of e-assessment systems. We looked at pre-post paired Likert items using the Wilcoxon Signed Ranks Test (Wilcoxon, 1965). In cases where items did not meet the assumption of a normal distribution of differences when checked with a Shapiro & Wilk (1965) test ($p = .05$) we used the Sign Test (Roberson, Shema, Mundfrom, & Holmes, 1995). We selected the second exam as post comparison point because this was considered the most settled set of events. The first exam represented first real use and final exams in each unit encountered some organisational difficulties that were likely to influence results. We also acknowledge that the relatively small sample sizes could have impacted the accuracy of the results due to the dropping of 'ties' in the analysis (Mendenhall, Wackerly & Scheaffer, 1989). We also used the Friedman test (1939) to examine if differences existed over a time series of measures (i.e. a pre and a sequence of three post-tests). Selected survey items that had shown significant results in the previous analysis step for the time series test were analysed in pairs. Missing responses were excluded on a pair-wise (test-by-test) basis. We agreed with Dermo (2009) in considering that opinion data did not represent an objective truth about the e-exam system, but rather statistical results are indicative of the strength of the opinions of this particular group of students. Similarly, the study is limited in that students were not randomly assigned to typing or handwriting conditions and relatively small samples mean that the statistical findings cannot be generalised beyond this study.

Findings

In the first-year unit a soft target of 30 typing places were offered to the class of 124 with 20 opting to attend the practice session and 14 typing the final exam. In the third-year unit e-exams were notionally run on an opt-out basis, with 29 (94%) doing the practice session and 27 (87%) typing the final exam out of 31 enrolled.

Following the series of exams and practice sessions we compared the pre and post survey responses shown in Table 1. Overall, students reported a positive experience of using the Moodle based e-exam. Question 10 relating to usability rated well and impressions of reliability (Q7 and Q8) increased overall (see Table. 1). When we compared student's pre and post opinions using a 'Sign test'. Missing responses were excluded on a pair-wise (test-by-test) basis. Three items relating to perceptions of reliability saw a significant increase in agreement from pre to post (p =< 0.05).

We investigated differences in opinions between units because units were at different year levels in the degree program, allowed different software to be used and experienced different logistical conditions. A Mann-Whitney U test was used to explore the opinions of 19 individuals from the first-year unit and 28 individuals from the third-year unit. Some differences between grouped responses were found, particularly later in the sequence of exams (See Table 2). The second exam in each sequence was used for post.

Table 1: Aggregated Likert Item Results for Pre and Post (Exam two)

Likert items (Strongly Agree 5, Neutral 3, Strongly disagree 1)	**Pre** *n*	*M*	*SD*	**Exam 2** *n*	*M*	*SD*	**M** Diff.	**Sig.** *p.*
1) My laptop is reliable for use in a computerised exam.	38	3.0	1.3	37	3.4	1.4	0.4	**0.05**[b]
2) I can use the e-Exam system just as well as my own laptop.	38	3.2	1.3	36	3.6	1.2	0.4	0.14[a]
3) It was easy to answer multiple-choice questions.[c]	16	4.3	0.6	25	4.4	0.6	0.1	0.38[b]
4) The included software was useful.	36	4.1	0.9	38	3.7	1.0	-0.3	0.42[a]
5) Moodle worked well as an exam environment.	36	4.1	0.6	39	4.2	0.6	0.1	0.55[b]
6) I am concerned about network outages impacting my exam.	36	3.3	1.2	39	3.1	1.3	-0.2	0.45[a]
7) I felt the e-Exam system was reliable against technical failures.	38	3.1	1.1	37	3.8	0.8	0.7	**0.01**[a]
8) I am reassured the e-Exam system was robust against network outages.	35	3.4	0.7	39	3.8	0.7	0.4	**0.03**[a]
9) I feel the e-Exam System is secure against cheating.	38	4.2	0.7	37	4.2	0.7	0.0	0.77[b]
10) Overall, I feel the e-Exam System is easy to use.	38	4.0	0.9	37	4.1	0.7	0.1	1.00[b]
11) I now feel relaxed about using the e-Exam system for exams.	38	3.6	1.0	37	4.0	0.8	0.3	0.50[b]
12) I would like to use a computer for exams in the future.	38	3.8	0.9	38	3.9	0.9	0.1	1.00[b]
13) I would recommend the e-Exam system to others.	38	3.6	0.9	37	4.0	0.7	0.4	0.33[b]

[a.] Wilcoxon Signed Ranks Test used. [b.] Sign Test used. [c.] This question was labelled 'skip of not applicable'.

Table 2: Likert Item Results by Unit for Pre and Post (Exam two)

Likert items (Strongly Agree 5, Neutral 3, Strongly disagree 1)	1st yr unit *mdn*[c]	*M*[b]	3rd yr unit *mdn*[c]	*M*[b]	*U*[a]	*p*
Pre 1) My laptop is reliable for use in a computerised exam.	3	3.2	3	2.9	146.5	0.51
Pre 2) I can use the e-Exam system just as well as my own laptop.	3	2.9	3	3.3	138	0.35
Pre 3) It was easy to answer multiple-choice questions.	4.5	4.5	4	4.2	22.5	0.36
Pre 4) The included software was useful.	4	3.5	4	4.3	77	**0.03**
Pre 5) Moodle worked well as an exam environment.	4	4.1	4	4.1	137	0.99
Pre 6) I am concerned about network outages impacting my exam.	4	3.5	4	3.3	123	0.61
Pre 7) I felt the e-Exam system was reliable against technical failures.	3	2.9	3	3.3	134	0.29
Pre 8) I am reassured the e-Exam system was robust against network outages.	4	3.4	3	3.4	125	0.79
Pre 9) I feel the e-Exam System is secure against cheating.	5	4.5	4	4.0	100.5	**0.02**
Pre 10) Overall, I feel the e-Exam System is easy to use.	4	3.7	4	4.2	143.5	0.41
Pre 11) I now feel relaxed about using the e-Exam system for exams.	4	3.5	4	3.8	161.5	0.84
Pre 12) I would like to use a computer for exams in the future.	4	4.2	4	3.6	98.5	**0.03**
Pre 13) I would recommend the e-Exam system to others.	3.5	3.6	4	3.7	160	0.80
Post 1) My laptop is reliable for use in a computerised exam.	5	3.6	4	3.3	125	0.31
Post 2) I can use the e-Exam system just as well as my own laptop system.	4	3.9	4	3.4	104	0.09
Post 3) It was easy to answer multiple-choice questions.	5	4.8	4	4.0	28.5	**<.01**
Post 4) The included software was useful.	3	3.5	4	3.9	125	0.23
Post 5) Moodle worked well as an exam environment.	4.5	4.5	4	4.0	105	**0.02**
Post 6) I am concerned about network outages impacting my exam.	2	2.5	4	3.5	101.5	**0.03**
Post 7) I felt the e-Exam system was reliable against technical failures.	4	4.2	4	3.6	94.5	**0.03**
Post 8) I am reassured the e-Exam system was robust against network outages.	4	4.1	4	3.6	102	**0.02**
Post 9) I feel the e-Exam System is secure against cheating.	4	4.2	4	4.2	153	0.75
Post 10) Overall, I feel the e-Exam System is easy to use.	5	4.5	4	3.9	87.5	**0.01**
Post 11) I now feel relaxed about using the e-Exam system for exams.	5	4.5	4	3.6	63	**<.01**
Post 12) I would like to use a computer for exams in the future.	5	4.7	3	3.5	37.5	**<.01**
Post 13) I would recommend the e-Exam system to others.	5	4.6	4	3.7	56	**<.01**

[a.] Mann Whitney U Test to compare the first and third year level units. [b.] M= mean. [c.] mdn = median.

Items of particular interest were perceptions of system reliability Q7 "I felt the e-Exam system was reliable against technical failures" and Q8 "I am reassured the e-Exam system was robust against network outages". Our initial analysis yielded significant changes between pre and post exam two (Table 1). We further investigated differences within units between each of the four events using a time series. Table 3 displays overall Friedman tests (F) for each series with only the first-year unit showing significant results. Post-hoc Wilcoxon tests (T) for adjacent pairs in the series show only the pre to post 1 adjacent pairs showed significant changes for Q7 (means and standard deviations are provided for clarity).

Table 3: Time series on perceptions of system reliability

Question	Pre		<– T –>		Post 1		<– T –>		Post 2		<– T –>		Post 3		F	
Q7 I felt the e-Exam system was reliable against technical failures	*M*	*SD*	*Z*	*p*	*M*	*SD*	*Z*	*p*	*M*	*SD*	*Z*	*P*	*M*	*SD*	$\chi 2(2)$	*p*
First year unit (n=8)	2.9	1.3	-2.226	**0.03**	4.1	0.8	1.00	0.32	4.2	0.8	0	1.00	4.1	0.9	11.526	**0.01**
Third year unit (n=17)	3.3	0.9	-2.111	**0.04**	3.7	0.8	0	1.0	3.6	0.7	-1.89	0.06	3.4	0.8	5.885	0.12
Q8 I am reassured the e-Exam system was robust against network outages	*M*	*SD*	*Z*	*p*	*M*	*SD*	*Z*	*p*	*M*	*SD*	*Z*	*P*	*M*	*SD*	$\chi 2(2)$	*p*
First year unit (n=6)	3.4	0.8	-1.633	0.10	4	0.9	-.577	0.56	4.1	0.7	-1	0.32	4.3	0.9	9.811	**0.02**
Third year unit (n=19)	3.4	0.6	-.277	0.78	3.5	0.8	-.351	0.73	3.6	0.6	-.277	0.78	3.7	0.6	2.333	0.51

We also examined if student's declared future use intentions and recommendations may have changed after each contact with the e-exam system. A time series was done by unit with respect to Q12 "I would like to use a computer for exams in the future" and Q13 "I would recommend the e-Exam system to others". Although some minor movements of ratings were observed over the time series these were not found to be statistically significant after running a set of Friedman Tests within each unit.

Finally, we reviewed the technical issues that arose during the trials. At each stage typists were asked "Did you experience any technical difficulties during this session?" A summary of the technical issues encountered during pre (practice) and post (exams) is shown in Figure 2.

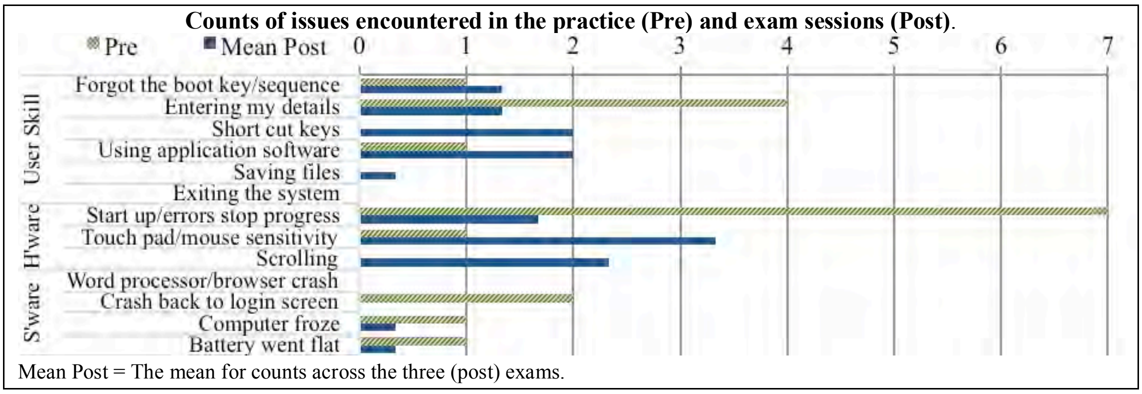

Figure 2: Reported technical issues

Discussion

Overall students were happy with the e-Exam system and agreed that they would recommend it to others (Table 1). Students agreed it was fit for purpose in terms of ease of use and reliability. However, it became apparent that lower ratings were given by the 3rd year unit group in post surveys. In many cases the ratings between the two-unit groups were significantly different (Table 2). Similarly, the ratings given for reliability items in the three post surveys (Table 3) were also lower from the third-year unit. The split in opinion could have been due to technical usability problems with the 3rd party 'Dim Sum' dictionary application used only in the third-year unit. We observed students frequently using it in solving exam questions and its problematic nature featured strongly in student verbal and written comments during exam sessions. It is therefore possible this coloured the 3rd year student's overall impression of the e-Exam approach. The final round of exams in both units suffered from some logistical failings on the part of the organisers and this may have also coloured participant's impression of the process. A dip or levelling off of mean reliability ratings can be seen in the third exam (Table 3).

Overall, the agreement scores and those from the first-year unit (which was not afflicted by the dictionary application) were in line with previously reported e-exam studies using a spreadsheet (Hillier & Grant, 2018) and word processor documents (Hillier & Lyon 2018a).

In regard to technical issues as shown in figure 2, those issues that related to user familiarity were linked to processes (i.e. use of non-standard user names on the test server, Apple users encountering the 'Windows' short cut keys used in the e-Exam system) and as previously mentioned, to poor usability of the 3rd party 'Dim Sum' dictionary application. Most of the hardware compatibility issues that could be considered 'blockers' were encountered in the practice sessions. If a student's own laptop was found to be incompatible then they were offered the use of a loan laptop. Therefore, the practice sessions served the intended purpose of heading off significant problems before they got into the exam room itself. When the exams were run, all students who started an exam with the intention to type was able to do so. In some of cases this meant swapping the student's own laptop with an institution owned laptop therefore reinforcing the recommendation for contingency measures such as having spare laptops on hand. Minor (non-blocking) issues such as sensitive touchpads and scrolling were more prominently reported in the exam events. Wired mice that could have solved the issue were recommended but few students took up the offer. Perhaps not enough time was spent in the practice session to surface secondary issues that in turn became more problematic in the real exams. Software related issues were mainly overcome (through further software development and driver updates) by the time real exams were run. Two glitches occurred in one of the final exams that necessitated a computer restart (due to system freeze) and a quiz restart (the user found themselves outside the Moodle quiz for an unknown reason either due to a browser glitch or user error) but in both cases students were able to continue the exam without loss of response data thanks to the backup provisions in the e-Exam system. Finally, in another exam session, one laptop lost the WiFi connection to the server that became apparent at submission time (a notice was displayed on screen). Attempts at a manual re-connection were unsuccessful, however due to the e-Exam system redirecting data backup to USB storage all responses were saved and were later uploaded to the Moodle server. Students concerns over exam interruptions due to network outages (Q6) were alleviated as time went on with drops between pre and post ratings (evident in Table 1 and 2). Overall, all students who typed the exam were able to successfully complete with the protective measures built into the e-Exam system working to prevent data loss.

Conclusion

In this study we set out to see if we can leverage the administrative efficiencies of a networked LMS for use in e-exams whilst overcoming the risks associated with the reliance on a live network during the exam. From this point of view we have been successful. Both bench testing and a series of live trials have proven that the e-Exam platform running a 'robust' implementation of Moodle can survive both system crashes and network outages without loss of critical student response data.

We also found that students were able to accept the networked edition of the e-exam system as being fit for purpose for undertaking supervised time limited exams. Student's gave reliability and usability ratings in line with previous off-line e-exam trial outcomes.

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Change is difficult: Making it happen and making it stick

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Monash University is transforming its educational offering with a focus on students actively engaging in their learning experiences with educators changing their teaching practice so as to make that happen. The disruption to traditional approaches to education through innovative curricula, multi-faceted modes of delivery and purposeful learning spaces is challenging our educators to think about how students learn, and how to provide students with a quality educational experience. The University has employed a group of Educational Designers (EDs) and embedded these in each of the ten faculties to lead the change. The EDs interpret and implement the University education agenda within their faculties, partnering with academics to innovate teaching and learning across the University.

This paper draws on case study methodology utilising two case studies, from the Arts and Science Faculties, to demonstrate how the EDs have enabled sustainable educational transformation. Despite working across ten faculties with various foci for enhancement, the EDs have coordinated their efforts to build staff capacity and resilience through a range of practical support strategies and programs. The strength of this support is grounded in the relationships that they are able to develop with our academic partners over time.

Introduction

Education transformation at Monash University commenced in response to the challenges of 21st century education (Trilling & Fadel, 2009) and as a means to improve the use of technology as a support to the teaching environment (Siemens, G., Gašević, D. & Dawson, S., 2015). Monash University is a research-intensive Group of Eight university with 73 000 students and 16 000 staff. Crucial to the University's education strategy is the quality of our student experience and graduate outcomes. To that end, Monash University is transforming its educational offering with a focus on students actively engaging in their learning experiences, guided by expert educators, using the best educational technologies and spaces, and informed by industry and community. The education agenda aims to disrupt traditional approaches to education through innovative curricula, multi-faceted modes of delivery and purposeful learning spaces. In 2015, the centrally-located Office of Teaching and Learning asked each faculty to 'enhance' units via the Unit Enhancement (UE) project, with a target of reaching 60% of full-time student load by 2018. Accordingly, Educational Designers (EDs) were employed by the portfolio of the Vice Provost (Teaching and Learning) and embedded within the faculties, partnering with academics to undertake this pedagogical work.

Coinciding with the UE agenda was the unveiling of Monash's state-of-the-art 'next generation' Learning and Teaching Building (LTB) which was purpose-built to promote an active learning pedagogy by removing the lectern from the front of the room and putting students at the centre of their learning - literally and figuratively. EDs supported the academics through this change by running training sessions in the different LTB rooms and giving them the practical hands-on guidance. Academics, who mostly attended in teaching teams, were presented with a variety of scenarios to help them practise using the space effectively to enhance the learning opportunities made possible by the affordances of these innovative teaching spaces.

Change is difficult (Lawson & Price, 2003). In this paper, we detail the process of EDs engaging with academics in a new culture of learning; their own and their students'. Academics are challenged as they navigate the unfamiliar educational landscape eschewing didactic teaching in preference for active and blended learning. This new paradigm is in opposition to many teaching academics' practice, as it takes them from the central position and brings the learner into the limelight. Lecturers may experience a form of 'culture shock' and may require support and direction to implement change. Change *is* difficult, but educators can seek support for this change from the EDs in their faculty.

EDs guide and support academics to fundamentally change the way they think about teaching and learning; to reconsider how they assess their students' learning outcomes; and to develop their content for delivery across a variety of modes in a more accessible and interactive way. The importance of supporting educators and increasing their levels of resilience cannot be overstated. Many have taught in a set manner and style throughout their entire careers. As such, they are anxious about change and reticent to embrace it, often simply because they do not know how, or they are afraid of failure (Brownell & Tanner, 2012). EDs are very sensitive to this anxiety and tread carefully to build trust, confidence and resilience so as to promote success.

In this paper we investigate two case studies to demonstrate that EDs embedded in the faculties have enabled sustainable educational transformation across a large university. Despite working across ten faculties with various foci for enhancement, the EDs have coordinated their efforts to build staff capacity and resilience through a range of practical support strategies and programs. The strength of this support is grounded in the relationships that they are able to develop with their academic partners over time.

Methodology

We have used case study methodology, in this instance, as it is well established in the Humanities and Social Sciences. This approach informs practice by delving into evaluation and review to illustrate efficacy, achievement and any issues encountered (Yin, 2009). Through inquiry we examine the impact EDs have had, across a large university, as they work in their strategic roles. We attempt to show, through two examples of very different faculties, how EDs rise to the challenge of making change to an established, didactic teaching and learning culture.

Case study - Arts Faculty

Monash University's Arts Faculty is large and diverse, with ten schools and seventy disciplinary areas. 13 000 students from over eighty countries are enrolled in Bachelors, Masters and PhD programs. We have 300 tenured academic staff, as well as sessional lecturers and tutors. In order to approach the UE project in a strategic and coordinated manner, our UE efforts focused on the more than thirty areas of Major study in our Bachelor of Arts (BA).

Each BA major is centred around a suite of core units that students take at first-, second- and third-year level. These units are the gateway, cornerstone and capstone units. They establish a learning pathway that students navigate as they progress through the program. By focussing our UE activities on these units, we identified the 'teaching moments' through a student's learning pathway where innovation could reap the most rewards.

The Associate Dean, Education and Senior ED implemented a model of constructive alignment to map the learning pathway that students navigate through our programs (Biggs, 2007). We constructed 'major maps', collecting on one page the unit learning outcomes, teaching and learning approach, and assessments in the core units of the major, that is, the gateway, cornerstone and capstone units, taken in first, second and third year respectively. This process was repeated for each of the thirty majors, and served as a 'conversation piece' in meetings with the teaching team - often the first time the teaching team had come together around a table to discuss the major.

In these meetings, we challenged educators' approaches to teaching and learning across three broad pedagogical areas: unit design for student engagement; diverse and meaningful assessment; and content delivery across a variety of modes (Boud, 2000; Boud, 2007; Wiggins & McTighe, 2005; Laurillard, 2012). We helped educators to reflect upon the skills and knowledge required by graduates in the major, and whether these skills and knowledge are developed with appropriate levels of clarity and rigour through the major. Unit coordinators reflected upon the place of their own unit in that pathway. Teams identified any gaps and opportunities for change at the major level. The results of these discussions enabled us to prioritise, for enhancement, the points at which students should develop, practice and be assessed on the knowledge and skills necessary for their disciplinary profession, in line with education frameworks (French et al., 2014).

The skills gaps that the Music major team identified in their students coming into the capstones - and in the curriculum of the core units in the major - were critical reading skills, digital literacy skills and group work skills. These skills are now developed through the major. For instance, critical reading skills are introduced in the gateway units with a 'guided reading activity' in Semester 1 and in Semester 2 with an 'annotated bibliography'; further developed in both capstone units with a more sustained 'reading assignment' and 'critical analysis' assessment; culminating in the research capstone with a guided, independent research essay. Digital literacy and group work and skills are introduced, developed and assessed in a similar way. Students undertake a podcast assessment in Semester 2, and depending on which pathway they choose, they undertake a podcast in Year 2, Semester 2, and a vodcast in Year 3, Semester 2. Group work skills are introduced in Year 2, Semester 2 units and culminate in group projects in both capstone units in Year 3. In this way innovations are implemented as part of an holistic approach to the learning pathway that a student takes through our program – rather than enhancements occurring in a vacuum.

The ED team worked with Music staff at the school level, providing targeted and dynamic teaching and learning (T&L) workshops, online resources for both teaching staff and students, and 'at-the-elbow' support to transform their T&L practice. We can see the results of UE in one of the Music major gateways units, "Popular music in global perspective". In 2016, the unit coordinator introduced weekly online quizzes to test students' engagement with readings, and a guided reading activity that develops students' critical reading skills. The unit coordinator adopted the new faculty LMS theme designed by the ED, and began to build towards a blended approach to delivery with some of the unit content delivered online to facilitate students' deeper learning in class. By 2018, the unit coordinator was ready to transform their face-to-face delivery to a genuinely active learning experience, and was invited to teach in the University's new LTB, with the entire cohort of students taught in a large flat-floor teaching space in a 2-hour workshop rather than smaller 1-hour tutorials. The traditional lecture has been abandoned.

Each week, pre-class materials are delivered via the LMS and consist of a 30-minute online lesson made up of mini-lectures and curated videos; one key reading; a curated 1-hour documentary film; and a quiz to test the students on all the pre-class materials (see Figure 1 of the LMS layout below). Each in-class workshop starts with a 'reveal' of the quiz results and small group discussion of the pre-class materials, culminating in groups posting responses to the questions: what are the key takeaways from the online lesson and key readings; what's clear; and what's unclear. Any issues or misunderstandings are addressed on the spot. The remainder of the workshop is spent with the students working in small groups on a variety of activities, for instance, playing African drums together to learn how traditional style inspires popular music; peer review, editing and feedback on guided reading responses and essay drafts; writing on the whiteboards and passing the microphone around to report back to the class; with time set aside to work together on a group assignment.

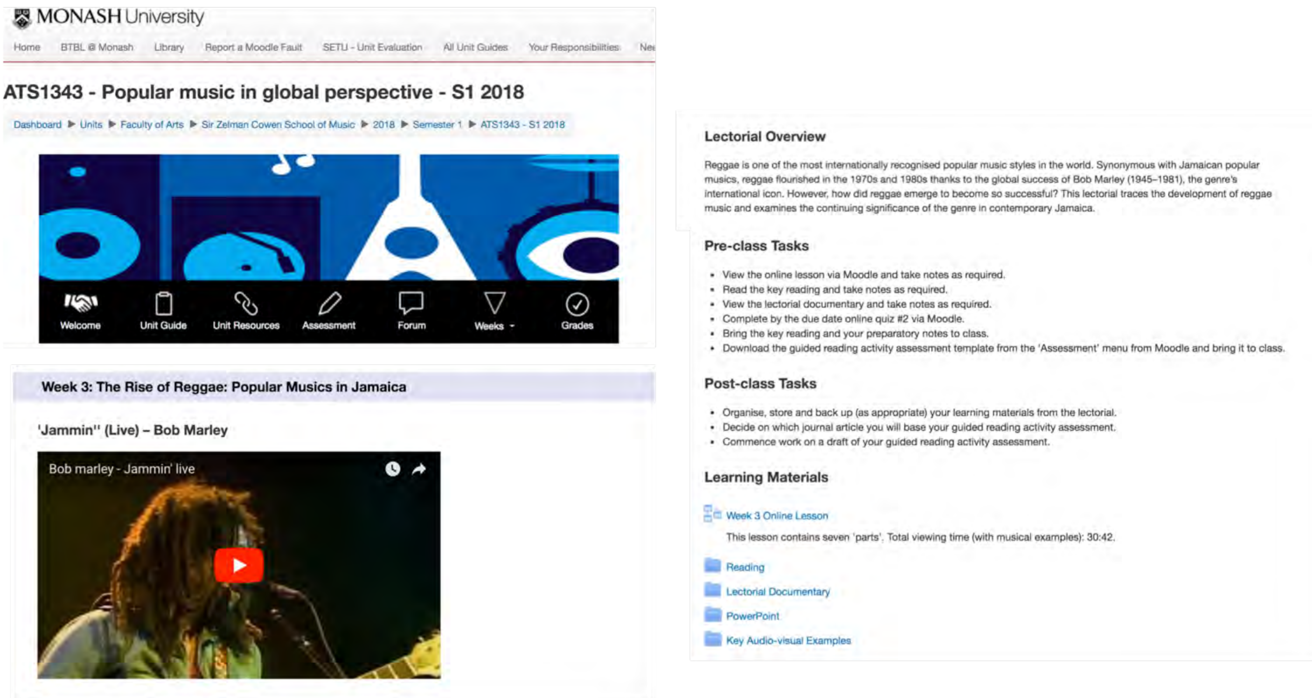

Figure 1: Popular Music - LMS layout

Student feedback on the blended approach to delivery and the focus on active learning in the workshop was overwhelmingly positive. The following comments are in response to the question 'Which aspect(s) of this unit did you find most effective?':

- "The resources for each week were of a high academic standard. Summating with a weekly quiz was a great way of forcing study and incentivising internalisation of the materials"
- "The online lesson and the interactivity of the lectorials"

- “Being able to discuss things every class”
- “The lesson prep is very beneficial”
- “The online lesson, documentary and reading made the information we needed to know for each week and each quiz very clear. There was never any confusion with what we needed to do each week.”
- “The online lessons were much more effective than lectures in relation to the content being learned”
- “The online lessons were useful for me. I have issues with auditory processing and being able to pause and repeat the lesson until I understood was far more useful to me than a lecture”
- “The incentive to comprehensively engage in the unit through the weekly quizzes.”

There were however, some students who did not enjoy the focus on group activity and engagement:

- “The amount of group work during each 2 hour lesson became quite overwhelming for myself who is quite introverted.”
- “It is difficult if everyone sits at the same table every time and people do not want to talk to you”

Comments such as these flag the need for the careful orientation of students to a constructivist approach to teaching and learning (Piaget 1953; Vygotsky 1962). As Biggs (2007) argues, it is the role of the educator to shape the teaching and learning context and enable all students to engage in higher order learning processes in the classroom. The unit coordinator will better guide students in the active workshop environment next semester.

Student performance for the period 2015 to 2018 had been consistently high. There has been a slight improvement in some of the indicators: the proportion of High Distinctions and Distinctions has risen from 70% to 72%, and the average mark has increased from 72.2% to 72.6%; while student enrolments remain between 49 and 60 students. These improvements in student performance are not solely attributable to the innovations implemented in the unit, but there is a correlation between enhancements and improved student performance, as demonstrated in the qualitative feedback from students above.

The student evaluation data for the period 2015 to 2018 reflects students’ experience with the enhanced offering (see Figure 2 below). In what has long been a highly rated unit (above 4 on a scale of 1-5), overall student satisfaction dipped with the introduction of enhancements in 2016, but is recovering as these enhancements are further refined. Students have responded favourably on the ‘plethora’ of learning resources on the LMS site, and the clear organisation of resources. Evaluation of the assessment practice in the unit is markedly lower than other factors. This is likely to be due to the introduction of a group presentation task for the first time this semester. Student feedback indicates that they require clearer guidance for the group project. We will continue to work with the unit coordinator to provide resources for students as they prepare for the group task.

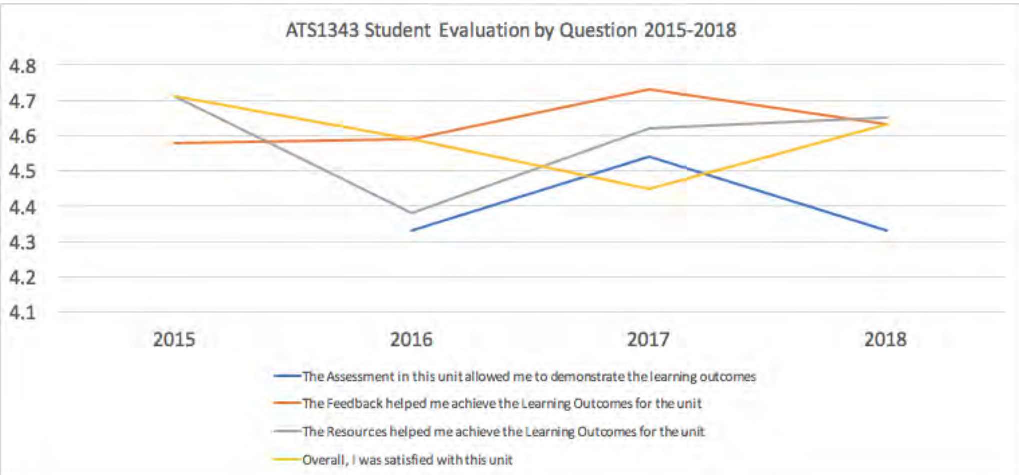

Figure 2: 'Popular Music' Student Evaluation Data 2015-2018

The unit coordinator is delighted with the changes:

> …the UE project has led to a revitalisation of the Music major…with a huge shift from knowledge to skills development…where students *apply* content in small groups in workshops…the students are pushed out of their comfort zone in a ‘safe’ way...the interactive

> time with teachers enables formative activities, related feedback, real-world assessment and improved quality of student submissions...I can see them building their analytical skills in class...I now receive so few email questions from students as most concerns are dealt with in class…
>
> ...with the focus on student-centred learning, I have extracted myself from the picture...it has been very exciting but has required a huge amount of planning...approaching 'blending' in a staged way has worked well for me, and I still have some tweaking to do, such as adding in a short video to each week's pre-class material to guide students through the reading...I will never go back to the [traditional] way I used to teach this unit. (Unit coordinator of 'Popular Music, and convenor of the BA Music major program, 2018)

Enhancements made at the unit level have been most successful when staged over a number of semesters. This incremental approach enables educators to trial and tweak innovations in response to student feedback and performance. It also allows a relationship to develop between the academic and ED, crucial in building trust for implementing change. Grounding these unit enhancements in the broader picture of the whole major through our model of constructive alignment - or 'major mapping' - has transformed education in the Arts Faculty. The approach has effected sustainable and scalable program-level change that is being adapted and applied to other contexts, such as our ten graduate coursework programs. The approach draws upon common understandings of best practice in constructive alignment across the ED Community of Practice (CoP), and the results have been shared with the CoP, with several EDs now preparing mapping documentation in order to implement this approach in their faculty.

Case study - Faculty of Science

The Faculty of Science, with over 314 academics and student numbers in excess of 5,600, is a large and complex organisation that incorporates five schools with each of these having its own culture and preferred methodology in teaching. This makes the task of introducing a changed teaching and learning paradigm a complex process; work done in one school is seen as irrelevant in another and the ED encountered comments such as, "it's different in [insert name of own school]", "our students are different", and "That might work in X but not here". Challenge accepted.

UE focuses on four areas of teaching that are critical to the successful transformation of traditional teaching into an active learning experience that is underpinned by learning theory and well-articulated pedagogic practice. These are constructive alignment, pre-class activities, active learning, and formative assessment (Biggs, 2007). It is through this process that the ED is able to guide and support the academics through a process to fundamentally change the way they think about teaching and learning; to reconsider how they assess their learning outcomes; and to develop their content for delivery across a variety of modes (face-to-face, online, industry).

This UE case study describes the work undertaken in a 3rd year unit of 27 students in the School of Earth, Atmosphere and Environment with an academic who has a high research profile and poor Student Evaluation of Teaching in Units (SETU) survey results. The ED and the academic met every week at first and then fortnightly throughout the semester. Together they formulated a strategy that would best approach the poor results and indifferent attendance. The strategy was compiled in an Issues Log and looked at the question "What aspects of this unit are most in need of improvement?" Students gave full and frank feedback. For example (paraphrased responses):

- Better organisation of the pracs
- Clarity and communication, the lectures were really hard to understand
- Unit is strongly disorganised.

Together the ED and the academic formulated responses to address these student concerns, one-by-one, in the Issues Log. Sample responses included:

> There are notes and instructions on Matlab in the Resources section and (academic name) has changed the way he approaches the Prac work. At first, the students will be given much of the formula and only produce a small section. (academic name) is also going to work through some problems in the lecture - making it a more interactive experience.

(academic name) communicates with the students through the Moodle forums and welcomes feedback. The contextualised content in Moodle should help students better prepare for the lectures and Pracs and a lecture has been included in Week 12 to help allay students exam nerves.

A customised blended learning strategy was developed by the ED for the academic and discussed in detail to determine the best approach for the learning materials, assessment, and importantly, the students. This included an increased presence in the online teaching space with opportunities for extended use of the forums, online assessment and feedback, and class voting all of which were seamlessly integrated into the face-to-face space. So, if students were asked to respond to a short online survey as a pre-class activity the results of this were brought into the face-to-face space and discussed to clarify meaning and extend understanding.

The online learning space was re-designed with a clear navigation to help students find their learning and assessment materials when they needed them. Figure 3 (below) illustrates this change from the online experience from no navigation and just the PowerPoints to a clear guide with icons and a drop-down menu for easy access to the weekly learning materials.

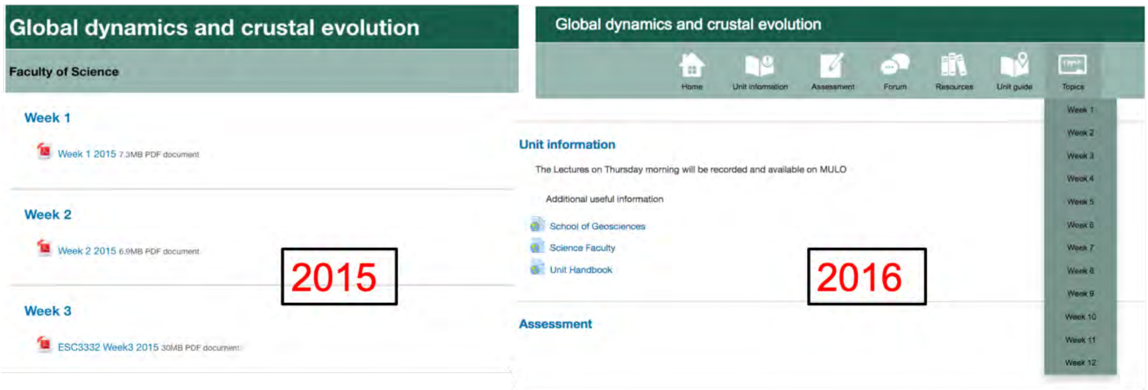

Figure 3: Better organisation and improved navigation

Thematic and weekly templates were designed for the online teaching space to guide the development of a contextualised learning pathway to maximise the learning opportunities. These set out the expectations for the week or topic, the range of learning pre-and post-activities to be completed, and any related assessments and practicals. Figure 4 shows the structure of Topic 4 with a contextualising explanation of what to expect, a page summarising the week's work with links to related materials (videos, voting activities, Prac materials, and readings) and Figure 5 is a snapshot of the weekly summary page with the learning objectives for the week, readings, and five other lecture tasks that are not shown. Figure 6 indicates the level of engagement in the online teaching space - students accessing the learning materials and activities more than once.

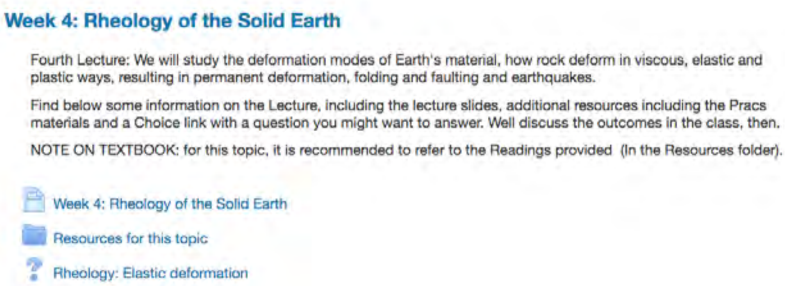

Figure 4: Overview of the week 4 learning activities

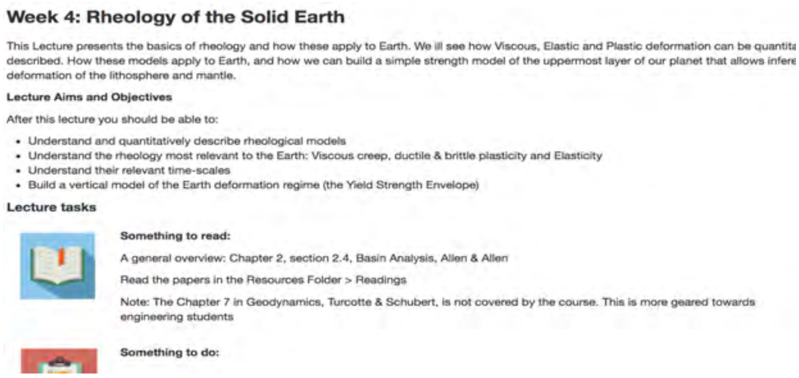

Figure 5:Weekly page summarising the learning and assessment activities

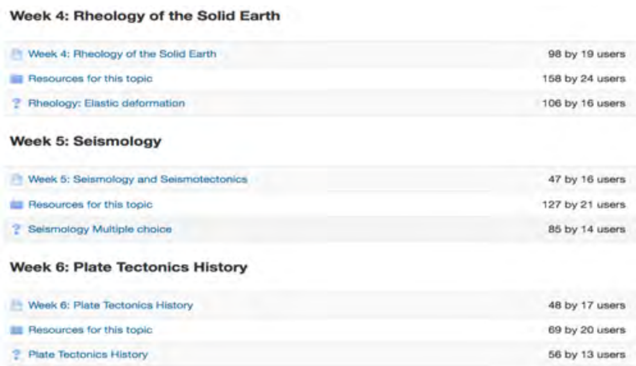

Figure 6: Student activity report

The learning materials did not change but rather the UE model of pre- and post-class learning activities, active learning, and ensuring that there was alignment of all learning activities and assessments to the learning outcomes changed the way the academic and students interacted across the face-to-face and online spaces. The academic re-designed the Practicals and scaffolded the learning to ensure that students had a better understanding of the key concepts to develop deep learning and better demonstrate this through assessments. As a result of this improved unit organisation and communication strategy the students had a better appreciation of the subject and this is represented through the improved SETU feedback shown in Figure 7. Although the University changed the SETU questions and moved some around, for example, Q4 on feedback is in both questions sets but the question on Assessment is Q9 (2013-15) and Q3 (2016). The chart also shows that overall students had a higher satisfaction with every aspect of the unit, Q5 (2013-15) is very low while Q8 (2016) is greatly improved.

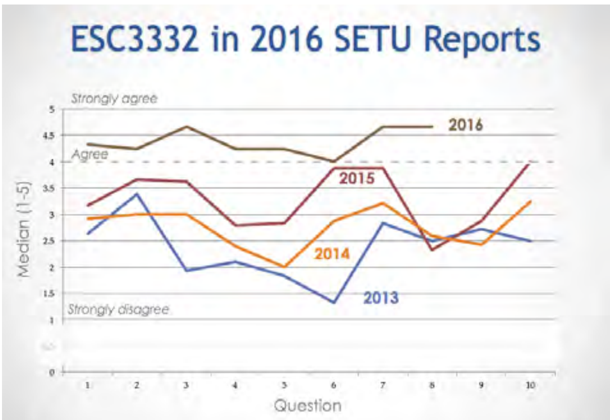

Figure 7: SETU data 2013-2016 showing improved student overall satisfaction with the new format

Key to the SETU questions:

Questions 2013-2015

1. This unit enabled me to achieve its Learning Outcomes
2. I found this unit to be intellectually stimulating
3. The learning resources in this unit supported my studies
4. The feedback I received in this was useful
5. Overall I was satisfied with the quality of this unit
6. The organisation and progression of the topics covered is sensible and coherent
7. The lectures helped me achieve the learning objectives
8. The tutors/practical classes/field work helped me achieve the unit Learning Outcomes
9. The assessment tasks helped me achieve the unit learning outcomes
10. Individual assistance (either face-to-face or online) was available when needed

Questions 2016 onwards

1. The Learning Outcomes were clear to me
2. The instructions for Assessment tasks were clear to me
3. The Assessment in this unit allowed me to demonstrate the Learning Outcomes
4. The feedback helped me achieve the Learning Outcomes
5. The Resources helped me achieve the Learning Outcomes for the unit
6. The Activities helped me to achieve the Learning Outcomes for the unit
7. I attempted to engage in this unit to the best of my ability
8. Overall, I was satisfied with this unit.

The qualitative comments were also very positive and reflected better engagement with the learning materials in the online and face-to-face spaces. Such comments included:

- "The lectures were informative and concise - the outlining of the learning objectives for each lecture helped guide what was important to note."
- "The layout of Moodle was really nice and made things more interesting"

Discussion and conclusion

The EDs, all of whom are engaged in UE, have formed a Community of Practice (CoP) to share expertise as they engage in the task of changing the culture of learning and teaching across the University (Wenger, 1998). This CoP is an essential element of the success of the UE initiative as each faculty has its own culture which requires a unique response to the changing education paradigm. Furthermore, the CoP provides support for its members with regular formal and informal meetings and communication for information-sharing, problem-solving and celebration of successes.

Embedding EDs in the faculties has been a highly successful strategy, measured by the number of units "enhanced" each year and reported to the centrally located Monash Education Innovation team . The model of embedding EDs in the faculties is not widely adopted across the HE sector; many institutions have a central model, in which EDs are sent out to the faculties according to perceived needs. Monash University's model is a sustainable innovation that builds staff capability, resilience and flexibility at the point of need. The embedded ED builds relationships based on trust and performance. The Faculty ED is there for the long haul, not 'fly-in, fly-out', and as such offers continual guidance and support where and when needed. Faculty EDs are called upon to be involved in wide-ranging learning innovation projects but UE is the core focus. The two case studies detailed in this paper demonstrate the process EDs in every faculty use when applying UE at a whole course level (as in Arts) and an individual level (as in Science). While they are typical, they are by no means the only work involved. There is a daily need for consultation on every aspect of teaching and learning, from managing the implementation of new educational technologies through to writing Learning Outcomes and developing authentic assessments to challenge and inspire our students to perform at their best.

Transforming the educational offering from a didactic paradigm to active engagement even when guided by EDs using the best educational technologies and spaces, is a long process of gradually changing priorities and developing a new culture of learning. A coherent approach to expand teaching strategies and develop the use of learning technologies for all teaching academics must address pedagogic issues. EDs strive to inspire, enthuse, support and teach the skills our educators need to implement innovative and engaging educational learning experiences into their methodology.

Change is difficult, but it is, as we have found, very possible. It can even be, in the words of the Music unit coordinator, "exhilarating".

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Surveying the digital literacy landscape for academic and professional staff in higher education

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In order to produce digitally literate graduates, it is necessary for institutions to have digitally literate staff. While this statement seems clear, the commitment and approach of Australian Higher Education institutions to professional learning focused on digital literacies is not. This paper describes initial steps towards clarifying the place of digital literacies in the context of professional learning for higher education staff. The researchers canvassed 31 higher education websites to identify institutional approaches, and conducted a targeted literature review to uncover models and practices that could have transposal value to institutions. This paper reports on which institutions are publicly committed, which units are typically responsible for digital literacy, the reasoning for institutional approaches and key themes in pedagogical designs. It is the beginning of a conversation, in an effort to distil the muddy waters that digital literacies occupies and generate greater transparency and understanding between educators in the Australian Higher Education context.

Keywords: digital literacy; higher education; staff; professional development

Introduction

The world of work is changing rapidly and in order to remain competitive in today's labour market, it is imperative for all workers to continue to learn throughout their career (Adams, Pasquini & Zentner, 2017; Bowles, 2013). This is sometimes referred to as lifelong learning and is an attribute (or a skill) often stated by universities as one they develop in their graduates. As we move into this new unknown and shift from a labour-economy to a knowledge-economy, we need to rethink the skills that are needed to succeed (Selwyn, 2016). One of these often cited 21st Century skills is the need to produce students who are digitally literate, ie able to navigate a digitally connected and information-heavy workplace. Current debates and discussion continue on as to what exactly these digital literacies consist of. For example "Digital literacy involves complex sets of skills and knowledge practices that are best developed as deeply integrated practice within the discipline" (Hagel, 2015, p. 12) and .....

> The term digital literacy is often understood and used differently depending on the context and discipline. In education we should be focusing on the literacies rather than the media, because the technology will change. We need to be wary of making assumptions about the skill levels of our students, because research is telling us that reading, teaching and learning using technology and the screen requires a different literacy paradigm. Lastly we need to engage everyone in a conversation about the deeper layers of meaning that sit behind the term digital literacy. In this instance, when we use the term literacy as a descriptor, it is because being literate is fundamental to how we communicate knowledge and meaning, and this includes the digital environment. (Combes, 2016, p.6)

It is all well and good producing digitally literate students who can keep on developing their skills once in the workplace, but what of the educators and other higher education staff who support and facilitate student learning? Who is supporting them to develop their own digital literacy skills so that they can, in turn, support their students? Some institutions fund roles named 'learning designers' or 'educational designers' or 'learning technologists' tasked with the job of providing one-on-one and group support to staff on learning technologies. Other staff within an institution will support staff with their use of general technologies - sections such as information technology departments and other areas of an institution such as the library offer support to staff with data literacy which often incorporates the use of digital literacy skills. So, with such a wide array of roles being 'partly' responsible for helping staff improve their digital capacities and capabilities it is easy to see how the term digital literacy soon becomes 'messy' in terms of who owns it, drives it and promotes it. There is further muddied water when we investigate the term digital literacy itself. Can it even be considered a singular construct? In his popular opinion piece, Mark Brown (2017a) reminds us that there are multiple terms used to describe this topic not least including digital capabilities, digital skills, digital competencies, and the term digital dexterity which has entered our vocabulary in recent times (Norman, 2012). In part 2 of his series, Brown (2017b) summarises a number of better-known frameworks and models of digital literacies from the US, UK and Europe. The question now is whether these or others adequately suit the Australian higher education sector and whether we can simply apply them to our context or whether a more nuanced adaptation is required. This concise paper attempts to answer this question and uncover any gaps in the literature,

The aim of this review paper is to clarify the waters around digital literacies in the higher education sector in Australia, by determining the uptake of digital literacies at strategic level, and seeking case studies of how strategy has been realised. This was achieved by completing an audit of Australian universities to find out how many currently have a strategy or use a framework to support the digital literacies of staff in their organisations. Alongside this, a review of the literature on digital literacies was undertaken to add a further insight into the varying contexts. The methods, findings and analyses will be reported separately and the discussion section will bring both sets of data together.

Digital Literacies in Australian Universities

Method

An audit of 32 Australian university websites was undertaken during 2018. The audit process involved reviewing each of these websites to collect data on any strategic plans, approaches or frameworks they publish on digital literacies for staff and students. The search terms used for the website audits were digital literacy or digital literacies. If we could not complete our checklist (see criteria in table 1), we then searched the institutions' library website and also the website of their learning and teaching central unit (or office). In some cases, these two sites required a browse to uncover whether or not digital literacy frameworks, programs or other information could be found.

Search results

Table 1. Audit results from 32 Australian websites, investigating the mention of digital literacy frameworks, policies, approaches or strategies, who owns them and who the information is aimed at.

Australian Higher Education Institution	**Mentions an institution policy/ approach/strategy**	**Digital information for or about staff/ students/both**	**Owner (LTC = central learning and teaching unit)**
Group of Eight (Go8)			
The University of Adelaide	yes	both	LTC The Learning Enhancement and Innovation portfolio
The Australian National University	no^	students	Library
The University of Melbourne	yes	both	Library
Monash University	yes	students	Library
The University of New South Wales	no^	students	Faculty (course)
The University of Queensland	yes	both	Library
The University of Sydney	yes	students	Institution
The University of Western Australia	no^	students	Library
Australian Technology Network (ATN)			

Curtin University of Technology	no		
University of South Australia	yes	both	LTC and Faculty (course)
RMIT University	no		
University of Technology Sydney	no^	both	Library
Queensland University of Technology	yes	students	Library
Innovative Research Universities (IRU)			
Flinders University	no		
Griffith University	yes	both	Office of Digital Solutions
La Trobe University	yes	both	library
Murdoch University	no		
James Cook University	yes	both	Institution
Charles Darwin University	no		
Regional Universities Network			
Central Queensland University	no		
Southern Cross University	no		
University of Ballarat (Federation University)	yes	both	LTC
University of New England	no		
University of Southern Queensland	no		
University of the Sunshine Coast	no^	students	Faculty (program)
Others:			
Australian Catholic University	yes	students	Library
Edith Cowan University	yes*	both	LTC
Victoria University	yes	both	Library and LTC
University of Canberra	no		
University of Western Sydney	yes	students	Library
Deakin University	yes	students	Library
Wollongong University	no^	both	Library
^ information appeared relating to specific subjects, programs or initiatives but were not linked to clear strategic plan. *not their own but mentions the JISC framework and also the Australian Government's Core Skills for Work Developmental Framework,			

The audits reveal that only 16 Australian universities have public information on their websites regarding an approach, framework or strategy linked to developing digital literacies. Nine of the 32 universities do not have any information pertaining to our search criteria on their public website. A further five surfaced information relating to digital literacies, but could not be linked to a strategic document or approach, for example one-off subjects at the faculty level or training resources tagged with digital literacy. This data is displayed in Table 1.

Of the websites that showed clearly evidence of a strategic approach to digital literacies, only eleven mentioned both students and staff. This may be because public information of institutions are oriented towards attracting prospective students. However, the number on a surface levels indicates that most institutions value digitally literate graduates, but paradoxically do not value digitally literate staff to develop this quality in students.

Analysis

Responsibility for digital literacy commonly falls onto the institution's library or central learning and teaching unit, with a total of thirteen and five institutions indicating total or shared responsibility respectively. It is telling that libraries are driving change in this area, after historically delivering information literacies which are arguably closely tied to digital literacies. The Council for Australian University Librarians has listed 'digital dexterity' as a key strategic priority for 2017-2019, perhaps in response to this trend. Interestingly, no publicly available information links digital literacy to the institutions Information Technology unit, despite the close ties to their core business.

A caveat is made here in that the information we were searching for may be behind a firewall, on an intranet, or in development at the time of this search. Further, the research was reliant on the search box present in each higher education website or the researcher's assumption on where to logically look, and therefore public information may have been missed.

Digital literacies in scholarly research

Method

A review of the literature on digital literacy for staff in the higher education sector was conducted. The following search was used: "digital" AND ("literacy" OR "literacies" OR "capacity" OR "skills") AND ("higher education" OR "tertiary" OR "university") AND ("staff" OR "teacher" OR "lecturer") in four databases - A+ Education, EBSCO (Education Research Complete), ProQuest Education, and Scopus.

The terms 'digital competency' and 'digital dexterity' were considered, however we felt that the first four terms would be comprehensive enough for our needs.. Determining a clear descriptor of higher education staff was challenging, due to the variance in terms for educators (i.e., teachers, lecturers, academics) and for other staff (i.e., professional staff, general staff). he results to peer reviewed journal articles and those from the past 10 years.

Search results

A high number of articles were returned during initial searches and we narrowed down the results by skimming through the abstracts and titles and excluding those that only referred to students. Articles that referred to both students and staff, as well as those with transposable value despite being written from a non-Higher Education context were included. Table 2 lists the details of the 18 articles that were considered for this paper. Only seven of these 18 articles hit the three main criteria for review: higher education context, professional learning and digital literacy-focused. However, the remaining 12 articles described concepts or had applications that could possibly be transposed our desired context.

Analysis

The abstracts were analysed and coded into seven themes. These are context (subdivided into HE, K-12, community, and not specified); framework discussion; owner (subdivided into library or learning and teaching); audience (student, teacher or both); future work skills; professional learning (formal, informal or neither); and collaboration. Some items within these themes will now be briefly discussed.

Discussion

Context

The range of contexts for the selected articles is presented in Table 2. One of the 18 articles selected for this review was from an unexpected source. It discusses the digital literacy skill acquisition for hearing and vision impaired members of the community (Tellefson, 2016). Whilst this is not our target audience or sector, the article presents a framework for developing lifelong learning skills in digital literacy and discusses the importance of enabling independence for this group.

Audience

As described earlier, it was difficult to find the correct search term to describe the target audience. We found thirteen articles specifically discussing student and staff needs in terms of developing digital literacies. Five of these covered both groups, one covered students only and the remaining eight articles discussed staff needs only. Of these 13 articles focussing on staff digital literacies, only three of them articulated a distinction between academic and professional staff with the latter being librarians (Hallam, Thomas & Beach, 2018; Hobbs & Coiro, 2016; Osborn, 2017). This connects back to our earlier discussion on the need for digital literacy capacity building across both professional as well as academic staff in the sector.

Owner

When we analysed the articles for details on who ‘owned’ the information we found there were three belonging to the library and eight to a learning and teaching unit. This finding is inconsistent with the results of the website audit, in which 12 institutions appeared to assign complete or some ownership to the Library while 5 assigned ownership to a central learning and teaching unit. This may be explained however, by the assumption that it is, more common for educators on an academic contract to publish their scholarly work as compared to library staff who are usually on a professional contract and more used to sharing in other contexts not necessarily in a journal article.

Table 2. Summary of articles reviewed for this paper.

Author	Year	Context	Audience	Owner	Future Work	Professional Learning	Collabor-ation	Frame-work
Bennet, L.	2014	HE	Staff	L&T	-	Yes	-	Yes
Combes, B.	2016	K-12	Staff	Library	-	-	-	-
Hall, et al.	2014	K-12	Staff	L&T	-	-	-	Yes
Hallam, et al.	2018	HE	S&S	Library	-	-	-	Yes
Hobbs, et al.	2016	K-12	Staff	L&T	-	Yes	Yes	-
McIntyre, S.	2014	HE	S&S	L&T	Yes	Yes	-	-
Mirriahi, et al.	2015	HE	Staff	L&T	-	Yes	-	-
Newland, et al.	2016	HE	Staff	L&T	-	Yes	Yes	Yes
O'hare, S.	2016	HE	S&S	Institution	Yes	Yes	Yes	-
Oakley, K.	2008	Generic	Other	-	Yes	Yes	-	-
Osborn, J.	2017	HE	Staff	Library	-	Yes	Yes	-
Owens, R.	2012	K-12	Staff	Institution	-	-	Yes	-
Poore, M.	2011	Generic	S&S	-	Yes	Yes	-	-
Sadaf, et al.	2017	K-12	Staff	-	Yes	-	-	-
Semingson,	2017	HE	Staff	-	-	-	Yes	-

et al.								
Tellefson, C.	2016	Community	Other	-	-	-	Yes	Yes
Tour, E.	2017	K-12	Staff	-	-	Yes	Yes	-
Wheeler, et al.	2012	HE	Staff	-	-	Yes	-	-

Table abbreviations:
HE= higher education
K-12 = pre-tertiary education
S&S = students and staff
L&T = learning and teaching

Framework

A number of recent articles have reviewed available digital literacies frameworks, the most recent being the NMC Horizon report which details and compares 11 contemporary frameworks (Alexander, Adams Becker, Cummins, & Hall, 2017). Only five of our selected articles discussed frameworks (see Table 2). One explanation for this small number of articles may be due to the fact that critiques and developments of such frameworks are now readily available in the literature though we found it interesting that other articles did not refer to them. Only one of the five discuss the use of an external framework ("Developing digital literacies", 2014), the others all developed their own contextualised structures.

Professional learning

As this theme was a main element of our search criteria it is not surprising that nine articles discussed this. In most cases this covered different approaches to professional learning with six of the nine articles discussing the value of informal learning to develop digital literacy skills. As we found only a few Australian institutions currently invested (publicly) in the development of digitally literate staff, directions could certainly be adopted from the literature.

There were two further themes present in the selected articles, one to be expected and one quite unforeseen. These will be discussed next.

Future work

The need for digital capabilities in order to be successful in the workplaces of the future. We expected to see more of this theme throughout the articles we reviewed though we found only six articles mentioned it. A recent graduate employability report (Davies, Fidler, & Gorbis, 2011) projected the skills that would be required for jobs in 2020 and rated a critical mindset at the top of the list. It may be pertinent therefore to start to consider how this skill can be developed rather than concentrating on the specific technology skill sets often encompassed within the term digital literacies.

Collaboration

The digital literacy debate is hard to resolve due to its complex nature not least involving the lack of consensus on its definition and yet further when we begin to consider the socio-political arguments regarding inequity of Internet access (Brown, 2017c). However, a final theme emerged in the reviewed literature, that of collaboration. This is encouraging since it is only through collaboration that institutions can stop working in silos on this 'wicked problem'. Development experts have argued that we may need to take smaller, more manageable steps to tackle these large-scale problems (Reinecke, & Manning, 2016). One example can be seen in the collaboration between Deakin University and Australia Post in the development of a MOOC for the general public to develop their capacity to engage in a digital world (https://www.mooc-list.com/course/digital-discovery-2-expand-your-world-online-futurelearn).

Conclusion and next steps

Our dive into the murky waters of digital literacies has led us to concur with other authors that the topic is somewhat confusing, chaotic and messy (Brown, 2017a; Martin & Grudziecki, 2006). We found that there is little research published on the development of digital capabilities for non-teaching staff (often called professional staff in the higher education sector) and this is an area for future investigation. Is work going on in this area but not published? One could theorise that professional staff do not tend to have workload allocation for scholarly research and therefore whilst this could be taking place in practice, it may be that publication is not a priority. Running a national benchmarking exercise across institutions could allow for further investigation into this area. Such an activity would also overcome the limitation of this current study in that much of the data of interest in the website audit was likely residing on intranets or behind firewalls and therefore not publically available. Another area for future research which came to light as lacking in the scholarly literature, is to investigate what theories have been used to underpin specific implementations of digital literacy frameworks, models or approaches.

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Digital disruption meets the academic timetable: start learning anytime

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Many universities claim to provide flexible learning opportunities, but most still require students to keep pace with prescribed curriculum delivery and assessment deadlines, and few have disrupted the academic calendar. In this paper, we report on an innovation called 'Start anytime' that was purposefully designed to break from a trimester model and instead give students the flexibility to study in their own space and pace online. Here we report on measures put in place to support students during self-paced online study, and share insights from research investigating students' expectations and experience of 'Start anytime'. For many students, the self-management required for self-paced study was a challenge, but for most students those challenges were out weighted by the benefits of flexible learning. Importantly, the majority of students thought that access to learning support and teaching staff was the same or better in 'Start anytime' units than in a timetabled unit, and many students found that self-paced study was easier and more enjoyable. Thus, we have shown that where it is carefully designed and supported, self-paced online learning and disruption of the academic calendar, can have considerable benefits for experienced adult learners who have difficulty fitting study around their busy lives.

Keywords: asynchronous study, self-paced online learning, student experience, flexible delivery.

Introduction

The ways in which university students engage with online and on-campus learning opportunities has changed as digital tools have become more advanced, affordable and accessible. Use of learning management systems and other online technologies to compliment face-to-face teaching is now standard practice in Australian universities and has changed the nature of both distance and on-campus learning. Students are opting to study online more and on-campus less: including both the proportion of students who choose to study entirely online, and the changing habits of those who enrol on a physical campus (Norton, Sonnemann, & McGannon, 2013; Stone, 2017).

These trends are not surprising given that today's students spend more time in paid work than their predecessors and are more likely to be balancing study with other commitments that include work, parental responsibilities and other carer roles (Gosper et al., 2010; Stone, 2017). For some students, online learning is also important to overcoming geographical constraints, commuting difficulties or other impairments that impede their access to physical campus spaces (Stone, 2017). Thus, contemporary students value and often require the flexibility afforded by studying partially or entirely online (George-Walker & Keeffe, 2010; Norton & Cakitaki, 2016; Sheppard & Smith, 2016).

Universities are increasingly making claims about providing flexible learning opportunities. However, the ways in which flexibility is offered are still very limited. Students are given opportunities to learn in different modes (e.g. online, on-campus or combinations of the two), but few universities have disrupted the academic calendar. Therefore, studying online provides students with greater flexibility over where they study, but contact hours and when students study is still largely prescribed by semester or trimester and weekly calendars. Some universities provide more frequent intake opportunities in a year, but when those study periods start and end is standardised, so students must keep up with the pace of curriculum delivery and meet imposed assessment deadlines.

Accountability to deadlines can help to keep students on track and allows teaching staff to manage their workload. However, studying at prescribed times and meeting deadlines can be challenging or even prohibitive for adult learners who are unable to prioritise study over other commitments and who cannot predict or control the demands of other aspects of their lives (Stone, 2017). For this reason, retention is lowest for mature-age and part-time students who are more often juggling other commitments and only studying part-time because they are constrained by other responsibilities (Higher Education Standards Panel, 2017; Norton et al., 2013)

In a nutshell, the relentless pressure of "week by week" learning progress can lead to student withdrawal. However, it does not need to be that way. Just as digital streaming had disrupted consumer viewing patterns, digital technologies have the capacity to disrupt prescribed patterns of learning. At its inception, free to air television broadcasting operated on a similar model: consumer entertainment patterns were prescribed by timetabled weekly instalments of programs that best suited the station and their advertisers. Video recorders later enabled viewers to have more control over when they viewed content, and provided the first opportunities for "binge watching". Now, internet streaming services enable consumers to watch what they want, when they want and on the device of their choosing. Likewise, digital education has the capacity to let the learner choose not just how they access learning, but also when, where and how quickly.

In this paper, we report on a Deakin innovation called 'Start Anytime' that was designed to disrupt the academic calendar. Having agreed to a strategy to enable "brilliant education where students are and where they want to go", we challenged ourselves to imagine how we might use digital tools to allow the learner to start, advance and complete their studies at the pace that suited them, not us. This meant allowing students to enrol in a unit on the day of their choosing, to move through the learning experiences at their own pace, and to submit their assignments when they felt ready.

Called 'Start Anytime', the pilot was designed to maximise flexibility by unleashing select units of study from trimester and weekly calendars. This created significant administrative challenges: in addition to redesigning learning experiences and assessments, we needed to address how this disruption would affect the academic workload model, the role of the teaching staff, enrolment systems, deadlines, fees, census dates, withdrawal procedures, boards of examiners, and student evaluation of the learning experience – to name a few. However, the scope of this paper is not to consider all of these challenges, but to report on the student response to the innovation. First, we briefly describe the measures put in place to ensure that Start Anytime' students were as well supported as those who chose to participate in trimester mode, we then share insights from research investigating students' expectations and experience of Start Anytime.

'Start anytime' pilot: context and support

We identified two existing postgraduate business units that could be redesigned to facilitate self-paced learning: Business Process Management (MPM701A) and Analytical Skills for Managers (MIS770A). Both units were already offered entirely online as well as on-campus. Both units continued to operate in the normal trimester mode, and we agreed that students who opted to enrol in 'Start anytime' – for whatever reason – could transfer seamlessly into the trimester mode if they wished. We agreed that 'Starting anytime' meant that students could enrol any day that the university was open for business (excluding university and public holidays); had to remain in the unit for a minimum of four weeks; and had to complete that unit within a year of completion. The Start Anytime pilot commenced in January 2016.

In recognition of the risk of isolation during asynchronous online study, measures were put in place to ensure that 'Start anytime' students were supported by their teachers and had opportunities to interact with their peers. These measures included the articulation of 'guarantees' so as to set clear expectations for a responsive relationship between students and their teachers. Those guarantees include a commitment to respond to student enquiries within 48 hours, and assessment of formative assignments within 5 days of submission. Students were also provided with multiple points of contact, including the unit chair's email address and telephone number and opportunities to meet with the unit chair (through Skype, phone or face-to-face) as required.

Discussion forums were also provided through the learning management system so that students could engage in asynchronous conversations with their peers and teachers. Non-compulsory online group meeting opportunities were also scheduled by teachers and facilitated using BlackBoard Collaborate. Given the asynchronous nature of the units, no specific content or activities were prepared for these meetings; rather, they were 'drop in' opportunities for students to get help or share experiences with other students and their teachers. Meetings were initially scheduled for two hours once a week. However, in response to low attendance (four students or less) in the first month of the trial, these were exchanged for four 30-minute sessions staggered throughout the week to increase the flexibility of engagement opportunities. However, student attendance dropped to zero, so meeting opportunities were dropped after a two-month trial.

To encourage student engagement, login reminders were initially sent to students who had not logged into the unit sites every two weeks. However, these were adjusted to once a month as teaching staff realised that students were reaching out when they wanted or needed help.

The units chosen for the pilot were pre-existing units selected for their suitability for self-paced study in that they were already designed so that students could follow detailed prompts and sequences appearing throughout the respective units' comprehensive modules of learning. However, various adjustments were made in each unit to improve clarity and avoid student misunderstanding. These changes included removal of references to weekly schedules, due dates and timeframes. An introduction to the importance of self-management to accomplishing the learning objectives and assessments was also included in the online study guide. Other changes varied by unit. For example, one unit chair pre-recorded seminars to introduce the unit and each of ten learning modules. These spanned 30 - 60 minutes and covered all of the content that would ordinarily be covered in a two-hour interactive session on-campus or a 90 min interactive session online. Students could stream these from the learning management system or download them for later listening. All resources were provided at enrolment, so that students did not need to wait for week-by-week instalments.

Assessments were also redesigned to remove group work and live assessments (such as examinations and presentations) and to mitigate the risk of plagiarism. For example, in one unit an assessment creation system was developed to automate the production of unique detailed assessment briefs that included comprehensive hypothetical, organisational scenarios and arrays of data, randomly computed from within predefined ranges.

Research methodology

All students who enrolled in the 'Start Anytime' units were initially invited to complete two surveys, one at enrolment and a second at completion. The enrolment survey was designed to investigate students' motivations and expectations of self-paced online study. The completion survey included the universities standard student evaluation question set, as well as questions specifically targeted at understanding students' experience of the 'Start anytime' mode of study. Both surveys were sent out every two weeks to any students who had newly enrolled in or completed either of the units. To ensure that enrolment and completion survey invitations were received by all students who enrolled in the first year of the pilot the enrolment survey was sent out for approximately one year and completion survey for two years. Sixty nine students (30% response rate) responded to the enrolment survey and thirty seven students (29% response rate) responded to the completion survey. For this paper we have provided an analysis of a reduced data set from those surveys, including students' responses to the following questions:

Enrolment survey

1. Why did you choose to enrol in this unit in 'Start Anytime' mode instead of a timetabled trimester of study? (open-ended question, followed by four-point agreement scales against related statements)

2. Do you think studying in 'Start Anytime' mode will be associated with any challenges? (open ended question)

Completion survey

1. How does studying in a 'Start Anytime' unit compare to studying in a timetabled unit? Students were asked to make a choice between: 'greater in a 'Start Anytime' unit', 'greater in a timetabled unit' or 'no difference', for the following:
    - Convenience;
    - Difficulty;
    - Depth of learning;
    - Enjoyment of learning;
    - Access to learning support/teaching staff; and
    - Ease of communication with peers.

2. What benefits were associated with completing this unit in 'Start Anytime' mode? (open-ended question)

3. What challenges were associated with completing this unit in 'Start Anytime' mode? (open-ended question)

4. Would you recommend 'Start Anytime' mode to other students? Why or why not (Yes or no, with an open-ended comment)

Student expectations at enrolment

The majority of students who responded to the enrolment survey, said that they chose to study in a 'Start Anytime' unit because they wanted or needed flexibility to accommodate other commitments. These included work, family, travel and other study that was associated with less flexibility (i.e. other units with "extremely strict deadlines"). Students were often juggling multiple demands on their time, for example:

> "I find it very difficult to manage work, family and study commitments. My time to study is limited and I need to do as much as possible when I have the opportunity. Having resources released all at once and flexible due dates will allow me to fit in study when I can, allowing for unexpected things such as child illness, intensive projects at work, etc. I have previously had to withdraw form units in the course I have just discontinued, as there is very little room in my schedule for things to go wrong, as they inevitably do."

Some students indicated that they had selected the mode of study because it had allowed them to continue studying despite a significant disruption that would have prevented them from enrolling in a timetabled unit, or because it had given them the confidence to enrol in more units despite other commitments. Essentially, students saw the longer duration and flexible deadlines as a "safety net". Other students had enrolled in the unit of study so that they could take the time to learn more deeply, to accommodate learning difficulties or to accommodate other commitments.

Some students had enrolled in the 'Start Anytime' mode because they wanted to accelerate their study. However, few students intended to accelerate the completion of the unit itself. More commonly, students wanted to accelerate the completion of their degree program, by starting the unit earlier, utilising free time during trimester breaks, or by taking on a greater study commitment (more units at a time). For some students, this desire to accelerate the completion of their degree was out of necessity, for example, one student said:

> "I would also like to finish my course asap as I am undertaking this degree to reskill after redundancy in the mining sector and having difficulties in gaining employment in my original profession".

Other students enrolled in the 'Start anytime' version of the unit so that they could complete the unit in time to meet a prerequisite requirement for the following trimester, or to reduce their workload in a following trimester. Students were also attracted to the mode of study because of the absence of an exam and group work, which were in themselves associated with greater flexibility, for example:

> "More flexibility, no exams and no group work makes the unit easier to manage for a student working full-time especially over the summer months".

Most students anticipated that managing their own time would be a challenge, in particular staying motivated and organised without deadlines and managing unexpected changes to work or personal life that might prolong the time required to complete the unit. Some students also recognised the potential for isolation and expected that there would be less opportunities for student-student learning and collaboration on assignments. Some students thought that understanding the requirements might be challenging and emphasised the importance of clarity in the learning resources. Students also suggested that communication with teachers might be a challenge because students would be at different stages of completion. For the same reason, other students suggested that the study mode would likely be associated with challenges for the teacher but not students themselves.

Student expectations after completion

The majority (92%) of students who responded to the survey after having completed a 'Start anytime' unit indicated that they would recommend 'Start Anytime' mode to other students. As expected, flexibility was the main benefit described by students, both in their reasons for recommending the mode of study to other students and in their responses to other open-ended questions. In addition to helping them to gain "study-work-life balance" and reduce the stress associated with study, some students felt that flexibility had enabled them to learn more deeply, for example:

> "Being able to access all materials from the start was excellent. Having plenty of time to engage with learning materials led to deeper learning. The flexible approach enabled me to fit study in with my work and family, and allow for unexpected problems. I felt more in control and way less

stressed. I have previously had to discontinue units due to sudden family issues as I have a disabled child, and this was just so much better"

"Juggling work and other study commitments with this course was easier because of the informal time constraints. That actually encouraged me to understand the course content when I got my head into it..."

Students had mixed perceptions of how studying in a 'Start Anytime' unit compared to studying in a timetabled unit (Figure 1). However, the vast majority of students (97%) agreed that studying in a 'Start Anytime' unit was more convenient than studying in a timetabled unit (Figure 1). The majority of students either preferred 'Start anytime' (39%) or thought there was no difference (33%) in their enjoyment of learning in a 'Start anytime' unit in comparison to a timetabled unit. More students did think that it was easier to communicate with their peers in a timetabled unit than in a 'Start Anytime' unit; however, 39% indicated no difference and only 3% indicated that this was lesser in a 'Start Anytime' unit. Furthermore, the most students indicated no difference between depth of learning (64%), access to learning support or teaching staff (58%), and difficulty (42%) between "Start Anytime' and timetable units, but other students had mixed perceptions about whether 'Start Anytime' or timetabled units were better (Figure 1).

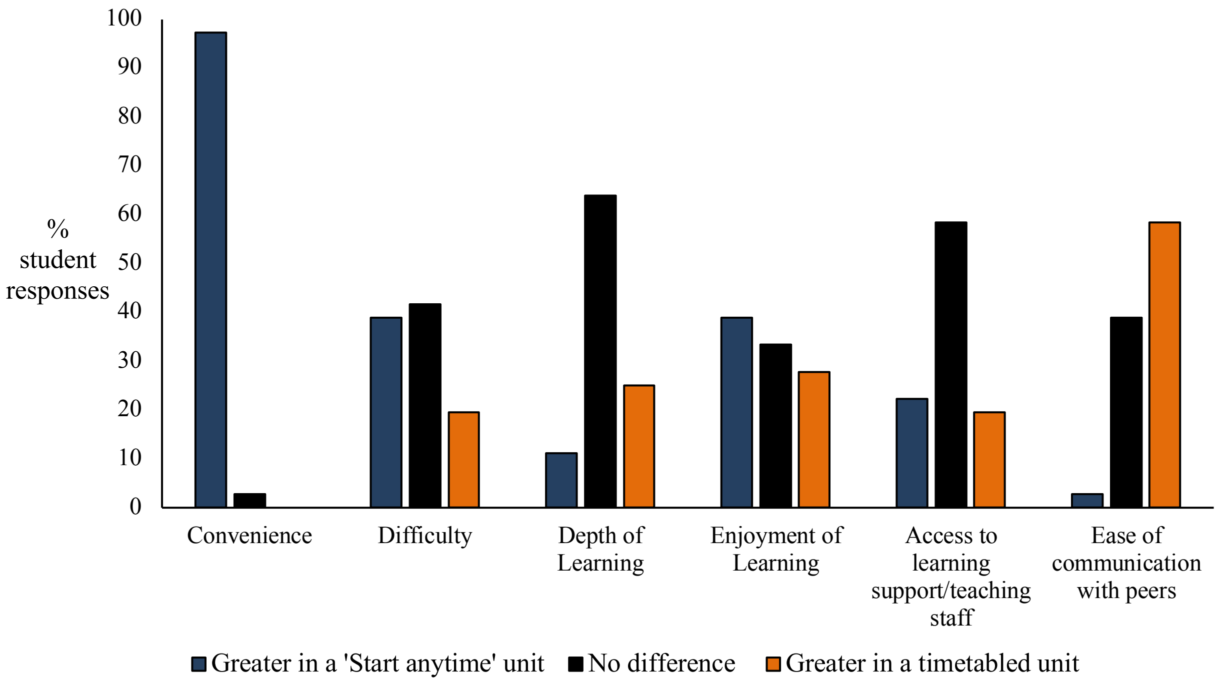

Figure 1. Students' comparison of the convenience, difficulty, depth of learning, enjoyment of learning, access to learning support and teaching staff, and ease of communication with peers in a 'Start anytime' unit vs. a timetabled unit.

The challenge most commonly reported by students was self-management, including: setting deadlines, remaining motivated, avoiding procrastination, and greater difficulty learning where they had delayed completing an assessment:

"As there was (sic) no fixed deadlines I continuously left the work and came back to it, which was more difficult than if I had completed (sic) in one go".

However, students who highlighted self-management as a challenge often tempered that viewpoint by acknowledging that self-management was their responsibility, a challenge that they had expected or a challenge that they were capable of overcoming. Some students actually suggested that improved self- or time-management were a benefit of completing the unit in 'Start Anytime' mode.

Only three students (8% of survey respondents) suggested that lack of peer interaction and support was a challenge, for example one student said:

> "Very little interaction with other students, feeling very much on my own. Couldn't bounce ideas off other people".

Discussion

Our analysis of students' expectations and experience of 'Start Anytime', suggests that self-paced online study can have considerable benefits for experienced adult learners who have difficulty fitting study around their busy lives. For some students online, self-paced study was clearly more enjoyable and rewarding than studying in a time-tabled unit. The postgraduate units selected for the pilot were chosen in recognition that this group of experienced learners more often study online and part-time because they need to balance study with other aspects of their lives such as work and family (Stone, 2017). Therefore, it is not surprising that want of flexibility was the most common motivator and benefit reported by survey respondents, as well as the main reason why the majority of students (92%) indicated that they would recommend self-paced online study to other students.

For many students, self-paced online study was challenging, especially the requirement for self-management. However, student expectations and experience of both the challenges and benefits of self-paced study were well matched, which suggests that students had realistic expectations at enrolment. For most students the benefits of 'Start anytime' clearly outweighed the challenges. However, variation in students' perceptions of how studying in a 'Start Anytime' unit compared to studying in a timetabled unit (e.g. the difficulty, depth of learning and enjoyment of learning), suggests that some students already use or more easily adopt strategies that help them to manage self-paced online study. This illustrates the importance of ensuring that students know what to expect so that they can judge which modes of study are best suited to their lives and learning context. Sharing vignettes and examples of strategies that students find helpful might also help new students to adopt behaviours that contribute to success. For example, one student suggested:

> "Start early, don't leave assignments to [the] last minute, interact with other class mate[s] on [the] cloud and do not [be] afraid to ask questions".

Our results suggest that for most students, communicating with peers is harder in a 'Start Anytime' unit than in a timetabled unit. However, it is telling that few students (only 3 individuals) listed this as a challenge in their open-ended responses. This likely reflects the interests, intent and needs of this cohort of students. The same time constraints that motivated these students to enrol in a 'Start anytime' unit, would likely also make it difficult for them to engage in collaborative learning in timetabled units (regardless of whether they were on-campus or online). This is consistent with other research, which has shown that older and postgraduate students (who also tend to be older) are less likely to be interested in campus life, are less likely to have the time to take advantage of campus life even if they are interested, and are more likely to enrol in at least one online unit of study (excluding research students who are usually required to enrol on a physical campus)(Norton et al., 2013). It is important for students to have choice and opportunities to engage in peer to peer communication; however, flexible learning also means respecting students' choices not to engage with their peers - where they do not need or want to.

Overall, student responses suggest that the measures put in place to support learning in the 'Start anytime' units were equivalent to that provided in timetabled units: the majority of students (80%) indicated that access to learning support and teaching staff was greater (22%) or no different (58%) to that in a timetabled unit. However, future work might explore the experience of the 20% of students who felt that access to support and teaching staff was greater in the timetabled units. This might reflect the preference of individuals for face-to-face interaction or scheduled meetings, or it could reflect reduced help seeking behaviour. Students in the 'Start anytime' units were provided with numerous ways to communicate with teaching staff, but are largely expected to request help as it is required. More frequent teacher instigated interactions might improve the experience of students who are more hesitant to seek help and might serve a dual purpose of providing motivation for students that are inclined to procrastinate.

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University-run learning and teaching blogs: a benchmarking study

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Providing relevant information, professional development and just-in-time support to a diverse group of teaching staff is a challenge facing many modern universities. A 'typical' university instructor today is time-poor, relatively isolated and has a limited capacity to engage in professional development and/or community building. Moreover, most of the teaching in Australian universities is performed by sessional staff (May, Strachan, & Peetz, 2013; Rothengatter & Hil, 2013), who are often not remunerated for professional development. A contemporary approach by which universities seem to be addressing the above issues is the learning and teaching blog. Such publications are adopted by an increasing number of institutions in Australia and internationally, however, little has been documented about their practices. This benchmarking study presents a survey of 12 learning and teaching blogs from Australian and overseas institutions and seeks to shed light on common types of content and topics, as well as the purpose and authorship of such blogs. The findings can be used to inform planning and development of university-run learning and teaching blogs.

Introduction

Improving learning and teaching has been an institutional priority for most universities for several decades (Biggs, 2001). It is now widely recognised that subject matter knowledge alone is simply not enough to engage a diverse population of students and provide them with high quality learning experiences, and that a university teacher also needs to develop a solid understanding of learning and teaching approaches and stay abreast of pedagogical best-practices.

This recognition has led to an emergence of various learning and teaching services worldwide. In Australia and New Zealand, they are usually referred to as 'academic development' and 'learning and teaching support', while in other countries they are often known as 'faculty development' or 'educational development' (Lewis, 2010).

These services usually encompass individual and group consultations, pedagogy and/or technology-related workshops, learning and teaching projects, community events, etc., and are delivered via different models (see Hicks, 1999): many universities have a '*central'* model wherein a strong central unit is responsible for supporting the entire university. Other institutions choose a *dispersed* model wherein different parts of an institution are resourced with their own learning and teaching support staff. There are also *mixed* and *integrated* models that combine the elements of the first two but to different extents/efficiencies.

One of the new developments in learning and teaching support, especially in the universities with the 'central', 'mixed' or 'integrated' model is staff-authored, institutionally supported learning and teaching blogs. These blogs emerged presumably in the hope of reaching a wider audience or providing the existing audience with a new means to access learning and teaching resources. This ability to communicate with diverse staff is particularly important for universities that have multiple locations and/or a considerable number of casual teaching staff (Lefoe & Meyers, 2006). These factors in particular are the reason that "[i]nstitutions are also seeing the benefit of institutional blog spaces that are semi-independent of specific courses, disciplines, and faculties" (Aitchison, Carter, & Guerin, 2017, p 9).

Indeed, the potential of blended environments in general, and the open, public-facing, rapid-impact blog in particular, to engage diverse audiences has been noted by scholars (Powell, Jacob & Chapman 2012). Such blogs have been recognized as a more social and less formal way to share research and scholarship in academia (Mewburn & Thomson, 2013) and have been seen as "a unique educational bridge between academia and the public" (Batts, Anthis, & Smith, 2008, p 1837). What is more, a blog is often viewed as a way to support or create a community of practice around an interest or discipline area (Ramsay et al, 2014; Guerin et al, 2014), or a more private journal that forms part of reflective practice (Sherry & de Haan, 2012). There may also be considerable professional benefits in starting a blog that covers a topic related to one's work (Guerin et al, 2014).

While there is a growing excitement about the potential of blogging to enhance teaching quality in the Australian and international tertiary sector, very little is actually known about institutionally supported blogs that aim to do this. Most literature on the subject examines blogs as a formal learning activity for students (for example, Deng & Yuen 2009) or simply mentions the potential of blogging for professional development of tertiary teachers (Lefoe & Meyers, 2006), so there is a real paucity of information about the types of content, topics, goals, authorship or frequency of such blogs. To the best of our knowledge, there is no existing literature that provides a current snapshot of different aspects of university-run learning and teaching blogs. The lack of this information is regrettable, as institutions and individuals considering leveraging the potential of blogs are often unsure how to go about this task, what type of content to focus on, or what topics to cover. The lack of documented practice also creates uncertainty about the legitimacy of blogs as a professional development tool or about the feasibility of conveying valuable messages via a blogging platform. It can also create unnecessary workload for blogging pioneers who must do their own research on existing blogs - a time-consuming and potentially onerous task. This paper seeks to fill in this gap by providing a current snapshot of university-run learning and teaching blogs from Australia and worldwide. We seek to shed light on the type of content commonly published in learning and teaching blogs, common topics covered, the seeming reasons for writing blog posts as well as the frequency of posts and typical authors who write for such publications. This information is valuable it its own right as it provides a baseline for documenting activities of learning and teaching blogs, and it can be used by various institutions to inform their decisions about blogging.

Methodology

To provide a current snapshot of institutional learning and teaching blogs, we performed a content analysis on all the university-run learning and teaching blogs we could identify at the time of the research. In order to be included in the analysis, the blogs needed to be official or at least institutionally supported sites of their University and be specifically focused on learning and teaching. We were interested in blogs that published a range of articles on learning and teaching topics. We excluded sites delivered via blogging platforms that were online learning modules rather than blogs *per se*, such as ANU Coffee Courses, and blogs that appeared to be inactive. We deemed a blog active if it had posts in the last 12 months (at point of capture) and had at least one post per month. These blogs were identified via a Google search using the following key words: ‘learning and teaching blogs’, ‘university blogs’, ‘higher education blogs’, as well as the researchers’ prior knowledge of the existing learning and teaching blogs from our own and other institutions.

12 blogs in total were identified. The summary of the selected blogs is presented in Table 1.

Table 1: Institutional learning and teaching blogs included in this study.

Blog name	Institution	URL	Country
Centre for Research on Learning and Teaching blog	University of Michigan	www.crlt.umich.edu	US
Futures	University of Technology Sydney (UTS)	futures.uts.edu.au	AU
Learning Technology & Innovation	London School of Economics (LSE)	blogs.lse.ac.uk/lti	UK
Realising Teaching Excellence at the University of Worcester	University of Worcester	rteworcester.wordpress.com	UK
Teaching@Sydney	University of Sydney	sydney.edu.au/education-portfolio/ei/teaching@sydney	AU
Teaching and Learning Blog	Loughborough University	blog.lboro.ac.uk/teaching-learning	UK
Teaching Commons Blog	York University	teachingcommons.yorku.ca/teaching-commons-blog-teaching-and-learning-at-york	CA
Teaching for Learning	McGill University	teachingblog.mcgill.ca	CA

Teaching Matters	University of Edinburgh	www.teaching-matters-blog.ed.ac.uk	UK
Teaching Matters at LU	Lincoln University	tm-lu.blogspot.com	US
TECHE	Macquarie University	teche.mq.edu.au	AU
University Centre for Teaching and Learning blog	University of Pittsburgh	teaching.pitt.edu/blog	US

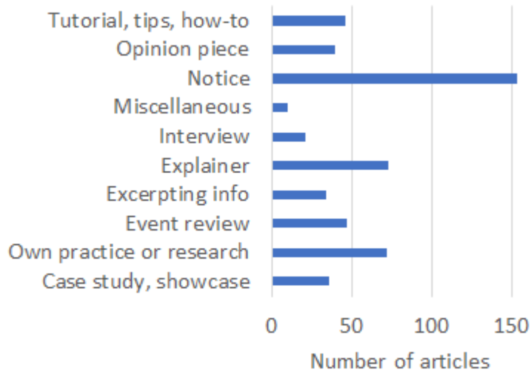
In order to answer the research questions, blog articles were coded using the following categories: (i) type of content; (ii) topics; (iii) a perceived intent; (iv) author role (if available); and (v) date.

Given different frequencies of blog posting in different institutions, 40 most recent posts from each institution, up to the end of May 2018 were coded. 40 was deemed a sufficient number for a representative sample of different learning and teaching blogs and resulted in the analysis of 480 blog posts in total.

A combination of inductive and deductive thematic analysis was used (Fereday & Muir-Cochrane, 2006). Initially, a subset of 20 blog posts from different institutions was coded for the type of content, topics, a perceived intent and author role. This allowed establishing the initial deductive codes for the type of content, a perceived intent and author role. The ‘topic’ category was kept open-ended. Once the deductive coding categories were established, the whole data set was re-coded using the established coding scheme, utilizing the online descriptive analysis tool Dedoose.

Results

Type of content



Our analysis identified nine types of content (Table 2), plus a miscellaneous category. Of these content types, notices and announcements were by far the most common, followed by posts that explained various learning and teaching issues or posts where the author shared their own experiences (Figure 1). If applicable, more than one code was assigned to the same blog post. When comparing institutions, it was clear that some had a higher proportion of certain content types in the selection of posts analysed for this study (Figure 2). For example, Teaching Matters from the University of Edinburgh had a large proportion of posts where academics were describing their own practice, while the blog from Macquarie University seemed to have no such content. At the same time, the Macquarie University blog had a sizeable number of interviews while the University of Edinburgh blog did not have any. Similarly, the University Centre for Teaching and Learning blog from the University of Pittsburgh had a large amount of content reposted from elsewhere, while blogs from UTS, Sydney, LSE, Loughborough and Edinburgh did not seem to use this type of content. Overall, however, most blogs seemed relatively well-balanced and used most of the content types identified in this study (Figure 2).

Table 2: Content types of learning and teaching blogs with examples

Content type	Description	Examples of article titles
Case study, showcase, profile	Describes someone else's learning and teaching initiative	"Rethinking the postgraduate learning experience: a case study from Law"; "Using Powerpoint to create engaging simulations"; "Three inspirational examples of technology enhanced innovations in learning and teaching"
Describing own research or practice	An author writing or reflecting about their own learning and teaching endeavours	"Flipping in the classroom: Evaluating an experiment in the humanities"; "The reason I teach grit to my students"; "Teaching and learning lessons from Turnitin"

Event Review	Overview or summary of a learning and teaching event	"Let's talk… about contract cheating"; "Authentic, inclusive assessment - takeaways from a workshop"; "Copyright, the future and Brexit - what does it mean for education?"
Excerpting information from elsewhere	Article that summarises, reviews, or otherwise highlights another article or piece of literature	"Smartwatches deemed least valuable technology in the classroom"; "A review of Carl Wieman's latest book on science education"; "How can we become better teachers?"
Explainer, concept overview	Clarifying or exploring a learning and teaching issue	"Connecting the dots in the new curriculum"; "Teaching with the case study method"; "How your students are using LinkedIn"
Interview	A conversational exposition of an initiative, person, or issue	"Top tips for tutors: Create a killer learning experience"; "Helping students communicate science - beyond the classroom!"; "A blueprint for peer-based and collaborative learning in a teaching laboratory"
Notice or announcement	Public or official notification relating to learning and teaching	"Launch of the immersive learning laboratory"; "Inclusive teaching: Registration open for May workshop series"; "Catchbox throwable microphones now available"
Opinion piece	Expression of professional judgement about a topic	"Teaching to the test - maybe not a bad idea?"; "Students these days"; "Blogging helps students AND professors to write more clearly"
Tutorial, tips, how-to	Practically-oriented guide for implementing a learning and teaching approach	"Designing effective educational videos"; "Why can't we be friends? PowerPoint and active learning"; "Delete and declutter"

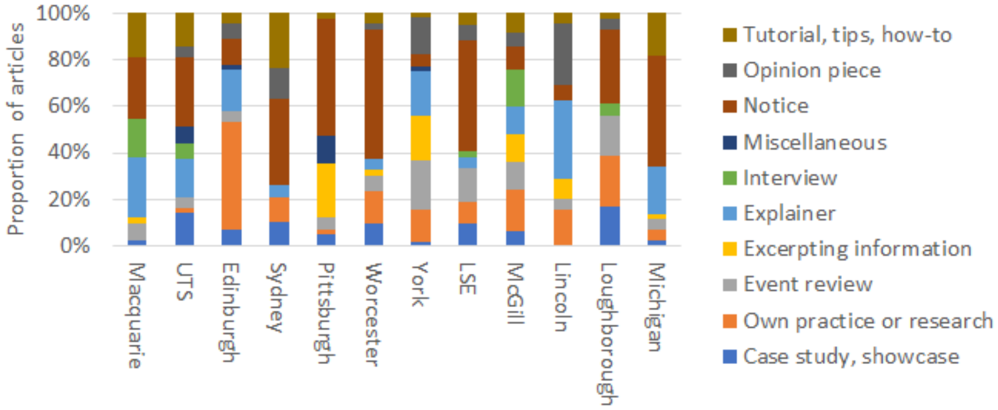


Figure 1: Distribution of content types per institution.

Topics

Our analysis revealed a wide range of topics. Specifically, we identified 147 individual codes, which we then grouped into 10 topics: (i) assessment; (ii) curriculum design and considerations; (iii) educational technology; (iv) learning and teaching approaches (pedagogies); (v) learning and teaching techniques; (vi) policy and governance; (vii) professional development; (viii) resource sharing; (ix) reward and recognition; (x) student transition and support and (xi) a miscellaneous category. Of the individual codes, the top 10 in terms of prevalence were (i) learning management system, (ii) awards and rewarding teaching excellence, (iii) professional development, (iv) collaborative learning, (v) employability, (vi) equity and diversity, (vii) student engagement, (viii) positive learning environment, (ix) students as partners, and (x) conference.

Across all institutions, the two most prevalent topics (Figure 3) formed from the individual codes were educational technology (including learning management systems, lecture capture, MOOCs, technology-enhanced learning, educational media, social media, etc), and learning and teaching approaches (or 'pedagogies', including active learning, experiential learning, research-informed teaching, students as partners, work integrated learning, game-based learning, collaborative learning, etc). The next three most prevalent topics in the blog posts analysed were assessment (including assessment design, authentic assessment, academic integrity, feedback, peer assessment, marking, etc), curriculum design and considerations (including curriculum redesign, learning design, equity and diversity, employability, social inclusion, academic skills, etc), and learning and teaching techniques (including positive learning environments, storytelling, student engagement, inspiring students, blogging as a learning activity, large class teaching, etc).

In the blogs of individual institutions (Figure 4), educational technology was generally the most prevalent topic, although there were some exceptions. Loughborough, for example, had a high prevalence of reward and recognition posts, whereas Edinburgh had a relatively high number of posts on assessment and curriculum design, and McGill had a higher representation of posts on assessment and learning, and teaching approaches and techniques.

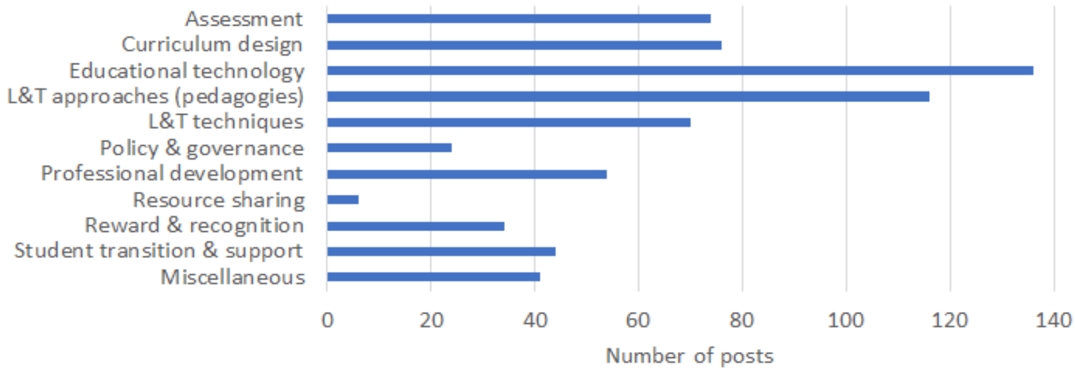


Figure 2: Overall distribution of topics across all surveyed institutional blogs.

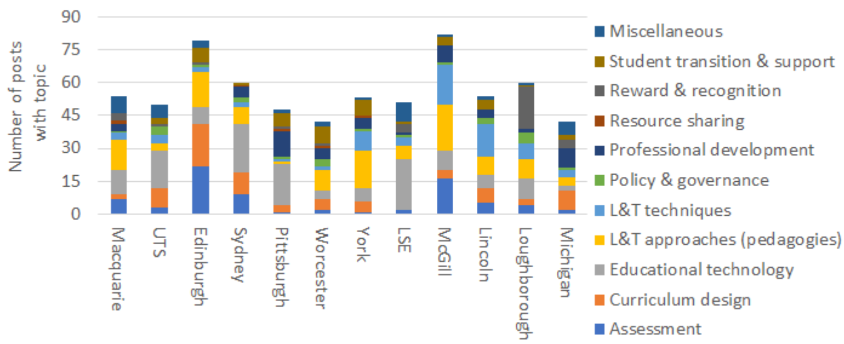


Figure 3: Distribution of topics per institution. Note that some posts were related to more than one topic.

Intent of the blog posts

Our analysis revealed a range of reasons why blog posts seem to be written. These 'intents' were interpreted from the posts themselves, based on the genres of blog posts, their call to action and other linguistic features. For example, a post that described an innovative application of educational technology would be characterised as 'more or better use of a technology', and a post that showcased previous grant winners and announced an upcoming grant round would be classified as both 'uptake of an opportunity' as well as 'awareness for an initiative that impacts teaching'. If applicable, more than one code was assigned. Based on this approach, the most frequently observed intent was increasing awareness for an initiative impacting teaching, followed by getting involved in an event/project (Figure 5). The next most prevalent intents across all institutional blogs were practical applications to teaching, more/better use of an approach, facility, technology, or service, and encouraging dialogue, conversation, or feedback.

Per institution, these intents were more evenly distributed than the topics or content types. There were some exceptions, notably Edinburgh, which appeared to have a higher prevalence of posts for raising awareness of an initiative that impacts teaching, and Lincoln, which appeared to have more posts aimed at eliciting dialogue, conversation, or feedback, at least in the posts that were analysed as part of this study.

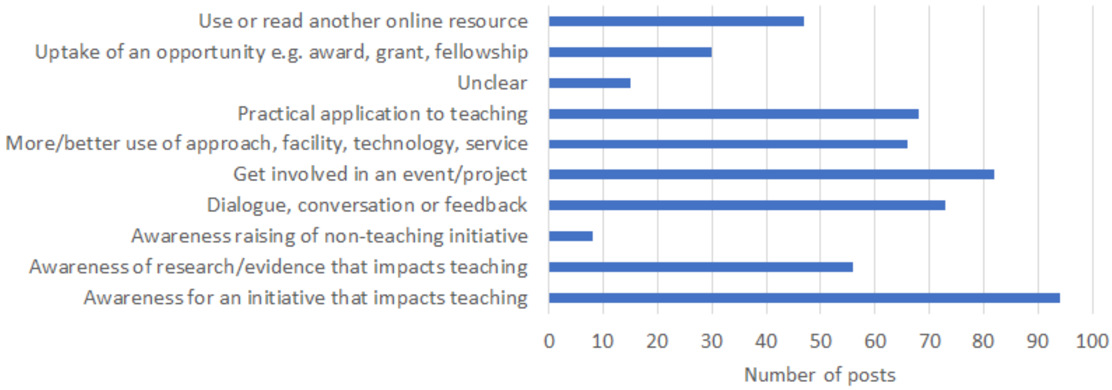
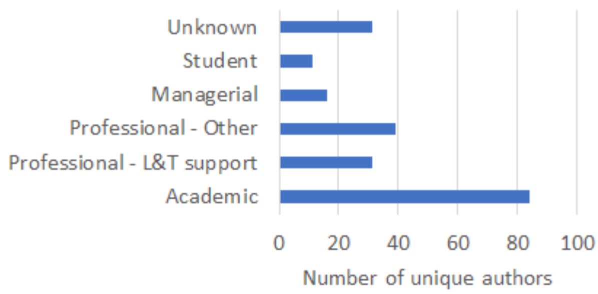


Figure 4: Overall distribution of interpreted intents across all surveyed institutional blogs.

Blog post authorship

Based on our analysis, some institutions had diverse authorship that included a range of academic and professional staff, as well as students, while other blogs seemed to be dominated by learning designers and academic staff (see Figure 4). Out of 480 posts, there were 212 unique author accounts, which were then grouped into five main institutional roles: academic, professional staff in learning and teaching support, professional staff in other roles, managerial staff, and students, as well as unknown or unidentifiable roles. In a small number of blogs, generic accounts were used to post so we were unable to identify the author and their role within the institution.

Somewhat surprisingly, the most prevalent author role type across all the surveyed blogs was 'academic', followed by professional in other roles, and then professional staff in learning and teaching support roles (Figure 6). Students were the least prevalent author role type overall. The institutional blogs at Edinburgh, York, and Loughborough had the highest proportion of academic authors, but also had the highest number of unique authors (Figure 7). Macquarie, UTS, and McGill appeared to have the most evenly balanced distribution of author roles, at least as represented in the blog posts that were surveyed as part of this study.



Interestingly (but probably unsurprisingly), the authors with academic roles were observed to write more opinion pieces and posts that described their own practice (Figure 8). This was also the pattern for student contributors. On the contrary, authors with learning and teaching support roles contributed a larger proportion of case studies, event reviews, interviews, and tutorial/how-to posts.

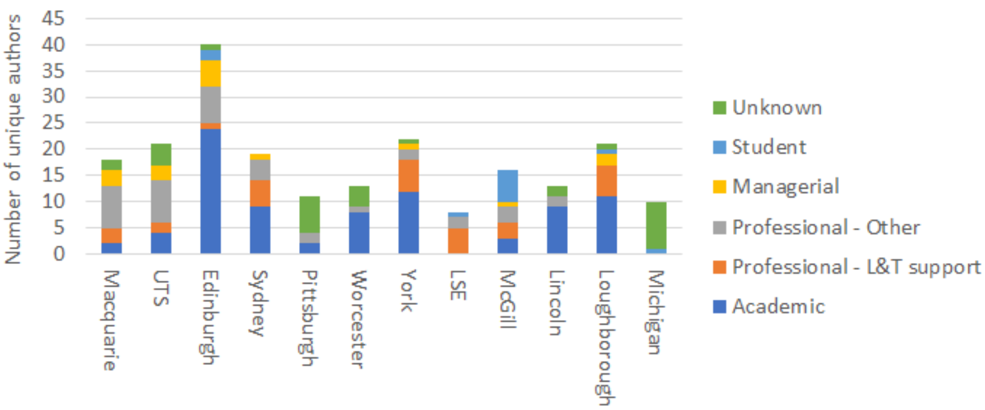


Figure 5: Distribution of author roles per institution.

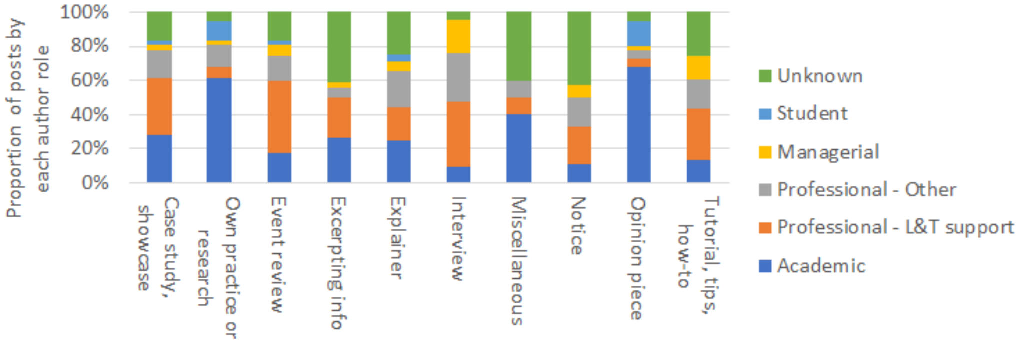
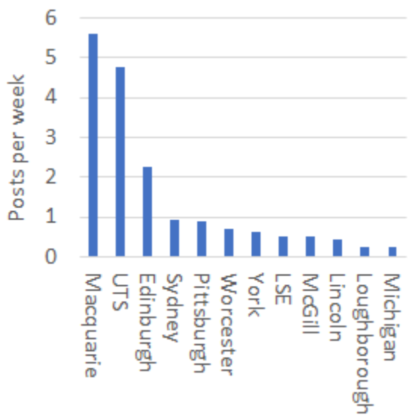


Figure 6: Distribution of author roles per type of blog content authored.

Frequency of contributions



There was considerable variation in the frequency of blog posts, ranging from 5.6 posts per week to one post every four weeks (Figure 9). The blogs from Macquarie and UTS had substantially higher contribution rates compared to all the other blogs analysed. All the other per-institution figures in this paper have been presented in descending order of frequency of contributions. From this, we observed that blogs that are more frequently updated tend to have a more balanced spread of author roles, and to have a higher proportion of professional staff authors (Figure 7). This may indicate that a distributed authorship that represents different types of role (academic, professional and so on) is important for sustaining blog output. From the data, the spread of these roles seems to be more significant than the actual number of authors publishing on the blog.

Discussion

As a newly emerging medium, institutional learning and teaching blogs have few (if any) formal guidelines or established genres. Contributors could presumably choose different topics, forms and goals, and one can expect a lot of variability among different blogs, especially when they come from different countries. However, our analysis found a range of striking similarities in types of content, topics and intent, which, we believe, reflect common values, concerns and challenges of learning and teaching teams worldwide, and go some way to explaining why these blogs were established.

It was interesting that out of many possible types of content, such as case studies, opinion pieces, describing one’s own practice or research, etc., it was the announcements that emerged as the most common type of content. Announcements did not tend to be written in the personalised style that generally characterises blog writing, and the high number of them raises a question of whether blogs provide a good ‘announcement’ platform and are effective for informing an institutional community about upcoming events and workshops, or whether the popularity of announcements is symptomatic of something else. An alternative interpretation might be that the blog writers feel that they are limited in their communication options and they turn to institutional learning and teaching blogs because they are available and welcome their contributions. Further studies might look at the effectiveness of announcements via learning and teaching blogs in order to provide the learning and teaching community with valuable information about dissemination channels. However, regardless of the effectiveness of blogs as an announcement platform, the fact that institution-specific announcements were, in fact, the most popular type of content provides a reason for having institution-specific blogs and may explain why such blogs were set up.

It is beyond the scope of this paper to explain institution-specific preferences, such as the large number of posts from academic staff describing their own practice in the blog of the University of Edinburgh and a seeming absence of this content type from the blog of Macquarie University. However, it may be hypothesized that some publications opted for different styles of posts in communicating similar content. For example, blogs with a low number of staff describing their own practice, like Macquarie University's blog, may prefer to convey similar information in interviews rather than posts written from the first person perspective, or they may have found this the most efficient way of eliciting contributions. Future studies could explore the reasons for such differences as they could reveal interesting editorial or cultural insights.

Be it posts describing one's own practice or interview-based pieces, there was clearly a strong focus on practical examples of teaching, which can be viewed as an attempt to fill a seeming gap between mostly theoretical academic literature and the practical needs of the learning and teaching community. Indeed, the discrepancy between teacher-educators' intention to provide practical information, and the new teachers' perception of it as too abstract and overly theoretical, has been noted in the literature (Loughran, 2013). The observed prevalence of describing one's own practice or research and writing about educational technology might also reflect the values of blog writers, who were often affiliated with the learning and teaching teams and/or learning technology teams. It may also reflect professional development approaches at some institutions, encouraging their teaching staff to engage in reflection and share their thoughts with the wider community of practice.

Another interesting finding was that raising awareness of an initiative that impacts teaching was the most common perceived intent of a post, followed by 'getting involved in a project/event'. Both reasons can be viewed as 'institution-specific' and further attest to the validity of having an institutional (rather than a general) blog platform. At the same time, the need to raise awareness of good learning and teaching practices can also be interpreted as a reflection of a 'lower' status often given to teaching in a modern university as compared with research (Young, 2006), and the need of learning and teaching teams to conduct 'awareness-raising' campaigns. Being an exploratory and benchmarking study, we are unable to provide a definitive explanation for the popularity of awareness-raising posts, and further interview-based research might shed light on these findings.

One of the questions that motivated this study was finding out more about typical authors of learning and teaching blogs. We found that some institutions have a diverse range of authors that included learning support and learning designers, students, career advisors, librarians, copyright advisors, etc., while other blogs were dominated by learning designers and academics. It is worth noting that the institutions with the most diverse authorship were also the institutions that most frequently published blog posts and had a higher proportion of professional staff authors. A high proportion of authors in professional roles is interesting, and it may be hypothesized that unlike academic staff, who often prioritise publishing in academic venues, professional staff may see learning and teaching blogs as an opportunity to publicly document their work and/or create a professional portfolio, or it may be built into professional staff workloads.

While 'the more authors - the more posts' is obvious from the 'output' perspective, the real question is what effect diverse authorship has on institutional blogs and whether blogs ought to strive towards a diverse authorship. It is currently unclear whether a diverse authorship creates a wider and more inclusive learning and teaching community, or whether it simply impacts the blog's output. Futures studies need to investigate the relationship between diverse authorship and the learning and teaching community.

We acknowledge the limitations of this study. There were several instances when we were not able to identify authors' roles, and 40 articles only represented a limited number of months for some prolific blogs. What is more, our study merely provides a snapshot of current practices, some of which may be effective or not. More in-depth studies are required to shed light on who reads these blogs, how readers engage with blog content, and what effect (if any) these blog posts have on individuals and learning and teaching communities. It would be also interesting to conduct a study looking at specific techniques used by blog writers to engage their audience and draw at least preliminary conclusions about the effectiveness of these techniques. This information could help to improve existing learning and teaching blogs and will be useful for those who are considering starting their own learning and teaching blogs.

We encourage researchers and practitioners to consider the abovementioned questions as the changing landscape of tertiary teaching makes community-building and just-in-time professional development increasingly important (James, Bexley, Davlin & Marginson, 2007). Learning and teaching blogs hold a potential to address some of the issues facing modern universities, and if used well, can contribute to enhancing the quality of tertiary education as well as creating institutional and cross-institutional communities.

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New E-learning 3.0 platform proposal and evaluation

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This research will explore how to improve the current University of Queensland (UQ) "BlackBoard" system, so that it fulfills the E-learning 3.0 requirements. Therefore, after adapting literature review methodology, a new E-learning platform will be designed and built, and it will be tested by the focus group for further development. Functions such as video and text chatting, file sharing and others, will be initially implemented to ensure it is an E-learning platform. The research will then be able to realize functions, such as recommendations of relevant learning materials, by using Web 3.0 technology, in particular the basic semantic analysis. The whole research aims to increase learning efficiency and provide students with a better learning experience. The research is co-operated by two researchers. Although sharing a mutual goal, the researchers will each have a separate focus. One will focus on developing text chatting, file sharing, records checking, relevant materials recommendation functions and other contents like user interfaces, while the other will focus on developing video chatting, room creation, login, and relevant functions as identified and recommended by tutors. On completion of these processes, the identified key improvements and modifications will be applied.

Keywords: Web 3.0; E-learning 3.0; Semantic Web; Learning efficiency

Introduction

With the development of Web technology, the E-learning platform has seen significant improvements. Nowadays, the E-learning platform can get artificial intelligence and relevant technologies involved (Sofiadin, 2014), so that it can assist students achieve a better understanding of knowledge. Therefore, this research decided to utilise various new technologies, such as basic semantic analysis, to enhance student learning efficiency.

Today, many lecturers at UQ prefer to use applications, such as slack or piazza to help them complete various study activities. However, some important functions like assignments submission are all based on the UQ "BlackBoard" system. It is inconvenient for students to keep switching between those applications and Blackboard. Also, there are many students who are living a significant distance from the university, and it is challenging to physically attend all the lectures and tutorials. The system could provide an alternative option for students who are unable to attend some of their classes. Based on these reasons, a new E-learning platform prototype is designed and built, which aims to combine with the UQ "BlackBoard" system and providing some functions to increase students' learning efficiency.

In this research, functions such as video and text chatting, and automatic recommendation will be implemented. In addition, the main technologies that would be used are Java Spring MVC framework, WebSocket, WebRTC and basic semantic analysis. All of these will be introduced in details later.

Literature review

In this part, the history of Web and E-learning are introduced, including the definitions, and relationships between the Web technologies and E-learning. Then, it will introduce how the idea of this research arose and what this research tries to implement.

Web & E-learning development:

Web1.0 & E-learning1.0:

In the past several years, the World Wide Web developed rapidly and has become entrenched as an essential part of modern life. An increasing number of users rely heavily on this global information media. At the first stage, the Web1.0 does not have many functions.

Figure 1: Features of Web1.0 (Nath et al, 2014)

Figure 1 depicts that the Web1.0 as a one-way system from the producers to the consumers. The websites in Web1.0 just include the contents provided by producers. That means this kind of web just allows users to read directly without any other interactions. In this situation, teaching and learning has begun with the aid of computers, which is the start of E-learning 1.0 (Ebner, 2007). In the E-learning 1.0, teachers deliver materials about knowledge to students via learning system (Ebner, 2007). The static learning system becomes the bridge between the teachers and learners.

Web2.0 & E-learning2.0:

The Web 2.0, as the next generation of networking service with more ways for communications, supports not only reading but also writing, modification and so on (Nath et al, 2014). Unlike Web1.0, Web2.0 enables websites to be able to interact more with users and process the data entered from users and sometimes yield results, as figure 2 shows.

Figure 2: Features of Web2.0 service (Nath et al, 2014)

In this stage, E-learning is evolving with the development of the World Wide Web and it becomes E-learning 2.0 which becomes more socialized. The teachers arrange the consultations, quizzes, and notifications, with the aid of the learning system, to their students (Downes, 2005). Also, students can share learning materials and learn together (Downes, 2005). As mentioned, chatting applications, including the UQ discussion board, facilitate student discussions and promote educational opportunities for sharing ideas and materials. This meets most features of E-learning 2.0 to some extent.

Web3.0 & E-learning3.0:

After both technology evolution and social evolution, the Web is moving into a new generation: Web 3.0. Figure 3 shows that, in the Web 3.0 phase, the machines are used more in the process of interaction between users and producers. As a result, the Web 3.0 is expected to demonstrate vast improvements from Web 2.0, such as the satisfaction of customers, data integration and reuse for getting new results and improving collaboration in the social web (Evans, 2007). On the other hand, until now, it is still difficult for different experts to give an exact definition of this new conception, but from the IT perspective, the semantic analysis and personalization are considered to be the main parts of the future web (Nath et al, 2014).

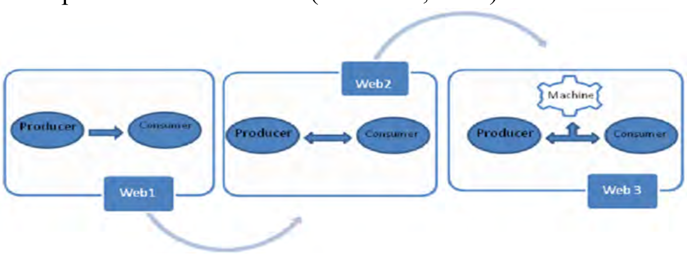

Figure 3: Web3.0 evolved from Web2.0 (Pattal et al, 2009)

The idea of the semantic web is first pointed out by Tim Berners-Lee who is the creator of the World Wide Web and foresaw the probability of machines understanding the meanings of semantic data (Barassi and Treré, 2012). In the current stage, the evolving of new technologies, such as smart mobile, big data, and AI makes the prediction of Web 3.0 be able to be realized. Then, another important feature of Web 3.0 from IT aspect is personalization. To some extent, the semantic analysis also aims to understand what users are thinking better so that the websites can provide more efficient and personal services for people in need.

At the same time, E-learning starts evolving to its next generation. Based on the available technologies of Web 3.0, the E-learning 3.0 is also expected to improve learners' ways of study and learning environment. To be specific, the E-learning 3.0 will be combined with smart mobile technology making it possible for learners to study anytime and anywhere (Rubens et al, 2012)

The prototype:

In this research, a platform is designed to improve the discussion board in the UQ system. After all, the Web 3.0 technology can indeed bring many benefits to the E-learning platform, including enhancing the personalized studying environment and managing learning information effectively (Miranda et al, 2016). The platform has two parts: building a basic E-learning 2.0 platform, and updating this platform to E-learning 3.0. The functions, such as video & text chatting and file sharing, will be implemented in the first part. These functions belong to E-learning 2.0, as they focus on the interactions and management of the educational information (Giannakos and Lapatas, 2010). The second part is to develop some personalized functions. There are various technologies included in the E-learning 3.0 area, as figure 4 shows (Dominic and Pilomenraj, 2014). Many directions can be developed in the E-learning 3.0 platform, and they all have their own advantages to students and instructors. For example, the 3D visualization could give students a better understanding of the molecular structure.

Figure 4: Technologies in E-learning 3.0 (Dominic and Pilomenraj, 2014)

In this research, the Web 3.0 technology that will be used is basic semantic analysis which is one of the core techniques in the Semantic Web area. The Semantic Web can be very helpful for assisting instructors from many aspects, including course developing, record storing and learning materials controlling (Morris, 2011). With the help of semantic analysis, the platform delivers convenience and benefits to the students.

Functions

In this research, the functions that have been developed are: login & creating rooms; Multiplayer video chatting service & Tutor video chatting service; Relevant tutors recommendation; Text chatting & File sharing & Chatting records viewing; Relevant materials recommendation.

Login & Creating rooms:

Login function is the basic function for validated students or tutors to enter this platform. Creating rooms is one of the main functions of this platform. The create room button is on the home page after successfully login as figure 5 shows.

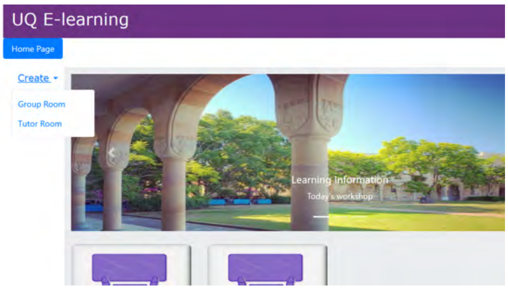

Figure 5: Create button on the left side of home page

When a student clicks the button of creating a group room, the form on the left of figure 6 will pop up. Also, when a tutor wants to create a tutor room, the form on the right of figure 6 will be pop-up.

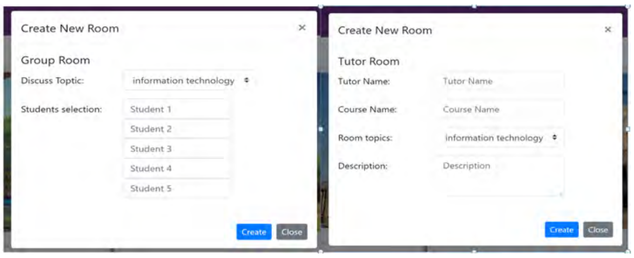

Figure 6: Pop up form for creating group room (left) and tutor room (right)

Multiplayer video chatting service & Tutor video chatting service:

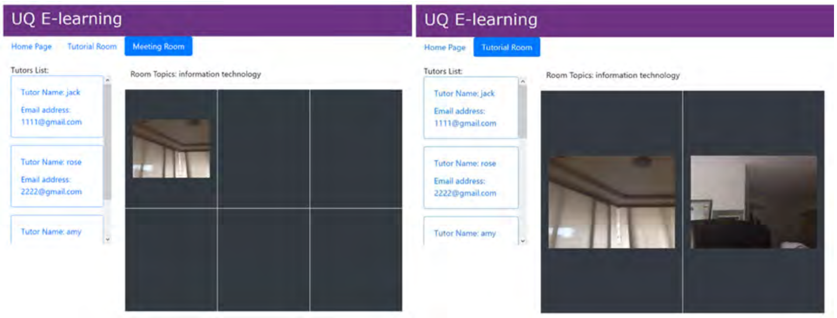

Figure 7: Study group room interface (left) and tutor room interface (right)

- In the study group room, there are up to six students allowed to have an online face-to-face meeting together. They can discuss the questions for the group assignments anytime and anywhere. The interface on the left side of figure 7 shows how the study group room looks like in this prototype.
- The tutor video chatting just allows one student and one tutor in each tutor room. Therefore, the tutor room is actually a one-to-one individual consultation or teaching room. The whole user interface of tutor room is shown in the right interface of figure 7.

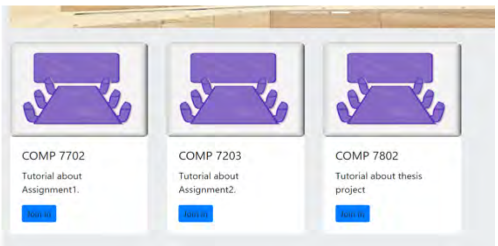

Figure 8: New tutor room showed in the home page

After the tutor created the tutor room, the home page will refresh and it will look like figure 8 (compare to with figure 5). Figure 8 shows the third new tutor room is updated on the home page when a tutor has created a room successfully. If students want to join in the room, they can just click the join button, and tutors also can choose to accept or reject these participation requests.

Recommendation for relevant tutors' e-mails:

This function uses the technology of basic semantic analysis. The system can gather the room topic, and the majors of room members, and search for the relevant tutors' data from the database. Finally, tutors' e-mails will be shown dynamically on the left layer of each room like figure 9 shows.

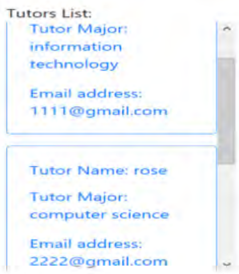

Figure 9: Relevant tutor recommendation

In that case, if students have any questions, they can send an e-mail to other relevant tutors during the online discussion or consultation. For example, if a group of Computer Science students are discussing some programs of Information Technology which is their room topic, and some questions arose. According to room topic and their majors, the room will recommend some tutors working in IT or Computer Science so that these students can find the relevant tutors' e-mails in need quickly without wasting too much time for searching these tutors on the UQ Blackboard.

Text chatting & chatting records viewing:

This function aims to provide a text chatting service to students in the same room. A notification will appear when someone joins in the room. During text chatting, as the figure 10 displays, the sending time and name of the student who sent the message will also be displayed. Furthermore, if the sender is the user, the user icon will be shown at the right, otherwise, it will be shown at the left, which aims to help students distinguish their sentences more easily.

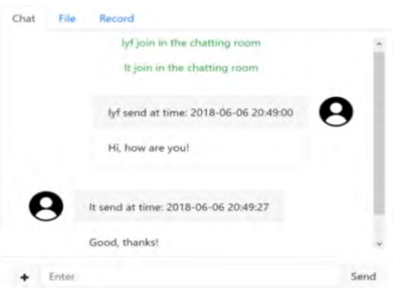

Figure 10: Text chatting situation

Some students may be late to join in the room, and they have already missed plenty of things when they join in the discussion. In that case, the chatting records viewing function is provided. Students can switch to the record tab and click the "Records" button to check all the chatting records.

File sharing:

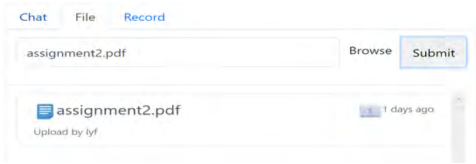

Figure 11: File sharing interface

This function provides a file sharing area for students in the same room to share documents. Each uploaded file will generate a hyperlink for downloading and displaying some detailed information, including who uploaded the files and so on. These files can only be accessed by the students in the same room. Figure 11 shows the situation when the file named “assignment 2” uploaded.

Relevant materials recommendation:

To reach the E-learning 3.0 requirement, the recommendation function is designed and it is automatic and dynamic. It will analyze the room topic and each discussing sentence. After filtering, the server will retrieve relevant materials and display them. Figure 12 shows that the system recommends one more book after entering the sentence which contains meaningful word “software”. Besides, all the materials information is forged and these materials are all use “Book X, link: XXXX” to represent.

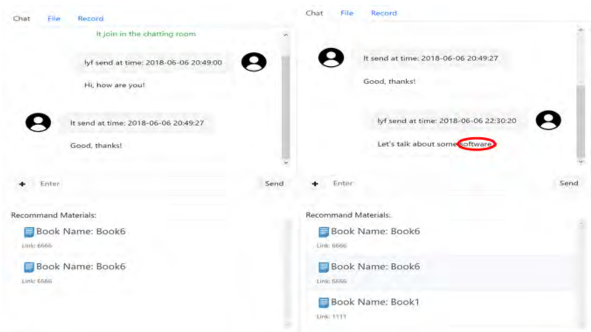

Figure 12: Comparison of materials recommendation situation after entering “software”

Technologies

The main utilized technologies are SSM framework, WebSocket, WebRTC and basic semantic analysis, which will be introduced separately. However, other utilized technologies will not be discussed in detail, such as JavaScript, JSON, Bootstrap, MySQL, JSP and others, as they are more familiar.

HTML5 & Java Web SSM framework (Spring + Spring MVC + Mybatis):

- The platform uses HTML5 technology because it makes user interfaces support multimedia, such as video and audio elements are added into the HTML5 (Pfeiffer, 2011), which make it possible to realize the design of multiplayer video chatting in this research.
- SSM is a popular framework for Java web programme development. It is based on the Spring framework in Java and combined with Spring MVC extension and Mybatis technology. Mybatis is used to connect to the database, to realize the data transmission between server and database.

WebSocket & WebRTC:

- WebSocket is a core technology to implement all the functions, such as video & text chatting, relevant materials and tutors’ recommendation in this research. WebSocket is a single-socket connection which has the features of full-duplex and bi-directional, and it can help developers to build real-time web applications (Pimentel and Nickerson, 2012). One of the advantages is that WebSocket is able to push messages to the users actively without waiting for users’ actions.

- WebRTC is one of the most important technologies in the platform. It provides the specific functions of peer-to-peer connection without distributing by the server, building a solid foundation for realizing the peers' video chatting. With the evolving of the multimedia, WebRTC mainly focuses on solving the problems of real-time and video-based communications in the browsers, which meets the requirements of the major ideas of this research. Besides, WebRTC is an updated technology that supports high-quality video and audio in the browsers without installing applications or plugins (Ristic, 2015). Until now, many browsers have already supported this technology, such as Firefox, Chrome and Edge.

Basic semantic analysis:

In this E-learning3.0 platform, semantic technology is used in a basic way in keywords filtering for finding out the matched tutors' majors and material's tags from the database, to retrieve relevant learning materials and tutors.

Results and discussion

Results:

Prototype design:

1. The core functions are all implemented successfully, and all the works have been integrated.
2. There are still some detailed problems and many suggested improvements have yet to be made. For example, some security problems of peer connections.

Focus group:

There are 6 students in the focus group, and they were invited to have a face-to-face meeting for testing this platform. Then the developers need to facilitate discussions and collect feedback based on a pre-designed question list answered by the focus group. There are 5 questions in the list, and they are designed to help the focus group identify and organize their suggestions. For example, some questions aim to check whether the platform can indeed help them, while some questions seek suggestions from the users perspective on what can be improved. As stated in the ethics application, all feedback and results collected will be anonymous

Discussion:

As mentioned, all the functions have some improvement spaces, and the suggestions from participants have been invaluable. Figure 13 shows the percentage of students' opinion of each question. In general, the results indicate that this platform is good.

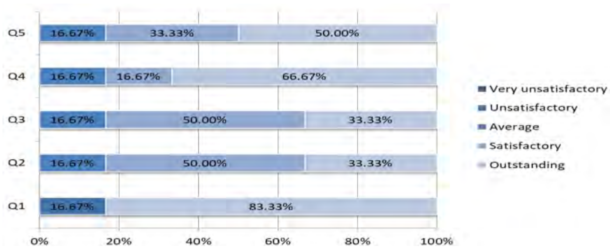

Figure 13: Marks for all the questions

Suggested improvements and some solutions are all shown below:

Creating rooms:

- When students try to join in the room, they should be notified of what position they hold in the queue or how long they will wait. If the time is too long, students have the option of completing alternative learning activities, which saves time and increases efficiency.
- To add convenience for finding rooms, the area for displaying available rooms should have page turning function. Setting a search filter may be a good choice, but should not exist with the searching function at the same time.

Tutor video chat service & Multiplayer video chatting service:

- Students can choose whether they want to open the video or not. For example, some students may decide that they are not in appropriate place to stream video (such as in bed) so they require an option to close the video while still using the audio function. This ensures students' privacy.
- During the video chatting, especially in the tutor room, the students' side should have a button for asking questions, otherwise, tutors may keep talking and until students types their questions through text chatting service, which is considered inconvenient.
- The join in approval should be removed because if many students keep clicking the join in button, this tutor room will be interrupted continuously, which is considered disruptive and annoying.

Recommendation for tutors' e-mails & Materials & Chatting records viewing & File sharing:

- Recommendation function needs to be improved and one tester even thinks it is unnecessary. Her reasoning is that there is no need to recommend the tutor's information in the tutor room, as the tutor is just there. Also, in most cases, the problem discussing happens among the students who are enrolled in the same course and potentially also in the same major, so they presumably know all the tutors' information already. After discussing, the solution may be: recommend other teaching staffs like lecturers and the staffs in the student center, and the recommendation will be improved based on more information, not only the room topic and majors.
- The focus group thinks the materials range need to be inclusive of large resources such as google scholar. Additionally, users can look into these materials with the UQ authority so they do not need to log in again.
- The platform should reconsider the authority limitation because they think the same students who enter the same room have the right to check the previous records while others cannot.
- One of the members thinks the platform should have a cloud server involved so that all the files can be uploaded to there and students can access that cloud server even if the room is closed.

Other improvements:

- The tutor rooms can add another online tutorial room which only provides one video from the tutor, and the maximum numbers of this kind of room could be 20 or more.
- The data visualization could be involved. By analysing the text messages, the server can provide a report or diagram which may identify and illustrate information such as what kind of problems are identified most frequently. This function can bring benefits to the tutors and lecturers.
- The collaborative notes taking function may also be a good idea, which allows students to create one note together and generate a copy and send to everyone when the room is closed.
- The focus group suggests the functions like first time using navigation, translation, and online-list could be implemented, too.

Conclusion

This paper introduced how the Web technologies and E-learning develop, and illustrates the implementation direction of this research. The prototype which the research mainly focuses on, aims to increase convenience for the students and to improve the study efficiency. An E-learning 3.0 platform has been built and all the functions are realized, including text and video chatting, room creating, login, file sharing, chatting records view and relevant learning materials and tutors' recommendations. The members of the focus group unanimously agree with that this platform can greatly assist students to complete educational requirements and learning activities with greater ease and efficiency. However, as mentioned, this platform is just a prototype. There are still several focus group suggestions yet to be realized and implemented to allow this platform to reach its full potential.

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Keeping everyone OnTask: Gauging the impact of personalised feedback through academic case studies

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Student-directed feedback is an important factor in student achievement. However, contemporary higher education presents challenges for instructors to be able to provide timely and personalised feedback, especially in the context of large courses. Learning analytics can be employed as a viable solution to the challenges of feedback provision, as it draws on learner engagement data and individual progress to enable personalised learning feedback to students. Many student-facing LA reporting systems have been developed, but these have been criticised as being too generic to be useful for stakeholders. Recently, research has begun to explore more contextualised LA-based approaches to feedback, which allow instructors to select relevant metrics of engagement to provide personalised feedback to students. This paper describes three case studies currently being carried out at one Australian higher education institution, which employs one such system, referred to as *OnTask*. The considerations of using such systems are discussed.

Keywords: learning analytics, higher education, large enrolment courses

Introduction

Student-directed feedback is a significant factor in student achievement (Hattie, 2014). In particular, personalised feedback has a significant impact on student self-regulated learning (Butler & Winne, 1995; Hattie & Timperley, 2007) and therefore, overall academic performance (Hattie, 2014). However, the challenge for 21st century higher education instructors is in providing feedback to large and diverse cohorts in an effective way. While quality teaching practice necessitates the provision of effective and high-quality feedback (Biggs & Tang, 2007), evidence points to students' dissatisfaction with their given feedback (Carless, 2006; Pitt & Norton, 2017). Learning analytics can provide a viable solution to the challenges of feedback provision, by drawing on learner engagement data and individual progress to provide a basis for personalising student learning feedback. This innovative approach positions "one of the most influential aspects in the quality of the student learning experience, feedback, within the current research space of the EDM [educational data mining] and LA [learning analytics] communities" (Pardo, Poquet, Martinez-Maldonado, & Dawson, 2017, p.168). This paper describes three cases of work-in-progress to use technology-mediated, learning analytics-based feedback to support students in different teaching contexts.

Feedback to support learning

When directed to students, feedback refers to advice or comments given to work that is done by the student, in order to improve that work (Boud & Molloy, 2013). The research on student-directed feedback is vast, resulting in the proposition of various theoretical models (e.g., Butler & Winne, 1995; Kluger & DeNisi, 1996). These have further been distilled into key principles for effective feedback that supports learning, of which the following are examples:

1. Effective feedback focuses on the learner's process and self-regulation (Hattie & Timperley, 2007). This entails providing information to students about how they can produce work or complete a task to the desired standard or enhancing their self-evaluation or confidence to pursue the learning task. In this way, students' mastery and deep learning are impacted.
2. Effective feedback is given in a timely manner (Shute, 2008). For feedback to improve learning, there must be uptake by students. If students receive only one point of feedback at the end of summative assessment in a course, this will have limited impact on their ability to act on the recommended actions to improve their learning in the course. Thus, timely feedback should be given either immediately after a learning activity or formative assessment task, and also at multiple points during the course.
3. Effective feedback is actionable, giving specific instruction for learners (Price, Handley, Millar, & O'Donovan, 2010). Related to Point 1, feedback is only effective when learners understand what they need to do from it. Hence, feedback provision should not be adopted as merely an administrative task, but with

the view to help students adapt their learning in order to attain the desired outcome or goal.
4. Effective feedback has a positive tone and prompts dialogues about learning (Nicol & Macfarlane-Dick, 2006). Negative feedback affects students' emotions, such that students are less motivated to act on it (Ryan & Henderson, 2017). Therefore, students' interpretations should be taken into consideration when constructing feedback (Carless, 2016).

Though the above principles have been demonstrated widely through research, in practice, they are not without challenges. Contemporary higher education is characterised by large, academically diverse cohorts (Pardo, Poquet et al., 2017), thereby affecting instructors' ability to provide personalised feedback that is timely and actionable.

Learning analytics as an evidence-based approach to feedback

Learning analytics

Learning analytics (LA) can be leveraged as a solution to the twin challenges of providing timely, actionable, personalised feedback, and doing so for diverse and/or large cohorts. LA capitalises on big datasets produced by technology mediation in education, e.g. the use of learning management systems or other online learning platforms and tools (Ferguson, 2012). Interactions with these technologies leave digital footprints or traces that may be used as indicators of engagement, potentially providing insight to key stakeholders—institutions, instructors, students—about students' learning progress (Dawson, Gašević, Siemens, & Joksimovic, 2014).

Early research in this field tended to focus on institution-level concerns particularly retention (Colvin, Rogers, Wade, Dawson, Gašević, Buckingham Shum, & Fisher, 2015). The last five years has seen an increase in interest to adopt LA approaches to 'close the loop' (Clow, 2012) by way of providing feedback to students based on their own learning data. Such data-driven feedback could take many forms, especially learner dashboards, and also recommender engines and intelligent tutoring systems (see Bodily & Verbert, 2017, for a review).

With the increase in LA approaches being employed in education, a constant criticism that has been levelled at the field is that such approaches tend to be one-size-fits-all (Gašević, Dawson, & Siemens, 2015). Even learner dashboards, which show students their pattern of engagement or their tracked progress, have been argued to be too generic to be of any use (Teasley, 2017). Essentially, it is argued that feedback provided based on LA must be contextualised to the instructional design or context (Gašević, et al. 2015).

In response to this criticism, research has begun to explore more contextualised LA-based approaches to feedback. In these recent developments, the focus is on putting the data into the hands of instructors (Pardo, Poquet et al., 2017), allowing them to select only those metrics of engagement which are relevant to their own courses, and using these as evidence of students' learning progress to provide feedback.

OnTask

OnTask (Pardo et al., in press) is an LA-based application that collates information about students and their learning in a course, such as online engagement activity (from learning management system data), lesson attendance, and academic performance. The platform allows instructors to develop "if-then" rules to generate personalised messages to all students in their course. The same platform is then used to send out these emails (see Figure 1). An important aspect of *OnTask* is that instructors choose the metrics that serve as indicators of engagement specific to the course, thereby providing more contextualised feedback and support, a process lacking in many generic LA-based systems (Liu, Bartimote-Aufflick, Pardo & Bridgeman, 2017).

OnTask is open-source software, which is currently available in three versions (see https://www.ontasklearning.org/tool/). The versions differ in terms of the underlying platform, namely NodeJS and Django, but have the same functionality of generating a matrix containing student data, creating rules for providing personalised feedback, and delivering the feedback emails. The version of the software used in these case studies was installed at an institutional level and integrated into the institution's learning management system (LMS) which in this case is Moodle. This means that the application is linked seamlessly with the Moodle course database which stores students' interactions with the LMS. Instructors can work from their own computers to access the application within their course LMS and decide on the relevant metrics to use to provide students feedback.

OnTask facilitates instructors to carry out effective feedback practices, as described in Lim, Gentili, Pardo, Dawson, & Gašević (2018). It has been trialed in a few courses in higher education institutions in Australia (e.g., Pardo, Jovanovic, Gasevic & Dawson, 2017) with promising initial results on student satisfaction.

The remainder of this paper will describe three case studies of the use of this LA-based system for giving feedback.

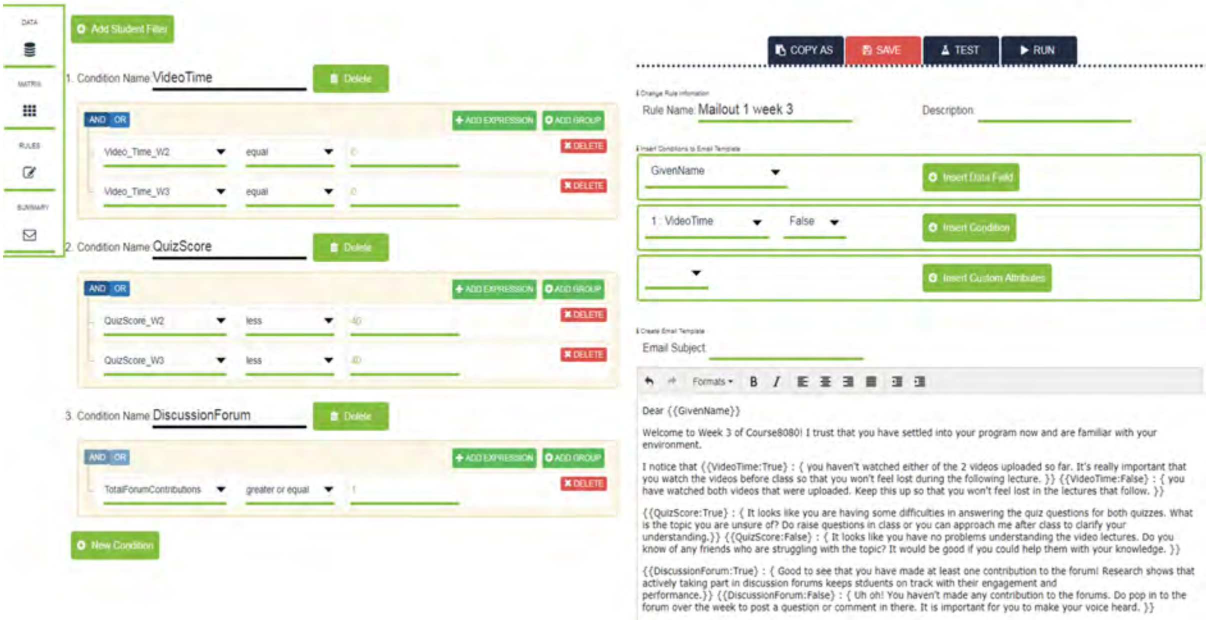

Figure 1: The OnTask interface showing "if-then" rule generation for personalised feedback

The case studies

Case Study 1: *OnTask* for Student Engagement

This case study was conducted with a group of third year undergraduate business students in the course Managing Decision Making. Students are required to undertake a number of formative and summative exercises throughout the study period as scaffolding for their major assignment. The course coordinator currently implements a non-automated system sending emails sent through MS Word email merge at key points throughout the study period to remind students to engage with the course materials as well as the formative and summative tasks required for completion that support the scaffolding of the major project. The focus of this case study is the encouragement of students to engage in the completion of the formative quizzes which allow both the student and the staff to understand their abilities with MS Excel software.

In 2017 the course coordinator was introduced to the *OnTask* software. *OnTask* has the ability to be set-up prior to commencement of the course(s) with the goal of improving the student learning outcomes that have been identified, through previous course coordinator knowledge, as not being achieved by some students. Pardo et al. (2017) identified that the use of this technology allows the instructor to "transform [my] expertise into highly situated, personalised student feedback" (p. 9). This feedback can be specifically tailored and personalised email feedback as per key triggers, interventions or directions/guidance as needed.

Table 1 below compares the demographic data for the two cohorts examined in this case study. Cohort 1 is pre-*OnTask* from the first semester of 2017 whilst cohort 2 is the *OnTask* trial group, first semester 2018.

Table 1: MS Excel quiz comparison data

	Cohort 1 (2017)	Cohort 2 (2018)
Total student enrolments	137	154
Internal students	99	97
External students	38	57
Quiz type	Formative	Summative (low %)

Quiz open	17th Feb – 24th June	19th Feb – 29th April
Course material identification of quiz	20th Mar	23rd April
Reminders given	27th Mar (in course materials and in-class) 3rd April (course materials)	26th Feb, 5th Mar and 2nd April (in-class)
Email reminders (*OnTask*)	None	26th April (pm)

As can be seen in Table 1 above, the cohorts of both offerings of this course are reasonably similar. In the review of the 2017 offering the teaching team felt that the lower than previously experienced results in the group project could have been improved if the formative assessment activities used for scaffolding the project, including the MS Excel quiz, were updated to summative assessment. This should then enforce that students had undertaken the preliminary support activities and as such improve all around group performance. The MS Excel quiz was therefore included in a series of three online activities in the 2018 offering, each weighted at 5% of the student's overall grade. Prior to this change it had been the course coordinator's opinion and experience that students generally disregarded low stakes assessment items to concentrate on the major pieces of assessment.

The results of the analysis of the two cohorts, shown in Table 2 below, identified that using the in-class and course material reminders produced similar completion results with 46.7% of the 2017 cohort completing the quiz whilst 49.3% of the 2018 cohort had completed the quiz with these standard reminders. The inclusion of the *OnTask* email being sent to students 3 days prior to the closing date of the quiz in 2018 led to an additional 47.4% of the class completing the quiz. It could be argued that the change from formative to summative assessment did have some impact on the total number of students completing the quiz however it is the opinion of the course coordinator that the intervention email from *OnTask* had a greater impact on this completion rate.

Table 2: MS Excel quiz completion data

	Cohort 1 (2017)	Cohort 2 (2018)
Total student enrolments	137	154
Total attempts	96 (70%)	149 (96.7%) *
Completed prior to identification in course material	21	42
Additional completions prior to major reminder	43 (26th Mar)	34 (26th Apr am)
Additional completions between major reminder and quiz close	13	73
Open attempts automatically submitted on close of quiz	19	0

** two students who did not complete quiz also did not submit any assessment items for the course.*

In addition, it should be noted here that it was not only the non-completers who were sent the *OnTask* email. All enrolled students were sent a personalised, targeted email based on completion of the quiz and the score achieved in the quiz. Students who had achieved full marks were congratulated and asked to be support tutors in the following week's class where the use of MS Excel would be discussed. Students who achieved passing, but not full marks were encouraged to review their responses and look carefully at the functionality that they answered incorrectly whilst students who achieved a fail mark were encouraged to attend the following week's class to obtain personal assistance in improving their MS Excel skills. A full list of the email criteria and email content can be seen in Appendices 1 and 2 of this paper.

The results of this small, pilot use of *OnTask* have encouraged the course coordinator who is now in planning to use this method of communication to replace all current non-automated, large scale emails that are sent to the students, particularly in the early weeks of the course to ensure students are engaging with the course materials and given every chance to contribute to the learning process within the course. This has certainly provided an efficient method for providing proactive feedback to students regarding their engagement with the course materials and assessment items.

Case Study 2: OnTask for Large classes

When teaching a diverse student cohort in the enabling education space at a university pathway college (UPC) with mid-high course numbers (from 200+ to 600+) this can be an intensive process to be able to address all student needs individually. The context of this case is to assist in personalising of feedback for large classes and is to be trialled initially in the core University Studies course (200+ students) and to be implemented in the following iteration of this core course (600+ students). Students are new to the University system and with that may lack appropriate study skills and a sense of belonging within University culture and online study environment. In addition, UPC students may have limited positive past educational experiences and have a range of influencers including first in family, low socio-economic status (LSES), culturally and linguistically diverse (CALD) background or have been out of the schooling system for some time. These are similar issues that face large first year University courses and are complex considerations for decreases in student engagement, retention and potentially grades over a semester.

Using *OnTask*, as discussed in Case Study 1 above, allows the identification of specific trigger points at which feedback can be sent to students to prompt them to take appropriate action. Examples of triggers identified in this course include; engagement with the course site, assignment submissions, and performance in assessment. Data from these triggers allows the coordinator to target specific responses based on the level of engagement, submission and performance. Previous manual identification of these levels was specifically aimed at helping only students with critically low levels in each of these areas. However, *OnTask* not only enables this but also gives the coordinator the opportunity to remind and reward students who are active and performing well with ultimate goals of elevating performance by improving grades in all grade brackets together with increased student retention and engagement. Acknowledging and rewarding good use of digital tools or resources that assist with learning through the course site can improve individuals' engagement and performance through timely, relevant feedback with specific suggestions. The course coordinator, knowing the design of the course and therefore the key trigger points, can set-up *OnTask* parameters aligned with the intended course learning outcomes and LMS activities critical to course objectives.

Educators are already doing this manually and in conjunction with learning analytics data from course dashboards or students participation data however it is a very involved and time-consuming process. Due to limited time available, they generally only implement this with students at risk (low engagement/low grades) but are unable to do this with those students who, with further support, would have had the assistance to aim higher. For example, those students with P's to achieve C's or D's to HD's. It is not currently sustainable or the best use of an academic's time and therefore this automated (albeit personalised) system can assist with correcting (or reinforcing) positive learning behaviours and strategies.

In the context of this case study, the course coordinator currently implements a non-automated system sending individually constructed emails to students identified as being at risk through limited or no engagement with the LMS or low assessment grades. Using LA, LMS Dashboard, key roadblocks and assessment points across the semester, students were identified as 'at-risk' and personally emailed, messaged via the LMS or contacted by phone. As previously identified, this is a very time-consuming process particularly as course numbers grow or workload increases considering the pressures and changes to the higher education landscape. For a course coordinator to be investigating, emailing and/or contacting students at multiple time points throughout a study period is considerably demanding and becoming unsustainable. Currently the course coordinator only has sufficient time to capture those who completely non-engage or students on the pass/fail border to improve their outcomes if these interventions are early and timely. However, the coordinator also wants and understands the significance of supporting and connecting with students to elevate their grades to the next grade to further support and acknowledge the students' efforts.

This multi-strategy approach is summarised below:

- The less time spent sending individual emails and looking up student data equals more time for the course coordinator to provide elsewhere to help learners in deeper and more complex ways.
- There is a scalability component of the process and it can also be used for future course iterations.
- To enhance student engagement and further improve student retention.
- Develop students further with their grades and understanding i.e. from C's to D's or D's to HD's.
- Help to increase support provided to students and also reward those who currently tracking well (or are in the higher-grade ranges) that with limited time the coordinator does not have the time to focus on if they are busy trying to help students at the cusp of passing to be able to pass the course.

A comparison will be drawn with a previous course iteration with no specific feedback provided (2016), to the following year with increased feedback (albeit manually in 2017) to the 2018 cohort with the automated *OnTask* emails delivered. Evaluation of the intervention will be conducted using student feedback via MCE questions and delve further into student experiences with focus groups and/or a small survey. The evaluation would focus on investigating how the *OnTask* feedback intervention improved; final completion rates (attrition), student satisfaction, increased LMS engagement through assessment and/or activity logs via LA and overall grades as one particular student success measure. This system can also reinforce engagement with online materials and activities by reaching out, making connections and communicating with students.

Further enhancement and tracking of emails will be trialed by embedding short URL's into the initial email to test whether this data is able to track how immediate the response can be from a student and how this situated and personalised feedback with specific links to support or activities within a course can assist students.

Case Study 3: *OnTask* for Student Wellbeing

In addition to Case Studies 1 and 2; engagement and performance, this case study will discuss the inclusion of *OnTask* interventions assessing student wellbeing as an emotional state of mind. The proposed use of *OnTask* is to develop a series of specifically targeted, personalised feedback emails which will provide students with suggestive correctional changes to improve their wellbeing and, as a result, their academic performance.

In the context of this case study, the course coordinator currently implements a non-automated system sending emails with remedial guidance for early engagement, low participation and poor assessment and has been additionally trialling corrective advice concerning personalised self-regulatory self-assessment of a student's state of mind at various points in course progress.

The aim of this case study is to develop and evaluate student positioning on a graph representing common emotional experiences or states of mind that generally occur in the course. This study is situated in a first-year design course targeting attrition and retention and will be subsequently rolled out in a second-year digital communications course targeting the reduction of student worry and anxiety, and motivation to improve their performance through emotional stability. These courses displayed high student attrition, unsustainable levels of staff involvement and poor student knowledge retention. Ellis and Goodyear refer to this as "surface and achieving", where the student focusses on short-term performance rather than deep learning (Ellis & Goodyear, 2009).

A recent course redesign has followed Clow's Closing the Loop (Clow, 2012) realigning objectives, outcomes and assessment with a strong grounding with learning analytics through effective interventions. The redesign incorporated scaffolded learning activities aligned to course objectives and outcomes. Assessed online quizzes tested application of knowledge learnt in activity workshops however, these provided little individual feedback. Workshop activities allowed an environment to understand and test the skills required for each task and set appropriate challenges to test content understanding and comprehension. As the semester progressed, challenges increased in difficulty and required less staff support.

Two outcomes drive developing the use of learning analytics and data-driven responses. Reflecting on the approaches from case studies 1 and 2 above, the desire to increase personalised feedback within the current environment where academic staff have a reduced capacity to provide individual students advice on academic progress. The second driver extends Wright, McKay, Hershock, Miller & Tritz's (2014) concept of 'Better than Expected', where learning analytics are used to extend student achievement at all levels, to student experience and expectation of performance.

Staff observation and student feedback of previous courses identified a range of (emotional) experiences from worry and stress to confidence and boredom related to the in-class tasks, activities and exercises. These 'states of mind' align with Vygotsky's Zone of Proximal Development and Csikszentmihalyi's Flow Theory. Terms such as of scaffolded learning, "in the zone" or "in the groove "and "in the Flow" are central to Vygotsky's and Csikszentmihalyi's theories and provide an opportunity to realign teaching intentions with course learning objectives and form the basis for the design of the student questionnaire (Shernoff, Csikszentmihalyi, Schneider & Shernoff, 2014).

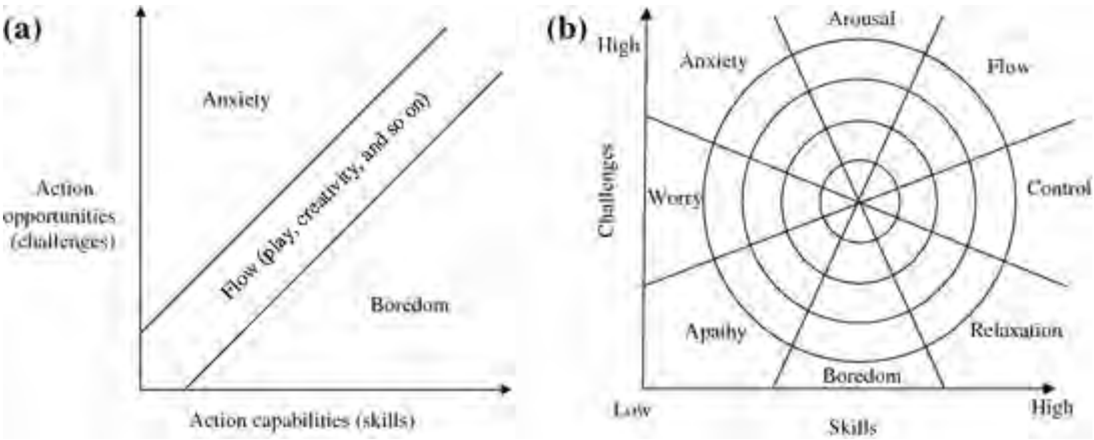

Figure 2: Csíkszentmihályi's Flow theory (Nakamura & Csikszentmihalyi, 2014)

Delivery of the questionnaire will occur at two key points throughout the semester. This questionnaire will allow students the opportunity to self-assess their positioning on an adapted version of Figure 2(b) above. A response will offer understanding and supportive acknowledgement of this placement and suggestions or techniques to return to a balanced position in the flow. For example, a student who identifies with worry will receive an automated response from *OnTask* indicating that the subject matter that they have recently been learning may be difficult to understand at first. Suggesting that the student revisits the course content and develops the skill set required. This will help alleviate their stress and reduce the worry or concern that they have indicated they are currently experiencing. In future iterations of the survey, student responses will trigger specific suggestions for attaining the required skill set.

Designing techniques for evaluating student development and engagement enables a closing of the loop (Clow, 2012) including greater alignment of objectives and continuous feedback (Biggs, 2012). The data gathered through the student surveys will ascertain identification and accuracy of the classifications, to determine whether re-direction from either side of the 'Flow' graph is helpful as a feedback tool and ultimately whether data driven interventions reinforce learning, promote and extend application of knowledge and contribute to a healthier ecology in the course (Ellis & Goodyear, 2009).

Conclusion

The common theme in the three case studies presented in this paper is the desire of the course coordinator to be able to efficiently and effectively identify, elevate and acknowledge student performance, leading to increased engagement with the curriculum and therefore reduce attrition and increase student grades. Case Study 1 has shown that not only was this achieved but has enabled a reduced academic workload for future iterations. Case study 2 complex large cohort approach seeks to help students feel empowered with their learning and enhances what the course coordinator has undertaken in the past with guidance, feedback and support. The outcome of this strategy is to assist in transitioning students to independent learners. Case Study 3 extends the use of *OnTask* to facilitate support in assessing student wellbeing as an emotional state of mind. This is achieved through the early intervention emails providing feedback and personalised responses to targeted students.

An area of reflection from the perspective of the course coordinator is the apprehension of utilising the feedback software replacing traditional student communications i.e. email and discussion forums. It is the view of the authors that automated feedback systems that utilise the coordinator's voice and that are specifically focused on personalised feedback, create a more efficient and effective method for communicating with the learners. Automation of these processes supports and reinforces best practice in teaching and learning by allowing a structured approach to the provision of feedback when the student needs it most.

Further research into the use of *OnTask* is already underway with the course coordinators from Case studies 2 and 3 above implementing a range of applications in late 2018 and proposed additional work for 2019. Case study 2 has commenced work on the pilot addressed above with a cohort of 300 students which will be expanded to a core course in early 2019 with an anticipated enrolment of around 700. It will also be used in non-core science courses with an aggregate of over 300 students. These studies will also consider the student perceptions of the emails that they receive from *OnTask*.

Case study 3 will be specifically targeting a second-year digital course (80 students) where students self-assess their state of mind which enables skill and challenge levels within the course to be evaluated (see Figure 2). The roll-out of the pilot study in case study 3 was undertaken in anticipation of embedding these opportunities in this second-year course. A full evaluation of the student experience and outcomes of the personalised feedback will be reported in future publications.

The course coordinator for case study 1 is working with other academics within the Business School to implement a wider rollout of *OnTask* in early 2019. A comparative study of a variety of undergraduate courses will be considered to further explore the impact on retention and assessment results of the personalised feedback.

To ensure that the intent of the feedback is understood, it is essential that clear responses are used to direct students, ensuring that the tone and specific language used are commensurate with that of the course coordinator. The key focus of all three course coordinators is that the approach must be learner centred – so that no matter where students start in the learning journey, the *OnTask* system can enable a personalised approach which builds on the skills they already possess.

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Appendix 1 – *OnTask* Criteria example from Case Study 1

Condition 1: Not Completed: Quiz Grade = 0
Condition 2: Completed but needs work: Quiz Grade >0 and <=10
Condition 3: Completed HD: Quiz Grade >10 and <15
Condition 4: Full Marks: Quiz Grade = 15

Appendix 2 – *OnTask* Email Example

Dear {{STUDENT_FIRST_NAME}},
Welcome back after the mid-break. I hope you are now working hard towards the completion of this course. Over the next few weeks we will be concentrating on completing your Group Project tasks as well as your Decisions in Meetings Blogs.
{{Not completed:True} : {I note that you have not yet completed the Excel Basics Quiz which is due this coming Sunday, 29th April. Please log in and complete this as soon as possible as we will be using the results of this quiz to customise our teaching next week when we look specifically at the use of Spreadsheets for decision making. }}
{{Completed but needs work:True} : { I see that you have been proactive and completed the Excel Basics Quiz due this week, well done. Your result of the quiz shows that there are some areas that you need to work on to improve your use of MS Excel. We will be working on these in our internal workshops and external virtual classrooms next week so please come with your questions. }}
{{Completed HD:True} : { I see that you have been proactive and completed the Excel Basics Quiz due this week, well done. Your result of the quiz shows that you have a very good knowledge of MS Excel and may only have a couple of areas to look at. We will be working on these in our internal workshops and external virtual classrooms next week so please come with your questions. }}
{{Completed Full Marks:True} : {I see that you have been proactive and completed the Excel Basics Quiz due this week, well done. Your result of the quiz shows that you have an excellent knowledge of MS Excel as shown by receiving full marks. As we will be working on these skills in our internal workshops and external virtual

classrooms next week it will be a good opportunity for you to take up the learn-do-teach philosophy of improving your knowledge by training others. I will be looking for you to assist other students in your group with how to use MS Excel.}}
[…other text added here…]
Please note: The information in this email is correct at the time of sending and does not reflect your activity after this time.
Kind regards

Please cite as: Lim, L., Barker, S., Fudge, A. & Kelly, S. (2018). Keeping everyone OnTask: Gauging the impact of personalised feedback through academic case studies. In M. Campbell, J. Willems, C. Adachi, D. Blake, I. Doherty, S. Krishnan, S. Macfarlane, L. Ngo, M. O'Donnell, S. Palmer, L. Riddell, I. Story, H. Suri & J. Tai (Eds.), Open Oceans: Learning without borders. Proceedings ASCILITE 2018 Geelong (pp. 184-193).

Visualizing Learner Behaviour in MOOCs using Sankey Diagrams

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It can be difficult to assess the design of, and learning, within Massive Open Online Courses (MOOCs). It is especially hard when trying to analyse this at the level of the individual learner. This study has developed a tool, inspired by Sankey diagrams, to visualise learners' behaviour and paths through MOOC content. This tool can be used to investigate if learners are interacting with the content as planned when the course was designed. It has been designed iteratively through four stages of rapid prototyping. This paper presents the narrative of the development of the tool with an emphasis on validation via feedback from three user groups at each prototype stage.

Introduction

Massive Open Online Courses (MOOCs) arguably have been one of the most significant disruptive innovations within education in recent years. These free to study courses, offered largely by universities, have attracted millions of learners to a growing catalogue of subject areas. In 2016, more than 6850 MOOCs ran with over 58 million learners (Shah 2016). They are often broadly categorised as either cMOOCs or xMOOCs where cMOOCs utilise a connectivist learning approach (Milligan, Littlejohn, and Margaryan 2013), and xMOOCs, which are commonly more didactic in nature, comprise a mix of video material, textual content and assessments using behaviourist approaches (Daniel 2012).

The success of MOOCs builds on the active engagement of massive numbers of learners (McAuley et al. 2010) who through engagement with other participants self-organise into learning communities where they share skills, objectives, knowledge, and interests, most often by commenting within the MOOC discussion fora and other social networking tools (McAuley et al. 2010). Downes suggests that when looking at the success factors of a MOOC, one should investigate why the course was made the way it was, and if the design has successfully achieved those aims. This should preferably be done at the individual participants level because each person has a different objective or motivation for taking a course and has different needs and objectives (Downes 2015). The analysis of individual user experiences is an important aspect of course evaluation but difficult to achieve when there are thousands of participants (Shi et al. 2014). High learner numbers make it virtually impossible to follow individual progress through material and gain a clear understanding of learner behaviour within the course. This is especially problematic within the more structured xMOOCs where it becomes difficult for the educationalists and learning designers to get an overview of the effectiveness of the structure, and indeed where certain parts of the MOOC might need to be edited to be more effective.

In this paper we present a tool developed at anonymous to visualize user behaviour within courses hosted on the edX MOOC platform. It uses the log files made available to edX partners and creates a specialised Sankey diagram. This has been found to create a useful overview for learning designers working within the MOOC team at anonymous.

The next section is a literature review of visualizing learner behaviour in MOOCs. Following this is the method section which leads into the implementation of the visualizer tool. This section is a narrative of four iterations of prototypes. It includes feedback from a group of users which is used as validation of changes for the following prototype.

Visualizing learner behaviour in MOOCs

Earlier studies that have investigated MOOCs from the perspective of individual learners have mostly used surveys or interviews around the user experience, participant demographics, and metrics of learner progression through course e.g. number of videos viewed or tests taken (Kop and Fournier 2010; Kop 2011; Kop, Fournier, and Mak 2011; Levy 2011; B. Stewart 2010; Breslow et al. 2013). Over time, as the number of MOOCs has increased, participation size and completion rate have become popular metrics to show the relative success of individual MOOCs, or to measure learner satisfaction (Adamopoulos 2013; Jordan 2013; Khalil and Ebner

2014; Jordan 2015; Onah, Sinclair, and Boyatt 2014; Stephens-Martinez, Hearst, and Fox 2014). These metrics are relatively easy to calculate and mirror common metrics already used by universities when evaluating formal education courses. The findings for these studies are mostly visualised using standard aids such as bar and pie charts, box plots and scatter diagrams. This represents a common approach to overcoming the complexity of MOOCs whereby participant behaviour is compressed into simple metrics, or individual experiences are taken as an overall reflection of the course experience. Although these tools and approaches can provide a useful basis for comparing MOOCs they inevitably hide the complexity of behaviour. However, there may be valuable information that becomes hidden during this process that would be helpful, for example, in rectifying problems with the learning design.

Process mining is a technique where event log data is analysed to create a model that can be used to analyse business processes. The model can be created using any type of data mining technique, however it commonly results in a visualisation to help further the understanding of a particular process (W. M. van der Aalst 2011). This technique has been applied in educational settings, for example, a combination of flow charts and process cubes have been used to analyse the video lectures in a business information systems course at Eindhoven University of Technology (W. M. P. van der Aalst, Guo, and Gorissen 2015). Process cubes have been designed to investigate multi-dimensional data, however there are challenges when using them for comparing and visualizing different types of cells (W. M. van der Aalst 2013).

A Sankey-like diagram was first used by Charles Joseph Minard in 1869 to visualise Napoleon's Russian campaign of 1812 (Friendly 2002). They are named after Captain H. R. Sankey who is accredited as using it first in an academic publication, where he used it to illustrate flows within a turbine (Schmidt 2008). Sankey diagrams visualise flows from one state to another by using the width of the arrows to indicate the quantity of flow within the system. They have been used in education for overviews of video consumption within MOOCs. Here, a specialized type of Sankey state transition diagram was used to illustrate the number of users who viewed each part of the videos hosted on the MOOC (Coffrin et al. 2014). Students who had watched all of the videos in succession could be identified and the course could be analysed from the viewpoint of 'qualified' and 'non-qualified' students. Google Analytics includes standard Sankey diagrams and can be used to visualise transitions on websites (Emmons, Light, and Börner 2017; Beaven, Codreanu, and Creuzé 2014; Kay et al. 2013). However, they are session based and therefore the same user will potentially show up many times in the same Sankey diagram with various starting points when the user uses the website many times (Analytics 2017). In MOOCs, participants are expected to access the course multiple times, potentially from many devices, and therefore this approach cannot be used to visualize the full interaction with the course by users.

Method

The application has been developed following a rapid prototyping paradigm (Connell and Shafer 1989). There have been four different prototypes that were used in the feedback sessions. Getting user feedback after each prototype is critical in driving a consistent improvement through the iterations. The edX reference group (ERG) at anonymous provided this feedback with suggestions and improvements for the following iteration. This group comprise learning designers, academics (some with prior MOOC experience), researchers in education and MOOCs and university administrators engaged in the MOOC production at anonymous. This provided access to representative of the four user types identified as key stakeholders for the visualizations, and were thus well placed to provide relevant feedback.
The anonymous edX MOOC was used throughout the development of the visualiser, and all of the Sankey diagram figures are from this course. The various prototypes used the logs available at the time of a particular feedback session, and therefore, some of the visualisations are not consistent over time.

Implementing the visualiser

This section describes four prototype iterations. Each iteration includes the feedback from the ERG, providing validation for the changes within the next iteration of the tool. This provides a coherent narrative for understanding the development and usefulness of the tool.

Initial prototype

The aim of this project was to create a visual tool that provides an overview of participant behaviour within MOOCs. It should use edX log files to provide the data in the first place, but it should be developed to be extendible. The decision was made to base the visualisation on the Sankey diagrams as they are an intuitive and well-understood.

The d3 library is a JavaScript library for producing dynamic, interactive data visualisations in a web browser, the visualization was made using and extending the d3 library's functionality for creating online Sankey diagrams (d3 2017). User data was extracted from database files and it was modified to the json data format needed by the d3 library (Figure 1) The logs were not used in order to speed up the development of the first prototype and the visualization (figure 2) was created with data embedded as an svg image.

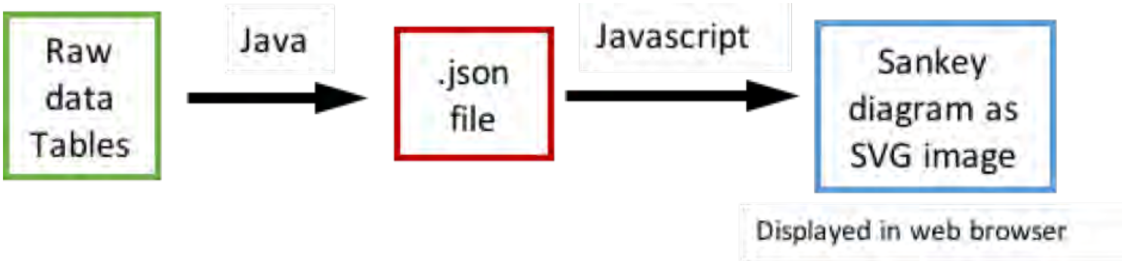

Figure 1: The data collection process for the initial prototype.

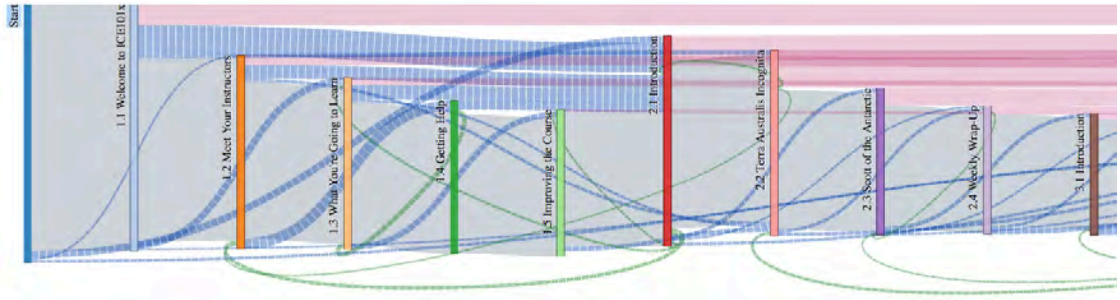

Figure 2: The first prototype showing the first two topics.

Each of the vertical bars are the course content pages laid out in the order provided on edX. The grey vertical paths indicate the participants who are moving from one step to the following step (the expected behaviour), blue paths are forward jumps (skipping the following page/s), green paths show backward steps, and red paths are the students who had their last activity at that given page. The visualization only shows paths with more than 20 students. When hovering over a bar or path it is becomes highlighted and shows the title and the exact number of participants following the path, or entering the associated content page.

In the feedback session with the ERG it was concluded that this approach was interesting and the group was able to use the view to make observations. Therefore, it was concluded that the approach of using Sankey diagrams was intuitive, in terms of presenting the course activity and several interesting participant behaviours were identified:

- It was clear when participants dropped out of the course. 15.1% of participants got to the last page i.e. end of the course. It is however impossible to see in this diagram how many participants in total completed the final quiz (which could also be defined as the end of the course), because the vertical bars included all visits to the associated content page. In other words, if a participant visited the quiz several times that participant would be counted numerous times.
- Introduction pages were skipped by many and therefore potentially essential information for participating in the course would not be seen. This suggested that learning designers should consider introducing important information as embedded in the regular course material.
- Most leavers departed early in the course. This highlighted that the designers should present reasons or hooks to combat attrition in the early sections of the course.
- Figure 3 shows that quizzes have a lot of unusual movement in and out, and reveals that many people skipped the quiz. It was difficult to understand the real impact of this behaviour, as the diagram did not show if this happened before, at, or after the first time seeing the quiz. The diagram was hiding key information about the user behaviour.
- The activity at the end of the course was much more linear than in the earlier sections (figure 4). The quizzes did produce some behavioural changes, but seemingly not to the same degree as the first quiz. Either the students had changed their behaviour or the visualization was hiding something.

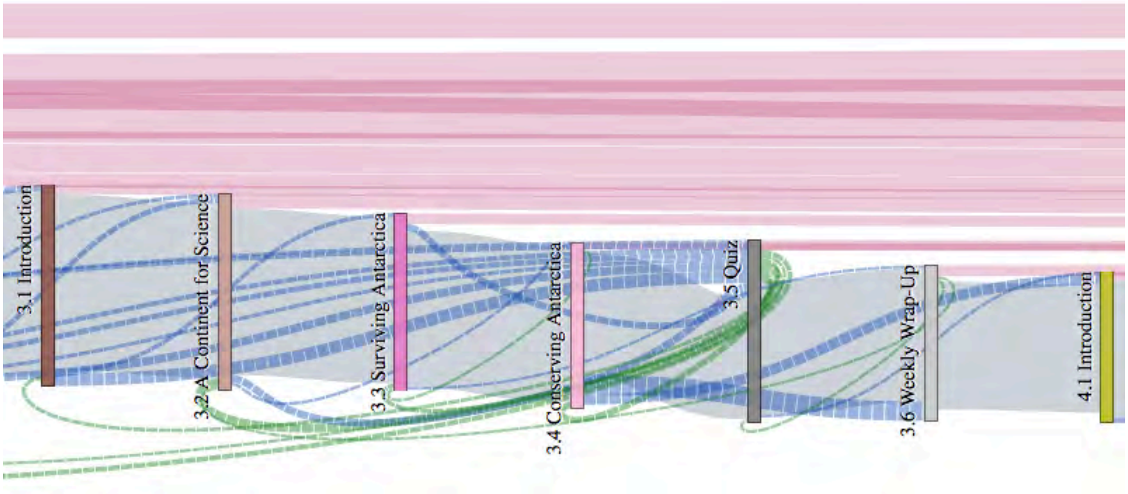

Figure 3: The first prototype showing the third topic.

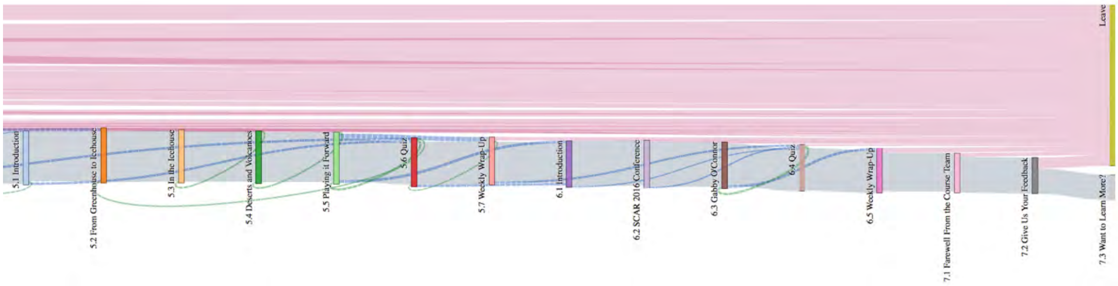

Figure 4: The first prototype showing the end of the course.

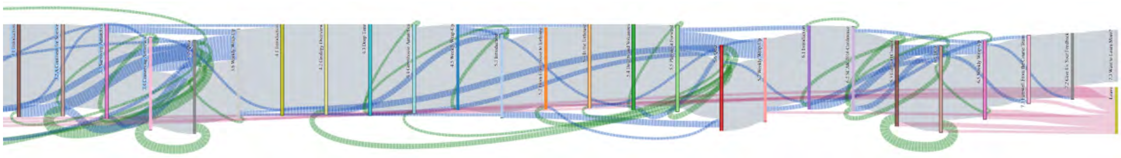

Figure 5: The first prototype showing the behaviour of paying participants.

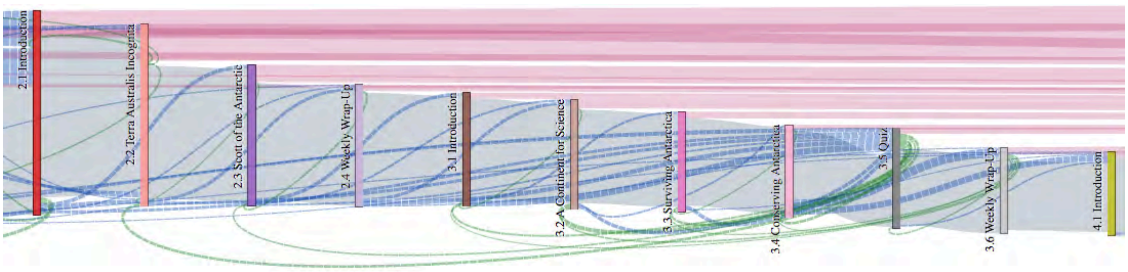

Figure 6: The first prototype showing the behaviour of non-paying participants around the first quiz.

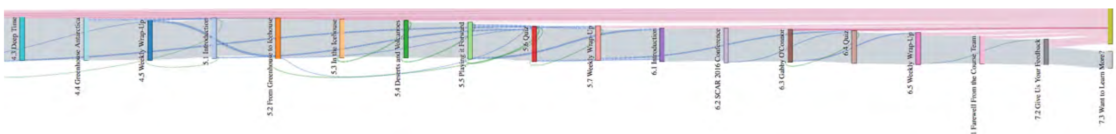

Figure 7: The first prototype showing the behaviour of non-paying participants at the end of the course.

The ERG suggested that it would be an interesting test to first, create differing views based on paying and non-paying participants, and second, activity before and after a major edX platform user interface change to see if this visualization could be used to indicate underlying reasons for the observations.
The observations made from these visualizations:

- Approximately 23% of non-paying participants jumped ahead to the first quiz, with most of the jumps being prior to topic 3.1. 75% of those then jumped back to the content, seemingly using the quiz as a guide on what to learn (figure 6).
- Although 38.7% of the paying customers jumped forward to the first quiz, 65.9% of these were short jumps (topic 3.1 or after), and they seemingly are engaging with the content more, and the quizzes are used to engage with previously viewed material throughout the MOOC (figure 5).
- The non-paying participants followed the end of course linearly with only a few jumps. For example, under 4% jumped ahead to the last quiz and 2.9% jumping back to previous material from that quiz. This indicates a change in behaviour (figure 7).
- The paying participants kept jumping around the material throughout the course. For instance, 19.8% jumped to the last quiz, with 20.4% jumping back to explore the material further, indicating a continued engagement with the material (figure 5).

The positive feedback from the ERG, and the indication that it could be used as a tool to analyse behaviour, led to the continued development of the tool. The following list of changes for the next iteration were based on the feedback from ERG and the initial objectives:

- Use edX logs files instead of database files. Using logs will provide future extendibility as they contain more information than the provided database files.
- To ensure that the vertical bars would show the number of unique visitors to a content page there were two suggestions; split the diagram into two rows with the upper row showing the first visits to a page and the lower row all subsequent visits. Embed a differently coloured bar inside of the vertical bar to indicate the proportion of first visitors to the page. It was decided to use the “two rows” option because this might potentially show a more detailed view of the participant’s behaviour with the content.

2nd Prototype

The next prototype was still a visualization with the data embedded inside the view, so therefore not a tool to be used with other edX MOOCs, however it was created as a website instead of an image. The recommended changes had been implemented, while keeping the same colour scheme and style of the previous view. At the data extraction level, the only difference was that the raw logs were used instead of the database files provided by edX.

The following are the observations of the ERG

- The diagram now showed movements of participants to previously viewed content, which provide a more informative picture of their engagement with the material (figure 8). The ERG concluded that the new view therefore was richer and more expressive than the initial prototype. However, some of the extra detail had made the visualization more difficult to understand. They agreed that the expressiveness was more important than the usability, but methods should be sought to make it possible to engage with the visualisation and to increase usability.
- The engagement with the content is still more linear in the latter stages of the course (figure 9).
- The first quiz is still disruptive to learner behaviour (figure 10) The first observation was that 4.6% more learners visit the weekly wrap-up than the quiz, and therefore skip the quiz. The second observation was that the combination of the quiz and the wrap-up seemingly was used by participants to study or review the previous material to enable them to answer the quiz. The quiz had over double as many revisits than first time views, and the previews content had been traversed extensively by these users. It was suggested that this to some extent might be the difference between the behaviour of paying and non-paying participants.
- Later quizzes showed the same impact on behaviour with 7%-8% avoiding them and an increase in revisits of previous content, although the jumps backwards only showed jumps to the closest previous content.

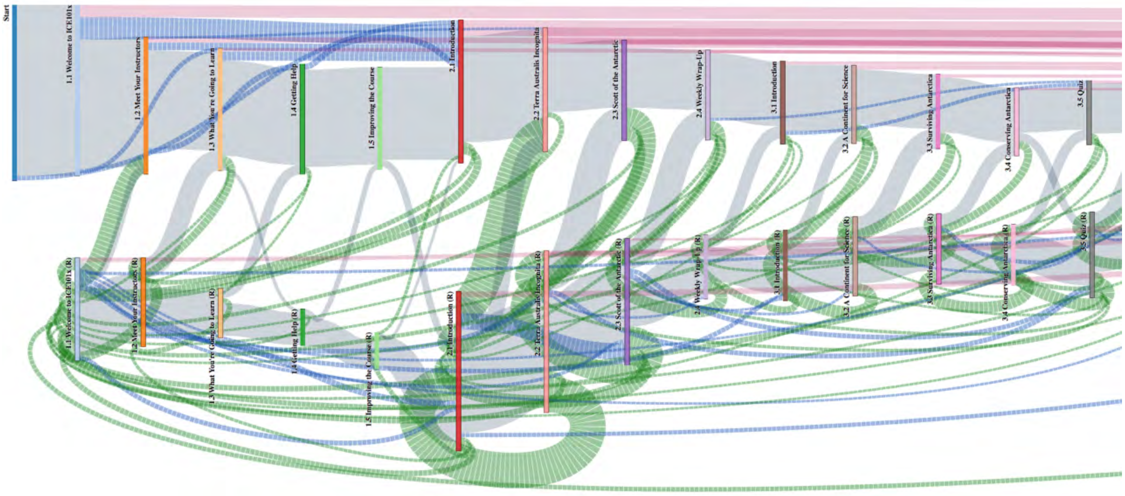

Figure 8: The second prototype showing the first three topics.

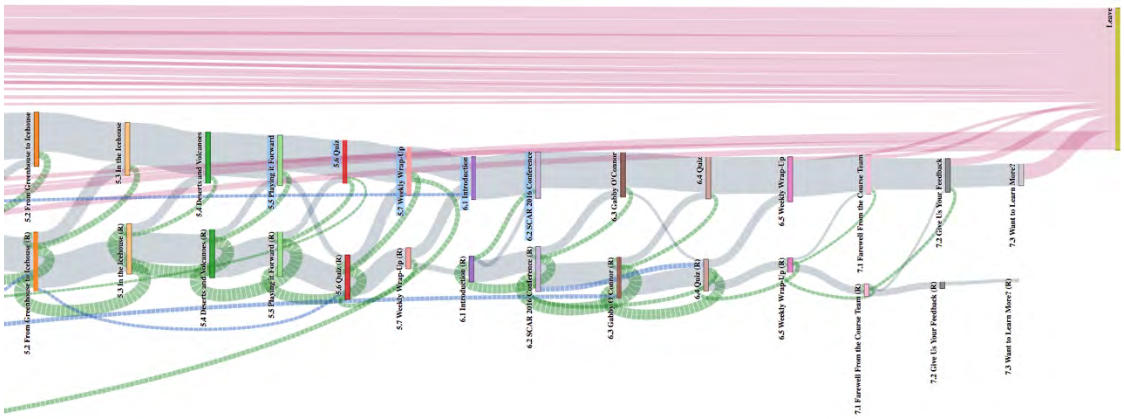

Figure 9: The second prototype showing the end of the course.

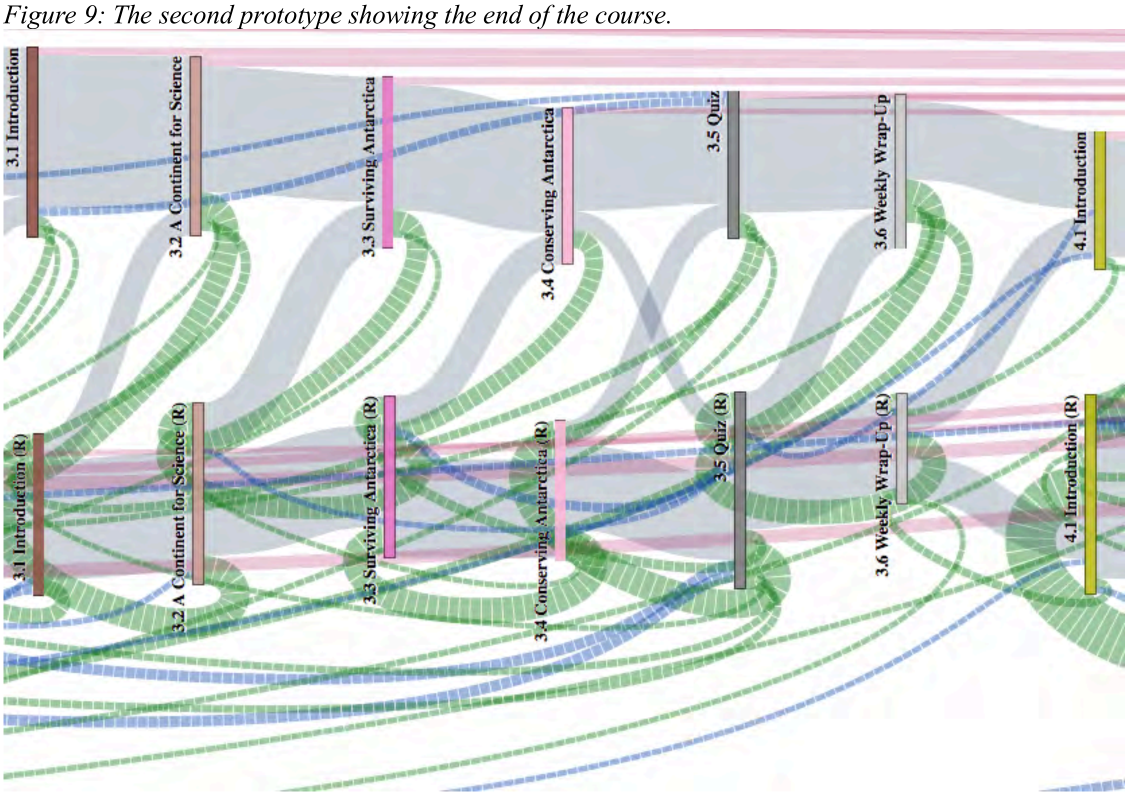

Figure 10: The second prototype showing the end of the course.

Furthermore, the ERG had become aware that a mid-course user interface change by edX (28/04/2017) might have contributed to the observed behavioural changes. The menu of content had been moved from the top of edX's course pages to a less prominent space at the bottom of the screen. Two special views were created to see if this had changed the participants' behaviour. Figure 11 and Figure 12 show the same content pages (vertical bars). The blue paths that can be seen in the top of figure 12 are there because all users were registered as visiting that page for the first time, even if they had been online before the user interface date. Almost all participants are following the expected route with only a few jumps forward and backwards. There is also a noticeable decrease in revisits to content pages.

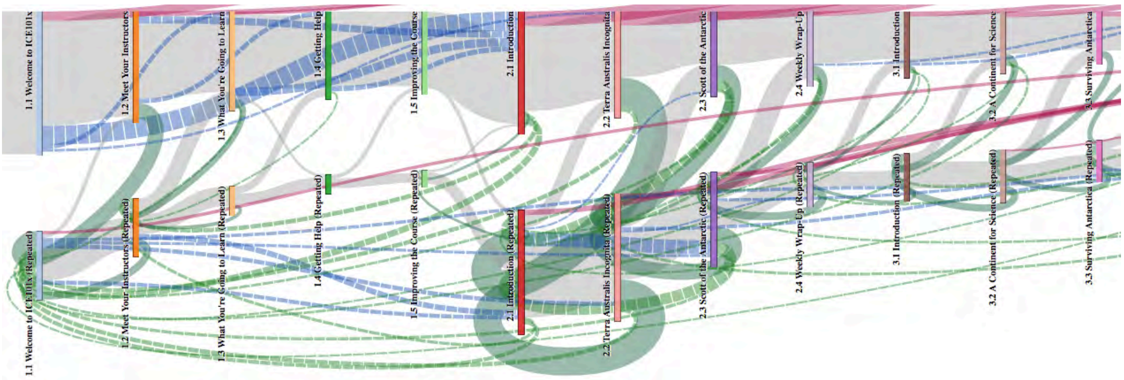

Figure 11: The second prototype showing before the user interface change.

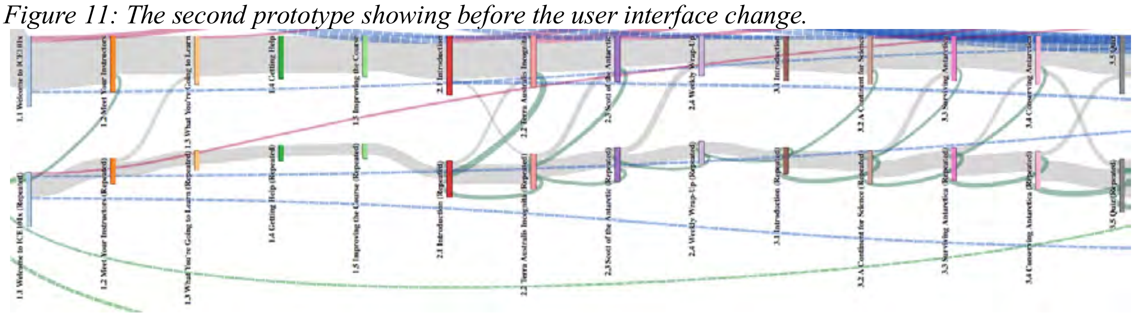

Figure 12: The second prototype showing after the user interface change.

The following changes were suggested for the next prototype:
- Increase usability of the visualization.
- Prepare for new views based on segments of users.
- Create views based on users who followed particular paths or visited certain content sections as represented by the vertical bars.
- Develop it as a tool that can be used with logs from other edX courses.
- The visualisation does not include movements lower than 20 to decrease complexity of the visualization. However, all visits to the content page ought to be shown in the vertical bars. They were excluded in this version. Therefore, the next version should include all visits in vertical bars, but still exclude low paths.
- Provide an option for the user to set the minimum number pf paths that are shown.

3rd Prototype

The biggest changes for this iteration were technical. The data extraction was developed into a tool that makes a webpage of the provided logfiles. This prepares the tool for other MOOCs and also for future expansions to create multiple views based on participant groupings, dates and other feature that can segment into behavioural groupings.

A web server was included to provide the views within browser. This allowed the generation of a new view when the user of the tool double-click a path or vertical bar based on the users who did this activity.
To increase the usability of the visualization the vertical bars were made movable so that the path ways in and out become clearer.

An input box was created to set the minimum number of users for displayed paths. The inclusion of all participants (i.e. include below the minimum number user paths in the vertical bars) did not radically change the view massively, but it now provides the correct number of participants on the vertical bars.

The ERG agreed with the changes. It was observed that the tool was slow at producing the specialized views, and it was agreed to investigate ways to increase speed.

4th Prototype

It was found that the speed issue stemmed from traversing the log files to produce the data for specific views. An intermediate data format was created that extract all user behaviours into on single list. This could be saved as a .ser file in the tool.

A GUI was added to allow a user to input the .ser file or raw log data files themselves. If raw data files are selected, a .ser file will be generated so that the raw data files don't have to be read next time. After selecting the relevant files in the GUI and clicking the start button, the web server is started, and the default browser is opened to show the Sankey diagram.

This approach has increased the speed of the tool significantly. The tool has been released on an open source license at https://github.com/MikeSolvalou/MikeSolvalou.github.io

Conclusion and Future work

The processes described above have helped validate the visualiser as a valuable tool for the MOOC development team at anonymous.
It is still being maintained and further developed. The current plan is to integrate user functionality to segregate the behaviours of various different user grouping and behavioural differences, so that any user will be able to create with views without manually creating the associated logs. This is currently achieved using scripts or by creating bespoke programs whenever a question arises.

A related future feature is to incorporate statistical tests. It would be useful to compare two different diagrams from the same course and be able to see if the two are significantly different from each other. It seems that the data is not normally distributed, so common statistical tools such as t-tests can probably not be used. The plan is to seek advice on this from statistical experts on this.

The tool has been prepared to support data from other MOOC platform, but due to lack of available data this has not been fully implemented yet.

The tool in its current form has already been used to analyse and understand user behaviour. It is being used with the learning design team to reflect and shift course design and pick up on potential loops in learner pathways that can be caused by inappropriate tests or content that is not well matched to the course objective.

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Typed *versus* handwritten essay exams: is there a need to recalibrate the gauges for digital assessment?

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In moving from handwritten to typed essay-based examinations (e-exams), the salient issue from an academic perspective is equivalence: can exams in the two modes be considered the same? This paper reports the findings of a literature survey addressing this question, conducted prior to a trial of e-exams at a leading university. The survey sought to establish whether the move results in 1) changes in students' strategies when composing an exam answer, and the resulting product, and 2) changes in academics' perception of typed exam scripts and their strategies in marking on screen. The research team concluded that the two modes of exam are not equivalent, even though differences in the marks achieved by students may be statistically insignificant. Recommendations arising from the analysis include moving to e-exams as the sole mode; supporting students and academics to develop IT proficiency for assessment; and capitalizing on the analytics available in e-exam tools to minimize the inequities that arise when exams are conducted in a single mode.

Keywords: analytics; digital assessment; e-exams; essay-based exams; on-screen marking

Introduction

Invigilated essay-based examinations, in which students write their scripts by hand, are traditionally the primary means by which students' knowledge gain is measured in tertiary education (Moore, 2018). Where such assessments are conducted in a face-to-face setting (i.e. an examination hall or other room allocated to the purpose), there is an emerging trend towards *e-exams*, in which students type their scripts either on their own laptops or on institutionally provided devices. The benefits include reduced physical discomfort compared with handwriting, the potential to incorporate multimedia elements into questions and the streamlined management of assessment (Hillier & Fluck, 2013; Sindre & Vegendla, 2015). Furthermore, typing is now the norm for students' coursework, and so handwritten exams may be both unnatural and anachronistic (Moore, 2018).

E-exams have been standard practice in US law schools for over 20 years (Augustine-Adams, Hendrix & Rasband, 2001; Mogey, Paterson, Burk & Purcell, 2010). They are becoming commonplace in Scandinavian countries, where Sindre and Vegendla (2015) have forecast a large-scale shift towards e-exams during the coming decade. In the UK there have been isolated trials of e-exams since at least 2008 (for a summary, see Masterman & Fresen, 2017). Many initiatives remain largely at the course or departmental level (Newland & Martin, 2016), but at least one university is undertaking an institution-wide implementation (Brunel University, n.d.). In Australia, pioneering work has been carried out by Hillier, Fluck and colleagues into e-exams conducted on students' own devices (referred to in their recent publications as eExams: Fluck & Hillier, 2017).

While much attention has been paid to the practical and policy aspects of implementing e-exams, such as technology, security, resources and procedures, the salient question from an academic perspective is that of the *equivalence* between typed and handwritten exams. As Noyes and Garland observe, since two different presentation and response modes are being used there is a "need for equivalence to be determined fully to ensure that overall performance outcomes are matched" (2008, p. 1357). They suggest that this is especially the case with "non-standardised, open-ended tasks" (p. 1371), i.e. essay-based exams, in contrast to "bespoke and closed" tasks such as objective tests, which can be made more similar in both digital and paper-based modes.

This paper explores, through a survey of the currently available evidence from the research literature, whether the cognitive processes in, and intellectual outputs from, e-exams can be considered the same as for handwritten exams and, if not, whether institutions should adjust their marking schemes and other measures. To adopt a maritime metaphor, it investigates the extent to which the move to e-exams is "plain sailing" for the students sitting them and the academics marking them, or whether we need to recalibrate the existing gauges with which we navigate the high seas of assessment.

The paper starts by outlining the context in which the literature survey was conducted. It then offers a model of the writing process as an introduction to coverage of research on the process and product of writing an exam essay, before turning its attention to the influences on academics as they mark students' scripts. It then looks at the evidence for differences in students' performance between typed and handwritten exams. It concludes by reflecting on the issue of equivalence and recommending possible ways forward in practice and research.

Methodology

The context in which the literature survey was conducted was a trial of e-exams at the University of Oxford, UK. Preparatory to the trial, the project team conducted a "landscape" study of a) the research literature on the cognitive and academic aspects of changing from handwritten to typed exams (reported here), and b) reports on the software and processes adopted by other institutions running e-exams, the resources required to run exams on computers, and the practical benefits derived for both students and academics (Masterman & Fresen, 2017). The study was intended to inform the design of the trial itself, which was conducted with 35 undergraduate and 30 taught postgraduate students in three subjects in April 2018.

The survey of literature on the cognitive and academic aspects addressed three questions:
1. For students sitting e-exams: Does moving from handwritten to typed exams change the intellectual process of responding to an exam question and, hence, the length and stylistic features of the resulting response?
2. For markers of e-exams:
   2.1 Does moving from marking handwritten exam scripts to typed scripts change the marker's perception of, and attitude towards, students' responses?
   2.2 Does moving from marking exam scripts on paper to marking scripts online change the intellectual process of marking an exam question?
3. If the move results in change, is there a difference in the marks achieved/awarded, and should the differences be considered important?

The literature was gathered primarily from an intensive search of online materials, conducted in June 2017 using Google Scholar. The search terms used to locate documents include:

computer + essay + exams	digital assessments	online exams
computer-based exams	digital exams	typed exams
computerised exams	essay exams	

We initially restricted our search to works published from 2000 onwards, largely because older papers described software with outdated functionality. Also, several authors included pre-2000 studies in their literature surveys, and we often felt it unnecessary to read the cited works as well. However, we made exceptions where the findings of pre-2000 studies proved to be particularly relevant to our purposes. Additional works of interest were located in the references of articles found through the Google Scholar search, and also on journal websites which listed related items alongside the article being read.

We collected a total of 46 works, comprising peer-reviewed journal articles and full-length conference papers; non-peer reviewed literature (reports of projects, evaluations and surveys; also overviews of the field); and blog posts. We categorized them thematically according to the areas of interest identified in the research questions. The author took responsibility for the detailed reading and analysis of the materials, and her analysis was subsequently critically reviewed by her co-researcher. The search was repeated in July 2018 in order to identify relevant papers published since the original survey; five such papers were located.

Typing versus handwriting exam responses

An overview of the writing process

In order to appreciate the potential differences between handwriting and typing exam responses, an overview of the fundamental metacognitive processes involved in text composition may be helpful. Peverly's (2006) survey of models of writing competence provides a basic understanding of these processes. Under exam conditions, the processes are:
- planning (goal setting, generating and organizing content),
- retrieving knowledge,
- translating (turning ideas into text) and
- revising the text produced so far.

Translating one’s ideas into text on the paper or screen entails two further processes: text generation and transcription. Text generation involves “translating generated ideas into language in working memory and then translating those temporary mental representations into more permanent external representations using the symbols of the writing system.” Transcription involves “retrieving letter forms and familiar word spellings from long-term memory, strategically spelling novel words, and motor planning to produce the letters [using the tool at hand]” (Peverly, 2006, pp. 199–200).

An individual’s capacity to carry out these high-level processes depends in part on the efficiency, or fluency, of the lower-level processes involved in outputting the text onto paper or screen. Summarizing a number of models, Peverly suggests that:

> Writers must (a) be fluent in generating ideas that can be written down and (b) write these ideas down quickly before they are forgotten. If writers are efficient in executing (a) and (b), they will be able to use the metacognitive processes … and other cognitive resources (e.g., genre and content knowledge…) to create reader-based prose. (2006, p. 199)

The pressurized environment of an exam may place additional pressure on the capacity of a student’s metacognitive processes, with a resultant impact on the quality of their responses (Connelly, Dockrell & Barnett, 2005). Introducing technology into the exam room may generate further pressures: namely, computer anxiety (Walker & Handley, 2016) and anxiety about technical failure (Hillier, 2014).

Intellectual process and product

Insights into differences between handwriting and typing in the intellectual processes of writing an exam response are derived largely from students’ self-reports. Hand-writers (i.e. students writing their exam responses by hand) in Lee’s (2002) study reported that they spent more time planning their responses before starting to write than did the typists (i.e. students typing their responses on the computer). Typists reported that they composed their responses in a rough form first, then went back and expanded them; they also paused more while they were actually writing (i.e. they may have needed more time to think while producing the text because they had spent less time planning).

However, studies are inconsistent, or even contradictory regarding the differences (Lee, 2002). For example, participants in Kohler’s (2015) study stated that they re-read and revised their writing more while typing than handwriting. This finding stands in contrast with the finding by Hillier (2015b), in whose study similar proportions of hand-writers and typists reported that they went back over their responses before submitting. The exact nature of differences in the process may differ from student to student (Lee 2004); furthermore, these differences may be insignificant from a methodological perspective (Mogey & Paterson, 2013).

Differences between typing and handwriting are more clearly discernible in the finished product. The salient difference is in length, with typists generally producing longer responses than hand-writers in several studies (Charman, 2014; Hillier & Lyon, 217; Kim, Bowles, Yang & Chung, 2018; Kohler, 2015; Lee, 2002; Mogey et al., 2010; Whithaus, Scott & Midyette, 2008). However, it is important to note that the length of a student’s exam response depends on their content knowledge and analytical skills as well as on their typing or writing speed (Augustine-Adams et al., 2001).

Discrepancies exist in the findings of research into the length and organization of sentences in students’ responses. Mogey and Hartley (2013) found that typists produced more, but shorter, sentences and arrange them into a smaller number of paragraphs; Kohler (2015) also observed that typists wrote fewer (i.e. longer) paragraphs than their handwriting peers. In contrast, Lee (2002) and Mogey and Paterson (2013) found that typists produced longer sentences.

Research into the linguistic features of typed and handwritten responses reveals further differences, although these are not necessarily significant (Kim et al., 2018). Charman’s (2014) detailed analysis of responses produced by high-school students revealed greater lexical variation (range of vocabulary) in typed responses, but a slightly greater lexical density (proportion of meaning-bearing words to functional words) in handwritten responses. Mogey and Hartley (2013) also observed greater lexical density in students’ handwritten responses. Both measures, variation and density, tend to be higher in writing than in speech. These findings led Charman, and Mogey and Hartley, to suggest that students may write in a more informal style on the computer than on paper. Once again, the findings are not consistent across studies: for example, Whithaus et al. (2008) found that handwritten exam scripts were in a more informal style than typed ones.

Influence of the tool

The speed of the motor act of transcription – whether handwriting or typing – can determine how much of a student's working memory is available for the higher-level actions involved in text composition (Peverly, 2006). Indeed, combined with exam pressure, speed can have an impact on a student's exam performance, as Connelly et al. (2005) point out in relation to handwritten exams:

> … it is only when cognitive load is high that handwriting fluency becomes an important predictor of writing quality. This does not bode well for handwritten exams, where it is presumed that the quality of knowledge produced reflects the learning of the student, not simply how fluently they can write. (p. 106)

In view of research suggesting extensive computer use can impair fine motor skills including handwriting (Sülzenbrück, Hegele, Rinkenauer & Heuer, 2011), the argument in favour of a move to e-exams would appear strong. It is further reinforced by the expectation that much coursework is typed; as a result, students may have little or no practice writing essays by hand (Mogey et al., 2008), except in subjects in which students are required to handwrite formulae or hand-draw diagrams (such as mathematics and the sciences). Indeed, a number of authors conclude that typing proficiency has a stronger influence on students' e-exam performance than the amount of their computer experience (e.g. Bridgeman & Cooper, 1998; Kohler, 2015). Furthermore, in a *dual-option* situation, where students are given the choice between handwriting and typing an exam, students who are proficient typists may be more willing to type their scripts (Mogey & Fluck, 2015).

Although it has been observed that students generally type faster than they can handwrite (Augustine-Adams et al., 2001) and that they may complete their exams more quickly (Truell, Alexander & Davis, 2004), neither observation is universally the case. Furthermore, students' typing speeds vary. Slow, two-fingered typists may report that the effort of typing interferes with the process of composition or forces them to write more concise responses (Fluck, Pullen & Harper, 2009; Lee, 2002). In contrast, those who have been trained in typing and can type faster are in a stronger position to perform well (Kohler, 2015). Kohler (2015) raises the additional possibility that using inefficient keyboard techniques may hamper students:

> … lack of fluency in lower order cognitive processes such as keyboarding or handwriting constrain higher order cognitive processes … To this end, it might make sense that less fluent typists would be forced to spend more time on lower order processes as opposed to higher order processes that have to do with the content and organization of their ideas in essays. (pp. 140–141)

It is also not necessarily the case that faster typists necessarily produce lengthier exam responses. Indeed, Mogey and Hartley (2013) found no association between speed and the number of words produced. This may be explained, at least in part, by pauses for thinking and a greater time spent on revision.

Given that handwriting speed and style (printed or cursive) can have a similar impact on the finished product (Graham, Weintraub & Berninger, 1998; Connelly et al., 2005), providing the dual option to students can prove problematic for them. On the basis of their statistical analysis of handwritten and typed exam scripts, Augustine-Adams et al. (2001) advise that students should type their exams if they are proficient typists; otherwise, it is preferable to spend time studying the substance of the course rather than improving their typing skills.

Speed is not solely a function of an individual student's typing proficiency; it can also be adversely affected by the device used. This is particularly the case where students take their exams on unfamiliar institutional devices (Hillier, 2015a; Lee, 2002; Walker & Handley, 2016). Indeed, Walker and Handley draw a distinction between "digital proficiency – reflected in the effective day-to-day use of technology for learning (e.g. from email to essay writing) – and IT proficiency for assessment, reflected in the capability to use unfamiliar technology under time pressure in computer-based exams" (2016, n.p.). A solution is for students to bring their own devices to the exam, but this raises a number of practical issues including computer security (Masterman & Fresen, 2017).

Marking e-exams

Perceptual and attitudinal influences on the marking of exam scripts

The research studies reviewed for this report suggest that a number of perceptual and attitudinal factors come into play as markers read and mentally process students' exam scripts.

Lee (2004) reports the negative impression created by "severely illegible" handwriting, which participants in his study felt "interrupted the smooth flow of reading and impaired their focus on content." He suggests that, in comparison with typed scripts, handwritten scripts may exercise a negative influence where markers find themselves in a "time-constrained testing condition" (pp. 13–14). In contrast, Powers, Fowles, Farnum and Ramsey (1994) refer to a "reader empathy effect" between the marker and a student who handwrites their exam script, with the marker feeling "closer to the writer" of a handwritten script (p. 221). Powers et al. suggest that the marker may give the student the benefit of the doubt over illegible patches or interpret crossings-out as evidence of the student's attempts to revise their work (and reward the student accordingly).

Although typed exam responses tend to be longer than handwritten ones, typed scripts give the visual appearance of being shorter than handwritten essays, even where their word count is the same or greater. In Powers et al.'s (1994) study, this remained the case even when typed scripts were subsequently transcribed into handwriting and *vice versa*. This finding is important because research generally indicates a positive correlation between the length of the response and the mark achieved, whether typed or handwritten (Augustine-Adams et al., 2001; Charman, 2014; Hillier & Lyon, 2018; MacCann, Eastment & Pickering, 2002).

A number of studies have reported on suspected differences in markers' overall expectations of typed and handwritten scripts (Lee, 2004; MacCann et al., 2002; Mogey et al., 2008; Mogey, Cowan, Paterson & Purcell, 2012; Powers et al., 1994; Whithaus et al., 2008). It has been suggested that markers may expect typed scripts to be qualitatively different from handwritten scripts, as Whithaus and colleagues explain:

> It is tempting to think of the writing ability that is measured on a high-stakes exam as first-draft writing and therefore not subject to differences in composing materials. … Having the exams keyboarded seems to have shifted readers' expectations away from first-draft writing toward higher expectations associated with texts that have been more thoroughly revised. (pp. 12, 14)

Students in Mogey and colleagues' (2008) study suggested that typing their exams might lead markers to expect their responses to approach the same standard as their typed coursework. This situation can be of concern to them as the standard of work expected an exam situation differs substantially from the standard expected from coursework (Mogey et al., 2008; Mogey et al., 2012): i.e. there may be a difference in the marks they achieve.

On-screen marking: influence of the tool

If students type their exams and submit scripts in digital format, it arguably follows that academics should mark the scripts on the computer. A number of studies address the experience of on-screen marking (OSM), but only in relation to handwritten scripts that have been scanned into the computer. Even so, some of the findings may also be relevant to the marking of scripts in typed directly onto the computer.

Shaw (2008), and subsequently Johnson and colleagues (Johnson & Nádas, 2009; Johnson, Nádas & Shiell, 2009), investigated whether cognitive processes differ between marking on screen and marking on paper. In addition to slower reading speeds on screen (Shaw, 2008) and a greater cognitive load at first (Johnson et al., 2009), differences were found in reading strategies, navigation and awareness of spatial relationships within individual scripts, and annotation practices.

For example, Shaw's (2008) work suggests that the mode in which an exam script is read (i.e. on paper *versus* on a computer screen) has an impact on the marker's reading strategy. Participants in his study reported that they were more likely to read in a linear fashion on paper and in a haphazard fashion on the screen. They also found it harder to skim-read scripts on the screen in order to elicit the salient themes of individual responses; instead, they had to resort to multiple readings. Shaw comments:

> If examiners construct meaning by processing at different levels concurrently in an interactive way then they must be able to apply simultaneously, elements such as context and purpose together with lexico-grammatical and discoursal features. If mode affects their ability to do this, then not only will a different reading strategy be employed on-screen but recovery of the intended meaning of a candidate's answer might be compromised when marking on-screen. (p. 267)

Differences in performance

Students' performance

As with other aspects of e-exams, research comparing the actual marks achieved in typed and handwritten responses has yielded contradictory results. Among the studies read in this survey, higher marks were awarded to handwritten responses in the work reported by Bridgeman and Cooper (1998), Kohler (2015), Lee (2004), Mogey et al. (2010) and Powers et al. (1994). Higher marks were awarded to typed essays in the work reported by Augustine-Adams et al. (2001), Charman (2014), MacCann et al. (2002) and Whithaus et al. (2008). Lee (2004) found that handwritten responses received higher marks than typed responses when scored holistically, but the situation was reversed when responses were scored analytically (i.e. using a set of specified criteria). MacCann et al. (2002) also report discrepancies when scripts we marked holistically and analytically. However, in almost all of the studies the differences between the marks awarded were not statistically significant.

Reasons put forward for the higher scores awarded to handwritten essays include the greater visibility of errors in typed scripts (Kohler, 2015; Lee, 2004; MacCann et al., 2002; Whithaus et al., 2008); the greater perceived length of handwritten essays; and the possibility that markers have higher expectations of typed responses.

Researchers have also investigated the potential role of specific demographic characteristics in students' performance in typed *versus* handwritten tests. Gender and ethnicity are ruled out as influencing factors in Bridgeman and Cooper's (1998), and Augustine-Adams et al.'s (2001) studies. ESOL (English as a second or other language) status is also dismissed as a factor by Augustine-Adams et al. (2001); however, in Kohler's (2015) very small-scale study of eight ESOL students, six participants performed better in handwritten exams.

It is possible that gender may have an influence on performance in dual-option situations. When students in Mogey and colleagues' studies were given the choice, more male students opted to type than females, although the difference was more pronounced in the study by Mogey and Hartley (2013) than in the one by Mogey et al. (2012). Given that boys may produce more text, and their essays may be of higher quality, when they type their work (Dixon, Cassady, Cross & Williams, 2005), the dual option may help male students to lift their marks.

The lack of consensus among study findings may be attributable in part to the settings in which the studies were conducted or to shortcomings in the methods adopted (Lee, 2004). Most of the studies surveyed refer to the assignments that students were required to complete as "essays" or "tests", since few were actually carried out in actual examination settings. For example, Mogey et al. (2010) observe that "mock" exams or artificial settings can influence participants' attitudes. Bridgeman and Cooper (1998) noticed practice effects where participants were tested in both modes, regardless of which mode they took the test in first. Mogey and Fluck (2015) admit to differences between the cohorts that they studied in Edinburgh and Tasmania.

Markers' performance

As well as investigating students' performance in typed *versus* handwritten exams, it is important to consider possible differences in the performance of the academics who mark the scripts. Indeed, Whithaus et al. (2008) specifically highlight "the need to analyse how the medium of reading an exam impacts the raters' ability to apply assessment criteria" (p. 14). Measures of markers' performance include severity and reliability.

Regarding severity, Whithaus et al. (2008) found that markers were no more severe on typed scripts than on handwritten scripts, despite the reported difference in expectations. Johnson et al. (2009) detected no significant difference between handwritten scripts marked on paper and scanned handwritten scripts marked on the screen: "Where an examiner was severe or lenient in one mode they were also similarly severe or lenient in the other mode" (p. 7). However, a subsequent study by Johnson, Hopkin, Shiell and Bell (2012) found that markers were slightly more lenient on screen than on paper.

There are empirical indications that reliability between markers may be improved by the marking of typed scripts. Bridgeman and Cooper tentatively ascribe the improvement to "the greater standardization in the word-processed essays in which raters cannot attend to differences in handwriting or overall neatness" (1998, p. 4). The difference may also depend in part on the marking scheme adopted: Lee (2004) found greater reliability in the marking of typed scripts when they were marked holistically, but not when they were marked analytically.

On the basis of a comprehensive literature review on reliability in the OSM of scanned handwritten scripts, Tisi, Whitehouse, Maughan and Burdett (2013) suggest that OSM tools may contribute to greater inter-rater reliability in two ways. Individual exam papers can be split up so that different individuals mark different questions (item-level, as opposed to paper-level, marking); and the collection of analytics makes it possible to detect inconsistent or inaccurate marking throughout the marking period and to act where needed.

The question of equivalence and its implications for implementing e-exams

Among the authors whose papers are surveyed in this report, Whithaus and colleagues (2008) stand out in considering that the processes of handwriting and typing do not differ significantly. For them, it appears more important that students are given the dual option so that they can choose the mode in which they feel the most competent. In contrast, Lee's (2002) findings suggest that:

> … the constructs measured in computer and paper modes are not the same. That is, the incorporation of computers into writing assessments involves a new way of thinking about composing processes, which introduces a source of variability in the original constructs. Inevitable sources of non-equivalence of the construct between them might lead to differences in test performance to some extent. (p. 152)

In relation to research questions 1 and 2, the preceding survey of the research literature leads us to conclude likewise: the move to e-exams does lead to changes in the processes and outputs of sitting and marking typed and handwritten exams, so they are not equivalent. This view rules out the dual option as a solution for students whose typing is less proficient, or who prefer to handwrite their exams for other reasons. An alternative solution is to make e-exams compulsory and offer students opportunities to develop their overall proficiency in general and IT proficiency for assessment in particular, so that they can concentrate on demonstrating their knowledge of the topic in the e-exam rather than expend cognitive resources grappling with the mechanics of production. Indeed, Weigelt-Marom and Weintraub (2018) report that learning to touch-type can narrow the gap between typing and handwriting speeds, and, with time and practice, students may touch-type faster than they handwrite. The positive effect is greater among students with special needs; even so, the option to handwrite must remain open to certain students in this category.

The marking of e-exams is another area for careful consideration. The largely insignificant differences between the marks achieved in typed *versus* handwritten exams suggest that the risk of grade inflation (conversely, deflation) resulting from the change of tool is negligible. So the key question becomes: Do markers treat typed responses akin to coursework essays and, therefore, expect higher standards? If yes, then there may be a requirement to recalibrate marking schemes. Also, if marking typed scripts on the computer improves reliability, a case could be made for compulsory OSM, accompanied by training in IT proficiency for marking. However, such a move would have implications for academics' freedom to make their own choices. Finally, since most of the existing evidence of academics' OSM strategies so far is derived from studies involving scanned handwritten scripts, we advocate a closer investigation into the OSM of typed scripts and its impact on academics' marking strategies.

Regarding research question 3, although the differences in academic outcomes may be statistically insignificant, they matter to students whose marks hover on the boundaries between grades. Some will benefit from a move to e-exams, but others will be disadvantaged. However, we should balance this concern against the inequity that has historically existed in handwritten exams, where some students can write more fluently than others, thereby achieving higher marks. Indeed, we may need to reframe our approach to the question. Rather than puzzle over the conflicting evidence of differences, or design further studies that attempt to replicate the conditions of high-stakes exams in low-stakes exams or "mock" settings in the search for a definitive answer, it may be more productive to adopt e-exams across the board and use the analytical tools in the e-exam software to understand better students' writing behaviors and academics' marking strategies in a digital medium. For example, data on the number of characters that a student types, their typing activity over the course of time and the length of their script may yield insights that can be used to help them adopt appropriate writing strategies for e-exams. The potential for analytics in checking, and improving, reliability between markers (Tisi et al., 2013) was referred to earlier in this paper. Research into the contribution of analytics to our knowledge and understanding could, together with training in IT proficiency for assessment, go some way towards minimizing the inequities in students' performance that inevitably arise when they have no choice over the mode in which they sit their exams. Arguably, with such digital tools at our disposal, e-exams may ultimately prove more equitable – or at least less inequitable – than handwritten exams.

As the preceding paragraphs imply, changing the tool used for a particular activity may (and arguably should) prompt a reassessment of the activity itself. Indeed, moving from handwritten to typed exams raises deeper questions about the purpose, nature and validity of essay-based exams as a form of summative assessment:

> … when the stress in the course work has been on word-processed output, then handwriting extended prose under exam conditions could be regarded as a poor alignment of assessment practices with intended learning outcomes (Biggs 1999) and further, it may not be an accurate reflection of the quality of work the student is capable of producing. (Mogey et al., 2008, p. 39)

However, a wholesale transformation of summative assessment cannot be achieved overnight. Essay-based exams, conducted increasingly on the computer, are likely to persist as a feature of assessment in higher education for a number of years, and so the research reviewed in this paper should be of ongoing relevance.

Future work

Two possible directions for future research into e-exams were indicated in the previous section; namely:

1. A comparative study of the marking of typed scripts on the screen vs on paper, in order to determine whether the outcomes are equivalent: hence, whether academics should be able to exercise choice regarding the medium in which they mark.
2. An investigation into the potential role of analytics, and specifically keystroke metrics, in uncovering students' behaviours in planning, writing and revising typed exam answers, with a view to supporting them to develop appropriate strategies.

Regarding the role of analytics, studies have already been conducted on coursework essays by, among others, Conijn, van der Loo and van Zaanen (2018) and Türkay, Seaton and Ang (2018). Interestingly, Conijn *et al.* found discrepancies between students' self-reported behaviours and their actual behaviours as tracked by the software. Given that some of the research reported in this paper has relied on self-reports, Conijn *et al.*'s finding opens up an additional avenue for future investigation.

Conclusion

The literature survey reported in this paper has focused on the academic implications of moving from handwritten exams to e-exams. This by no means downplays the practical and policy implications of the move, addressed in the other part of our "landscape" work (Masterman & Fresen, 2017). Institutions will wish to take all factors into account when planning the implementation of e-exams.

The paper set out to explore whether handwritten and typed exams can be treated as equivalent, by addressing two research questions relating to the students who sit the exams and the academics who mark them, and a third asking whether differences in students' performance matter. Our conclusions suggest that there are indeed changes in moving from handwritten to typed mode: that is, we can answer research questions 1 and 2 in the affirmative. The answer to question 3, whether differences in performance matter, is more nuanced. True, existing gauges in the form of marking schemes may need to be checked, and recalibrated, for exams conducted on the computer. However, by additionally capitalizing on the analytics available in e-exam tools, we should have new and powerful gauges by which to understand the strategies adopted by students and markers and, thus, to navigate the high seas of assessment in a digital age with more equitable outcomes for students than hitherto.

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Designing for learning with mobile and social media tools—A pragmatic approach

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Over the last decade, mobile and social media (MSM) tools have been in a constant flux. A growing ecology of tools and affordances have enabled multiple types of user actions and abilities never witnessed or imagined before. Educators all around the world are actively exploring and investigating learning and teaching design and approaches to harness some of these opportunities for improved student learning outcomes. This paper discusses the findings from a PhD study that used a design-based research approach to investigate how MSM tools could be used to facilitate learner-driven and determined learning (heutagogy). A set of draft design principles was formulated to guide the development of a course—implemented and evaluated over two years. A summary of the findings from the study is discussed and a set of refined design principles is provided—capable of guiding educators in designing significant learning experiences using MSM tools.

Keywords: authentic learning, heutagogy, mobile learning, social media, design-based research, design principles

Introduction

The exponential growth of social media tools over the last decade (Kemp, 2018) has brought with it many challenges but also new and unforeseen opportunities for learning and teaching (Schoenborn, Poverjuc, Campbell-Barr, & Dalton, 2013; Cook & Santos, 2015). Due to the vast and growing number of social media tools, it is difficult to account for all Web 2.0 affordances (Bower, 2015). Anderson (2007), however, states that the ability to create content, form online communities, access to data and information, the participatory nature of the design, networking, and the ability to edit and remix user content are some of the core affordances that could be pedagogically harnessed. In this regard, Laurillard (2013) contends that such emerging affordances offer an opportunity to examine the relationships among the teacher, student, and what is being learnt (p. xvi)—more critically, the process through which knowledge is created and acquired by the learner (Cochrane, 2014). While the Web 2.0 juggernaut continues to roll on, the emergence and ownership rate of smart mobile devices (Kemp, 2018), such as smartphones and tablet devices, have added another layer to an otherwise tethered architecture.

Mobile learning as a concept has existed for almost half a century (Naismith & Corlett, 2006) albeit decades ahead of time and coming to fruition only in the last 10 years (Parsons, 2014) because of the meteoric advancements of mobile technology and affordances (Crompton, 2013). Early stages of mobile learning dwelled on the technological aspects of how mobile devices could be used in learning and teaching (Bannan, Cook, & Pachler, 2015), perhaps because Web 2.0 tools were still in its infancy. Mobile learning, however, took a turn when social media tools became operable on mobile devices. The ubiquity and mobile connectivity provided by the smart devices meant that the social media affordances (the known and continually emerging) could now reside in the user's pocket—available whenever the need arises. The confluence of the affordances of mobile devices and social media tools significantly amplifies what the user is able to achieve and when (Burbules, 2014). The omnipresence of mobile social media allows its users the ability to embody several tasks, which before were only achievable on a computer, in everyday life—helping overcome the temporal and conceptual limitations (Sharples, 2016; Traxler, 2016a). The implications of the mobile learning for education meant that learners could now personalise their learning and learn in contexts they found useful, and engage and collaborate with people and peers to solve problems and create new knowledge—all, possible as part of everyday life (Sharples, 2016). The central construct of mobile learning was that the learners could now be the main agents in their learning process, creating and gaining knowledge in authentic and real-world contexts, possibly from everyday experiences (Herrington, Herrington, & Olney, 2012; Traxler, 2016a).

Mobile learning and the opportunities it offers, however, have largely remained under-utilised to date. Traxler (2016b), a key commentator in the field delivered a keynote presentation titled 'What killed the mobile learning dream?' where he scathingly pointed out that the pedagogies underpinning the use of mobile devices have remained entrenched in traditional practices. Along with other issues and challenges compounding the use of mobile learning, he blames the lack of vision and creativity from the practitioners in designing for significant learning using the affordances at their disposal and lack of scalable models for practice—collectively impeding the growth and use of mobile learning. In relation to this, several meta-analysis studies of trends in mobile learning have reported that the main focus of research in the domain has remained on evaluating the effectiveness of mobile learning approaches and applications, and no or little attempt is made to reflect and build from previous studies—'it is hard for research in mobile learning to transfer already obtained knowledge as the starting point for new efforts' (Aguayo, Cochrane, & Narayan, 2017; Wingkvist & Ericsson, 2011, p. 11).

According to Bannan et al (2015), the overarching problem, and a factor underlying the issues that hinder mobile learning, is the way we perceive and conduct mobile research. They argue that research methodologies employed are often divorced from practice—they fail to 'speak directly to the problems of practice' that 'lead to the development of usable knowledge' (The Design-Based Research Collective, 2003, p. 5). Cognisant of these issues, its ability to bridge the research and practice gap and the pragmatic nature synonymous with the emergent nature of mobile learning, Bannan et al (2015, p. 8) state that a 'design research approach allows us to systematically seek out never-seen before possibilities to inform learning and research'. Alongside Bannan et al (2015), there is an increasing call from within the educational technology community to embrace design-based research (DBR), in order to grow our understanding of the domain and practice that is contextualised and yields transferable knowledge—capable of guiding other practitioners (Aguayo et al., 2017; Reeves, Herrington, & Oliver, 2005).

This paper discusses how a design-based research approach (Narayan, 2017) was used to create a journalism course for self-determined and driven learning using mobile and social media tools. The design of the course was informed by a set of draft design principles elicited from literature—implemented and evaluated over two years with the help of first year journalism students.

Methodology

Design-based research (DBR) according to Wang and Hannafin (2005) is pragmatic (agile and practical), grounded (implemented and evaluated in situ), interactive (collaborative) and iterative (cyclically evaluated and refined), integrative (uses multiple methods to achieve rigour) and contextual (documented in situ). These factors ensure that the known, yet undiscovered and future affordances of mobile social media tools are accounted for—creating a versatile research environment capable of producing transferable knowledge (Bannan et al., 2015).

While there are several versions of design-based research, Reeves (2006) four-phase DBR model was deemed appropriate for use in this study because it integrates technological affordances as a key factor within the four design phases. Figure 1 provides an overview of how Reeves' (2006) DBR model was applied in the study.

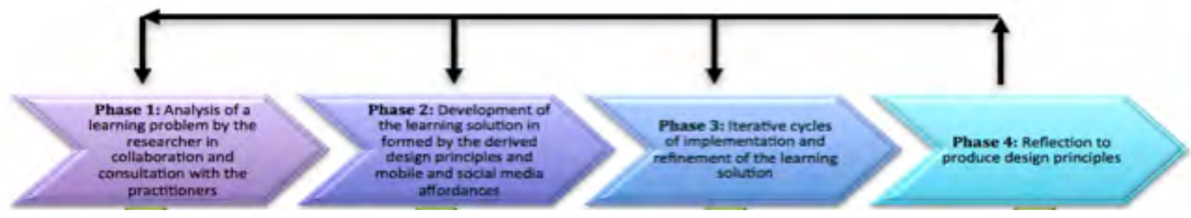

Figure 1: Application of Reeves's (2006) four-phase design-based model in the study (cf. Narayan, 2017)

Qualitative data were collected in the study (with ethical approval) from students and practitioners over two years (two iterations)—eliciting feedback of their learning and teaching experiences in the course designed as part of this study. The data were iteratively analysed and coded using the first two phases (data reduction and display) of Miles and Huberman (1994) data analysis method into *priori themes*—using Nvivo. The resulting units of data for each theme were then analysed using a constant comparative method (Glaser, 1965) to identify the themes and issues, which were subsequently grouped to form broader categories.

The following sections provide an overview of how the four phases of the model informed the study.

Analysis of the problem

During the first phase of the study, the researcher was invited to facilitate informal consultations with three journalism lecturers to understand the issues and problems they faced in teaching a first-year course. Consultations were held over a six-month period (one semester) on a weekly basis—practitioner reflections having taught the course for one year and experience of being former journalists helped identify areas that needed to be considered while designing the solution. A key element that the practitioners wanted to integrate in their teaching and the design of the course was the use of mobile and social media tools – the advent of the 'Arab Spring' in 2011 having illustrated the changed nature of journalism through the use of social media and citizen journalism. During the consultation period, the practitioners discussed at length the impact of mobile and social media tools and affordances on how news was reported and accessed by the audience—critically the change in the role of being a journalist. Due to the ubiquitous nature of mobile social media, news was created or at least reported at unprecedented speed —accessed by the audience almost instantly (Gerbaudo, 2012). According to the practitioners, there was a growing gap between how they taught journalism in the classroom and how journalism was emerging in the real world—further complicated by the emphasis placed on teaching the theory or journalism principles at the expense of practice. As a result, the challenge set in this study was to design a contemporary journalism course that situated learning in authentic contexts (Herrington, Reeves & Oliver, 2010) using mobile and social media tools—allowing students to enact journalism principles for reporting news. A plausible design needed to allow the students the same opportunities as a practising journalist—embedding journalistic practice as part of everyday life, be self-driven and determined, and produce and share trustworthy news using mobile and social media tools accessible by the audience.

Following this, an in-depth literature review was conducted to understand the problem and identify appropriate pedagogical frameworks and case studies that could help with the design of the learning solution for the journalism practitioners. In particular, three learning frameworks *heutagogy*, *Pedagogy 2.0* and *mobile learning* were identified from the review as probable approaches capable of guiding the design of the course. The literature also revealed that many practitioners and leaders in the field were also either grappling with similar issues the journalism lecturers faced or advocating further research within the gap that existed in current literature. For example, how to design for learning with mobile and social media tools (Bachmair & Pachler, 2014; Bannan et al., 2015; Harpur & de Villiers, 2015), how can students be the main agents of their learning and what role mobile social media plays in the process (Blaschke, 2018) and, how to design for student-driven and determined learning (Blaschke & Hase, 2016; Hase, 2016; Sharples, 2016; Traxler, 2016a)?

With the help of the journalism practitioners and the literature review conducted at the end of Phase 1, an understanding of the issues faced by the lecturers was gained, key pedagogical frameworks were identified and the overall research question and three secondary questions were formulated to guide the study.

Research question: *How can mobile and social media tools enable student-generated content and context (heutagogy) for enhanced learning?*

Secondary research questions:
1. What are the pedagogical affordances of mobile and social media tools that enable the design and implementation of heutagogic learning?
2. How did the use of mobile and social media tools within a heutagogical framework enhance the learning and learner experience in an undergraduate journalism course?
3. What is the role of the teacher in facilitating a heutagogical learning experience using mobile and social media tools in a course?

Design and development of the solution

In the second phase of the study, a new journalism course was designed and developed—guided and informed by the draft design principles. Six draft design principles were derived from another round of targeted literature review (refer Narayan & Herrington, 2014) focusing on the three learning frameworks *heutagogy*, *Pedagogy 2.0* and *mobile learning*. Table 1 provides an overview of the draft design principles and how they were used in the development of the course.

Table 1: The draft design principles and how they were used in the design & development of the solution

	Draft design principle	How it was used in the design of the course
1	Design learning tasks, activities and a learning environment that integrates the affordances on mobile social media and actively encourages student participation (share and collaborate), productivity (producers of content) and personalisation (ownership of the learning path and process).	As an overarching assessment event, students in the course were required to compose a multimedia news story based on a person, place or event in the real world. The learning tasks and activities were designed to scaffold student learning and help compose the news story—as an ongoing and embedded assessment in the course. For example, students needed to: 1. share a reflective blog on weekly basis discussing the journalism principles and how they applied them for composing their news story 2. capture or create multimedia content using mobile social media tools for use in writing their news story 3. engage with appropriate audience or entities (either online or in the real world) to collect evidence and data to compose a trustworthy news story
2	Facilitate learning using tools that are open, platform independent and learner-owned devices.	As part of the course, the students were encouraged to create a WordPress blog and a Twitter account. Several free to use and open mobile social media tools, such as Twitter, WordPress, Vine, Vyclone, Piktochart, Hyperlapse, SoundCloud, Google Maps and YouTube were introduced to the students on weekly basis to help with composing the news story. A Twitter hashtag was also created for use in the course in both iterations.
3	Situate learning in authentic contexts determined by the learner to encourage exploration and experimentation.	As the main assessment in the course, the students had to compose a news story based on a person, place or event in the real world. The learning tasks and activities allowed students autonomy to explore and experiment with their ideas enabled by mobile social media affordances.
4	Design formative assessment events that encourage learner participation and reflection in the process.	While the main assessment event was defined—students still had the freedom to select a story they were interested in composing—encouraging participation. The weekly blog posts (assessed at the end of the course) and learning tasks were designed to facilitate reflection *in* and *on* action.
5	Provide a clear explanation, expectation and the rationale for the use of tools.	The students were provided with an overview of the course setup and the rationale for using mobile social media tools in the first week of lecture. Students were also encouraged to ask questions during the tutorial sessions and on Twitter to seek clarification when required.
6	Provide technological support and model pedagogical use of the tools.	The mobile social media tools were introduced to the students on weekly basis during the tutorial sessions. The practitioners also discussed, modelled and shared examples of how the tools could be used for journalist practices.

Figure 2 provides an overview of the learning environment that was created for use in the course—guided by the design principles.

Iterative cycles of implementation and refinement

In the third phase of the study, the solution designed and developed in Phase 2 was iteratively implemented and evaluated in practice. The course was implemented two times over two years and data were collected during and at the end of each iteration. Several methods were used to collect the data in the study. This included an end of course student questionnaire, focus groups (three per iteration with 5-10 participants), interviews (8-10 per iteration) and student-generated data, such as social media content (Twitter, Vine, Vyclone), blog posts, videos and pictures. Similarly, data in the study were collected from the practitioners involved in the study. The researcher kept a log of any pedagogical and design issues arising in the weekly meetings, focus group (end of each iteration), and practitioner created artefacts shared with students as part of the learning and teaching process were also curated. The data collected at the end of each iteration were analysed to identify and improve the design of the course—changes were subsequently made before the implementation of the next cycle. The analysis of the data from both iterations also helped refine the draft design principles and informed the findings in the study.

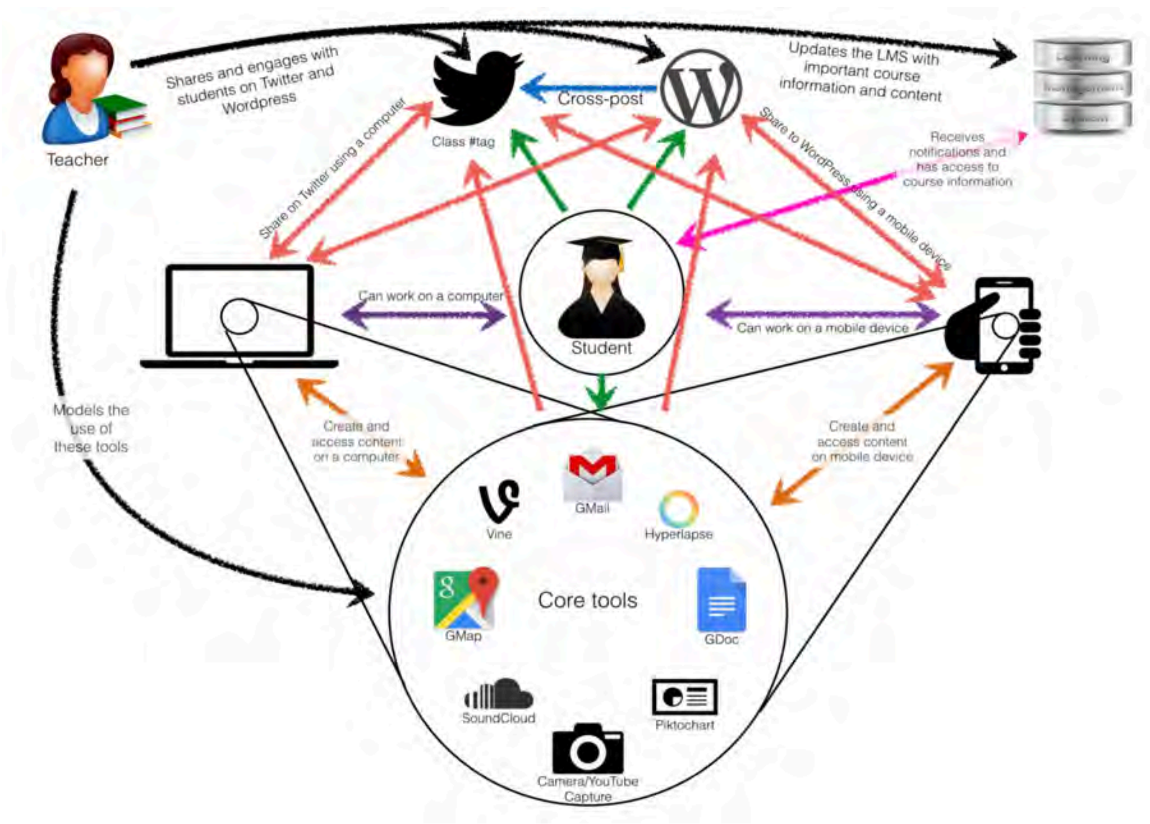

Figure 2: The design of the learning environment used to facilitate the course

Findings and design principles

In the final phase of a DBR study, the researcher reports the findings from the study and shares a set of refined design principles—informed by the findings and reflections on the entire process. The refined design principles are a significant output in DBR as it is capable of guiding other practitioners and learning designers in creating learning environments that help facilitate learning.

The findings related to each design principle helped the researcher answer the three secondary questions that guided the study. A summary of the findings (cf. Narayan, 2017) and the resulting design principles are discussed below.

Secondary question 1: *What are the pedagogical affordances of mobile and social media tools that enable the design and implementation of heutagogic learning?*

The findings from the study suggest several mobile and social media affordances helped operationalise the design principles that enabled heutagogical learning (learner-directed and determined learning), in particular:
1. the ability to share, communicate and collaborate
2. create and consume content
3. openness
4. the mobility, pervasiveness and connectivity of learner-owned mobile devices.

These categories of findings are discussed in more detail below.

The *ability to share and communicate* led to the formation of an organic learner-community that was shaped by the conversations between the learners and the learner and the teacher and the ideas and resources shared by them in the space. This increased the degree of interconnectedness between the learners and learner and the teacher and created new opportunities for collaboration between them. As a result, the learner gained autonomy over the type of support and scaffolding they needed and who best to receive it from—a critical step towards achieving self-directedness.

The *openness* of the social media tools further amplified when, how and who the learners are able to collaborate with. The open nature of social media tools allowed the students access and opportunity to seek and collaborate with other informed persons and subject experts beyond the bounds of the classroom and the learner-community, across time and geographical barriers to build knowledge and understanding—enabling self-determined learning. The lack of hierarchical structures in open social media platforms provided the students with the ability to create ad hoc communities, allowing them to build genuine connections and create a network with people and experts who were willing to participate, collaborate and inform their learning—redefining learning as participation *in* communities, to learning by creating communities *for* learning—helping the learner to be self-directed and determined.

The *mobility, pervasiveness, connectivity and the ability* to use social media tools on learner-owned mobile devices allowed the students to transcend the conceptual, physical and social spaces and temporal limitations. These mobile affordances acted as a *mobile studio* that allowed the students access to people, communities and learning resources, opportunity to weave thinking and learning across contexts and the ability to create authentic content by capturing data and information in meaningful spaces—enabling the students to apply the knowledge and skills in new surrounding that helped build capability, lifelong learning skills and informs the process of learning to become.

The students faced several challenges learning with mobile and social media tools in the course. In particular, learning how to use the tools and difficulty in conceptualising their role in relation to mobile and social media affordances. As a result, technological support and pedagogical modelling were critical for the students in heutagogic learning.

Secondary question 2: *How did the use of mobile and social media tools within a heutagogical framework enhance the learning and learner experience in an undergraduate journalism course?*

The specific pedagogical affordances of mobile and social media tools discussed above were found to have provided an enhanced learning experience for the students in the study—their impact on the learning and learning experience are discussed below.

Increased visibility as a trigger for higher cognitive processes

The social affordances of the mobile and social media tools such as the ability to share, communicate and collaborate effectively led to the creation of a learner community. The learner actions and interactions afforded by the tools and artefacts created and shared by the students in the public domain increased the visibility of their work to the peers and teachers in class and also to the general public. The increased visibility of students work to each other in the study was found to have caused cognitive conflicts within the learner that triggered higher cognitive processes in their learning. The findings revealed that because the students were able to see each other's work, they were able to learn from it. The students commented that the ability to learn from and with each other brought the best out of them in the learning process. The visibility of a student's own work and the work done by peers in class provided them with '*motivational competition*'. It motivated the students to complete the task to the best of their ability and share it with others. The students also commented that reading another student's work, triggered reflections and encouraged them to form connections with the literature and their own work and understanding.

Learner autonomy over the learning process

A central construct and an element that was enabled by the use of learner-owned mobile and social media tools in the study was learner empowerment and autonomy over the learning process. The tools enabled the learner the ability to direct and determine their own learning according to their learning needs and knowledge. The social media tools enabled learner autonomy within the processes of participation, personalisation and productivity. At the same time, the mobility of learner-owned devices enabled learner autonomy over where and when they could learn. The learners, as a result, were able to seek guidance and scaffolding for their learning, collaborate and participate with peers, teachers and experts as and when needed, determined by them and their learning requirement at the time. The students were also able to establish connections and networks to create communities where long-term support and scaffolding was needed for learning purposes. Similarly, the affordances also allowed the students to assume an active role in their learning by helping them transition from being consumers of information and knowledge to being creators of content and meaning through participation and personalisation. The affordances of the social media tools bundled with the mobility and connectivity of learner-owned mobile device also enabled the learners the ability to learn in and across contexts. This resulted in learning in formal and informal contexts—where the informal contexts (conceptual, physical and virtual) was purposefully selected by the students according to their learning needs. As a result, learner autonomy enabled by mobile and social media tools was observed to have acted as a critical component that wove the elements of participation, personalisation and productivity into a seamless act of learner-directed and determined learning that encouraged passion and provided motivation in the process. Autonomy provided the learners with an embodied learning experience that the students felt was ingrained as a part of their everyday life.

Context as a teacher

The mobility of the mobile device and the ability to use a variety of social media tools on it enabled the learner to participate and create contexts for learning purposes. The design of the course required the students to work and learn in real-world contexts that required them to gather and analyse data and information accessed online and gathered from social media tools. As a result, the learners participated in online communities, created communities to gather feedback and opinion, and at the same time interacted with entities and artefacts in the real-world contexts to elicit the details and information. The findings in the study revealed that the contexts the learners immersed in enabled them to explore journalism topics from multiple perspectives. It provided situations and events that required the students to step outside their comfort zone, thereby building confidence, and teaching tacit knowledge and skills. The learner-generated contexts also acted as a learning environment that the students could query, interact with and 'criss-cross' multiple times and as needed to create new knowledge and understanding. The contexts (conceptual, physical and virtual) allowed the students the ability to 'act', 'simulate' and 'experiment' with real-world journalistic practices that allowed them to implement and explore their ideas and theory that they were learning. The findings in the study also revealed that the learner's actions and interactions in authentic contexts enabled double loop learning—where the learning experience triggered learner actions and reflections that enabled them to reaffirm or build an understanding of who they are, their capability and weaknesses, beliefs and values.

From knowing to being

The learners' participation in and across communities and interactions and practices in the real world and authentic contexts were observed to have provided the students with a learning experience that scaffolded their learning from knowing the facts (knowledge) to learning the skills to being a journalist (becoming a professional). The conceptual, physical and virtual realm that the learners were constantly navigating and engaging with (including experts, journalists and digital artefacts) provided them with a platform to enact and perform journalistic tasks as a journalist would. The findings in the study revealed that these learning opportunities facilitated an ontological shift in the learner, where the learners apart from learning the principles of journalism (knowing) also learnt how to put them in practice as a journalist (learning to become).

Lifelong learning

The use of mobile and social media tools and learner autonomy over the learning process helped the students learn and build lifelong learning skills. The students in the study were constantly navigating the conceptual, physical and virtual realms seeking, generating, communicating and collaborating to create data and information, in order, to build their understanding. These processes helped the students build learning habits, skills and knowledge on learning how to learn (metacognition). According to the students, the learning processes in the study helped them gain digital fluency, capability, skills and knowledge that enhanced their communication skills. It also made them aware that learning can happen at any time and place and provided them with a framework, which they could build upon in the future.

Secondary question 3: *What is the role of the teacher in facilitating a heutagogical learning experience using mobile and social media tools in a course?*

The findings in the study revealed that the teachers played a versatile role in the process assuming the position required by the students or student according to the learning tasks and activities they were completing. The teachers in the study hence played the role of a guide in the learning process, sharer of knowledge and content to scaffold learning, collaborator, motivator, promoter, role model and a mediator (mediator of student learning by helping the learner navigate the learning contexts and processes to construct new meaning and understanding). The teachers also played specific roles in the learning process enabled by mobile and social media tools—discussed below.

Teachers to provide critical feedback

The teachers played a critical role in the learning process that was largely driven and determined by the learners, by collaborating with them, providing detailed and critical feedback, and mediating the learning tasks, activities and contexts—in a process that was *true-collaboration*. Teacher collaboration and feedback played an important role in scaffolding learner skills and knowledge for self-directed and determined learning. According to the students, the feedback from the teachers on their work enabled them to reflect on their performance and learning—helping them identify their capabilities and weaknesses, and providing pathways for improving.

Teachers as change agents

An important finding in the study was that the students had different expectations and conceptions of learning and how to use mobile and social media tools for learning. A majority of the students commented that they needed to be 'taught' how to use the tools for learning purposes. Similarly, it was also observed that a majority of the students expected to be told what to do in their learning and to be taught specific content and knowledge. As a result, a critical role for the teachers in the study was to help change students' learning expectations and behaviour, and help them re-conceptualise the role of mobile social media tools for learning.

The teachers in this study also played an important role of being the *brokering agent* for helping the learner navigate and move to higher-learning zones. In the study, the teachers played a critical role in scaffolding and guiding the students from their comfort-zones to a learning zone where they were able to apply their knowledge and skills with confidence in different contexts and environment—helping them build capability.

The secondary research questions and reflections on the entire process helped the researcher address the main research question: *How can mobile and social media tools enable student-generated content and context (heutagogy) for enhanced learning?*

To create a solution for the issues the journalism practitioners faced in teaching their course, draft design principles were formulated from literature—implemented and evaluated over two iterations. The findings from the study suggest that the design of the solution provided an effective platform for facilitating heutagogic learning with mobile and social media tools. Researcher reflections helped refine the initial design principles for clarity and understanding. Four of the six draft design principles were retained in their original form, one was revised and the other was deleted—resulting in five principles capable of guiding design for heutagogic learning:

1. **Design Principle 1.** Design learning tasks, activities and a learning environment that integrates the affordances on mobile social media and actively encourages student participation, productivity and personalisation
2. **Design Principle 2.** Facilitate learning using tools that are open, platform independent and learner-owned devices
3. **Design Principle 3.** Situate learning in authentic contexts determined by the learner to encourage exploration and experimentation
4. **Design Principle 4.** Design formative assessment events that encourage learner participation and reflection in authentic contexts to inform the process of learning to be
5. **Design Principle 5.** Provide technological support and model pedagogical use of the tools.

The findings from the study and researcher reflections helped understand the relationship between the design principles and how they impacted on the overall design of the solution, the learner and the learning process. The relationship between the principles and the model that emerged from studying their impact on the learning and teaching process, and the learner are discussed in more depth in a forthcoming publication (Narayan, Herrington & Cochrane, 2019).

Conclusion

This paper provides an overview of how a design-based research approach could be utilised to investigate, create and rigorously evaluate a research study in collaboration with practitioners in naturalistic settings. In particular, the paper reports on the findings from an empirical study that was undertaken in collaboration with a group of journalism lecturers interested in exploring an approach for embedding the use of mobile and social media tools in their course for enhanced learning outcomes. The paper discusses the design of the solution underpinned by draft design principles elicited from literature and reports how it impacted on the learner, learning and the learning process. Along with the findings, a refined set of design principles is shared capable of guiding other practitioners in designing for learning with mobile and social media tools.

As an exemplar, the study has demonstrated how design-based research can indeed help seek out the unseen and unimaginable mobile learning possibilities (cf. Santos & Cook, 2015) and grow our understanding, application and transferability of mobile social media (cf. Traxler, 2016) for learning through the production of refined design principles.

Further research

To understand the effectiveness and transferability of the design principles in different contexts, further research is currently being undertaken in collaboration with business, sport and recreation and physiotherapy practitioners.

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Struggle town? Developing profiles of student confusion in simulation-based learning environments

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A considerable amount of research on emotions and learning has been undertaken in recent years. Confusion has been noted as a particularly important emotion as it has the potential to trigger students' engagement in learning tasks. However, unresolved confusion may turn into frustration, boredom and ultimately disengagement. The study reported in this paper investigated whether learning analytics could be used to successfully determine indicators or patterns of interactions that may be associated with confusion in a simulation-based learning environment. The findings of the study indicated that when taken individually, measures on specific learning tasks only hint at when students are struggling, but when taken together these indicators present a pattern of student interactions or a student profile that could be indicative of confusion.

Keywords: simulation, learning analytics, confusion, predict-observe-explain, learning process

Introduction

Digital learning environments (DLE) are becoming pervasive in higher and tertiary education as they can offer scalable, economical educational activities for both teachers and students. While on the one hand simulation-based environments, depending on their design, can present students with exploratory and relatively unstructured learning experiences, there is a significant chance for students to become confused due to the absence of immediate guidance and feedback, either from the teachers or by the system (Pachman, Arguel, & Lockyer, 2015). Confusion is an epistemic emotion (Pekrun, 2010; Pekrun, Goetz, Titz, & Perry, 2002) – an emotion which arises when learning is taking place. Other epistemic emotions that may arise during the learning process include, surprise, delight, curiosity, as well as anxiety, frustration and boredom (Baker, D'Mello, Rodrigo, & Graesser, 2010; Calvo & D'Mello, 2010; D'Mello & Graesser, 2012). Understanding how students experience these emotions in DLEs is increasingly important for enhancing the design of these environments.

Prior research has shown that emotions play an important role in learning, motivation, development and memory (Ainley, Corrigan, & Richardson, 2005; Ashby, Isen, & Turken, 1999; Isen, 1999; Lewis & Haviland-Jones, 2004). Confusion is particularly important as it can arise in complex learning tasks that require students to make inferences, solve advanced problems, and demonstrate application and transfer of knowledge. Research has shown that in complex learning activities, confusion is 'unlikely to be avoided' (D'Mello, Lehman, Pekrun, & Graesser, 2014) and the resolution of confusion requires students to stop, think, reflect and review their misconceptions (D'Mello & Graesser, 2012). While confusion can be beneficial to learning, unresolved or prolonged confusion may leave a student feeling stuck and frustrated (Baker et al., 2010; Calvo & D'Mello, 2010). Such frustration can ultimately transition into boredom which can lead to students disengaging from the task (D'Mello & Graesser, 2012), a critical point which educators aim to prevent (D'Mello & Graesser, 2014b; Liu, Pataranutaporn, Ocumpaugh, & Baker, 2013). Thus, sustained unresolved confusion is detrimental to learning and has been associated with negative emotional oscillations (D'Mello & Graesser, 2014a; D'Mello & Graesser, 2012; D'Mello et al., 2014). D'Mello and Graesser dubbed the balance between creating 'useful' confusion for students and not making them too confused the 'zone of optimal confusion' (D'Mello & Graesser, 2014a).

While persistent confusion needs to be avoided, some learning designs aim to promote a degree of difficulty that is likely to result in confusion. These include teaching and learning frameworks such as problem-based learning

(Schmidt, 1983), device breakdown (D'Mello & Graesser, 2014b) and productive failure (Kapur, 2016). Another common learning design which can inherently promote confusion is the simulation-based, predict-observe-explain (POE) paradigm (White & Gunstone, 1992). POE is a three-sequence design where: (i) during the prediction phase students develop a hypothesis about a conceptual phenomenon, and state their reasons for supporting that hypothesis (ii) during the observe phase students explore an environment related to the conceptual phenomenon, view data, and see what 'actually' happens and finally, (iii) during the explain phase the ideas and concepts related to the phenomenon are explained and elaborated, and the reasoning about the conceptual phenomenon is provided to the students. It is likely that students in a POE environment may feel confused, particularly when there is a discrepancy between their current understanding (predictions) and what they find out (observations) while completing a simulation.

POE environments have mostly been used to investigate students' prior knowledge and misconception (Liew & Treagust, 1995) as well as to investigate the effectiveness of these environments in terms of peer learning opportunities (Kearney, 2004; Kearney, Treagust, Yeo, & Zadnik, 2001) and conceptual change (Tao & Gunstone, 1999). In our recent work (Kennedy & Lodge, 2016), a simulation-based environment was used to study students' self-reported emotional transitions. This study found that a POE based environment could help students overcome their initial misconceptions through feedback and scaffolding. The current study adds to this research by investigating whether learning analytics-based markers can be used to detect patterns of interactions that might suggest students are "struggling" or confused in a simulation-based POE environment.

The use of analytics in DLEs have been used for some time to investigate students' learning processes but have risen in prominence lately (Campbell, DeBlois, & Oblinger, 2007; Goldstein & Katz, 2005; Kennedy, 2004; Kennedy, Ioannou, Zhou, Bailey, & O'Leary, 2013; Kennedy & Judd, 2004, 2007) . The use of analytics to understand emotions in DLEs has received less attention in the literature (Lee, Rodrigo, d Baker, Sugay, & Coronel, 2011; Liu et al., 2013). Measuring or detecting emotions such as confusion is inherently difficult because, as an emotion, confusion can be relatively short-lived (D'Mello & Graesser, 2014a), unlike some of the emotions which sustain over a longer period (e.g. boredom; see (D'Mello et al., 2014)). Detecting confusion in naturalistic learning environments is also challenging as these environments restrict the way data can be collected, particularly in comparison to lab-based environments where sensors, physiological trackers, emote-aloud protocols, video recordings and many other data collection tools and techniques can be used (D'Mello & Graesser, 2014a). Moreover, relying solely on self-report measures of confusion can be 'insensitive' (D'Mello et al., 2014) and problematic due to 'intentional' misreporting (Komar, Brown, Komar, & Robie, 2008; Tett, Freund, Christiansen, Fox, & Coaster, 2012) which the students might do to avoid social pressure (Kennedy & Lodge, 2016). Therefore, the aim of this study was to investigate whether learning analytics could be successfully used to determine indicators of or patterns of interactions that may be associated with confusion in a POE, simulation-based learning environment.

Habitable Worlds

The DLE used in this research is called *Habitable Worlds* – an introductory science class that covers foundational concepts in biology, physics and chemistry (Horodyskyj et al., 2018). *Habitable Worlds* is a project-based **course** that encourages students to solve problems using logic and reasoning and promotes students' engagement using interactive tasks. The course is built using Smart Sparrow – an adaptive eLearning platform, which makes it possible to track students' learning activities and interactions. *Habitable Worlds* consists of 67 interactive **modules**, several of which are based on the POE protocol. *Stellar Lifecycles* is one of the first POE modules in the course and it was a primary focus in this study. In this module, several **tasks** were embedded that spanned 23 screens. A task in this context refers to a number of activities students are asked to complete on any given screen. These activities may include free-text answers to a question, watching videos, completion of a multiple-choice questions, or the "submissions" associated with interacting with simulations. For this paper, students learning interactions at the module and task level were analysed.

Students were asked to engage in a series of learning activities, the primary sequence of which is provided below.

- View an explanatory video about different objects in our universe and how they differ in sizes.
- Students then need to select a hypothesis about what they think the relationship between stellar lifespan and stellar mass is from five possible choices (i.e. make a prediction) and also report through free-text their reasons for selecting their hypothesis. Notably, students are not provided with any content relating to this question prior to this.
- Students next use a simulator to explore, and hopefully develop an understanding of, the relationship between stellar lifespan with stellar mass. Students use the simulator to create and manipulate virtual

stars, so they can observe the mass and the relative lifespans of stars. They can use the simulator as many times as they wish and each "run" of the simulation is recorded as a submission.
- After becoming familiar with the simulator, students are asked to engage with two more complex tasks: creating virtual stars of a given mass range and reporting on the lifespan of these stars. Again, students can use the simulator as many times as they wish and each run of the simulation is recorded as submission. After completing the simulation and associated questions students are then prompted to either accept or reject their earlier proposed hypothesis.
- The follow up task, which is only available to those students who had predicted an incorrect hypothesis and endorsed this prediction, asks students to update their hypotheses. Students cannot complete this screen without selecting the correct hypothesis; in effect the program narrows all options until the student chooses the correct one.
- Towards the end of the sequence of activities students are asked to watch a video that provides them with a complete explanation of the relationship between stellar lifespan and mass. On this screen each student's first proposed hypothesis is reproduced, as is the correct hypothesis and estimates of stellar lifespans for the various star classes.
- The final set of screens asks students to create and burn different virtual stars. These tasks require students to make observations on the *HertzSprung-Russell* diagram, which shows the changes in a star's colour, luminosity, temperature and classification. Students are asked to make decisions and selections about the stages through which stars go as they age.

It is important to note that the program was "adaptive"; which in this context generally meant the program provided students with feedback and hints on their responses (or lack of response). It also typically meant that students were not allowed to progress or move on until a task had successfully been completed.

Methodology

A total of 364 science undergraduate students from a large US-based university attempted *Stellar Lifecycles* as part of their undergraduate study. Over 15,000 interaction entries were recorded within the digital learning environment and these interactions formed the basis of the data collected for study. A range of measures were used, based on analytics recorded from the system, to develop patterns of interaction with the system. The measures used in the analyses are presented in detail in the results section but included measures such as time on task, attempts at tasks, accuracy of attempts at tasks, and content analyses of free-text responses. The analysis presented in the Results section used an iterative analytics approach consistent with that proposed by Kennedy and Judd (Kennedy & Judd, 2004).

Results and discussion

Module level patterns
Data analysis began with pre-processing and outlier elimination, which involved removing all individual measures that were outside five standard deviations from the median. An initial cluster analysis was undertaken at the *Stellar Lifecycles* ***Module*** level to determine students' general engagement patterns. Variables included in this cluster analysis were mean module score, mean module completions, mean attempts on module tasks, and mean time on module. A three-cluster solution was the clearest description of the data. However, it was clear that the third cluster, which contained only 22 students, were those students who had very low mean module scores, task attempts across the module, and mean time on the module. These students did not complete the module – they exited the module at the halfway point – and as a result they were removed from further analyses. The profiles of the remaining two clusters are presented in Table 1.

Table 1: Learners' overall engagement patterns in Stellar Lifecycles.

	Cluster 1 (n =212)		Cluster 2 (n=130)			
	Mean	SD	Mean	SD	T	p
Module scores	11.99	0.15	12	0	-1	0.32
Module task completions	0.9	0.04	0.8	0.04	20.03	<.001
Attempts at module tasks	16.7	3.8	29.4	8.83	-15.99	<.001
Time on module (mins)	140.13	163.56	258.63	644.61	-2.05	0.04

Table 1 shows that both clusters of students achieved the maximum score for the module, completing all the required tasks. However, students in Cluster 1 had a significantly higher number of task completions compared to students in Cluster 2 and students in Cluster 2 had significantly more task attempts and spent longer on module tasks. So, while students in both clusters were achieving the same end, they seemed to follow different processes getting there. This high-level data could be interpreted in many ways. One could be that students in Cluster 2 could be diligent and dedicated students who spent more time and had more attempts at tasks in the module, leading to success that was commensurate with those from Cluster 1 who seemed, for whatever reason, to arrive at the same end point “more easily”. Alternatively, students in Cluster 2 could have struggled more and have been more confused about their engagement with the module and its content compared to those in Cluster 1; and this struggle and confusion was manifest in their behavioural data, notably more attempts at tasks and taking longer to complete tasks.

We used this second working hypothesis to frame subsequent analyses. That is, we were keen to see whether other learning analytics-based markers at both the module and the task or screen level could help to further discriminate and characterise the two groups of students that had emerged from the cluster analysis at the module level.

Response time to module tasks
The next set of analyses concentrated on the average time students were taking to complete tasks presented to them across the module. To undertake this analysis students’ responses to tasks across all the screens of *Stellar Lifecycles* were analysed. The mean time students took to make each task attempt is presented in Figure 1. Figure 1 shows the number of attempts on the X axis (some students made as many as 10 attempts) and the mean time taken to make each attempt on the Y axis. It can be seen that students in both Cluster 1 and Cluster 2 were, on average, slower when making their first attempt at a task compared to their subsequent responses. It is also clear that Cluster 1 students were initially responding more quickly to tasks than Cluster 2 students. There may be a number of reasons for this: students in Cluster 1 may be more confident, and/or have higher prior knowledge than those in Cluster 2; conversely students in Cluster 2 may be more careful and/or more unsure or more confused about their response to the tasks. What is also noticeable from Figure 1 is that there is a general reduction in response time across attempts for Cluster 1 students, and there are clear spikes of response time for Cluster 2 students (attempt 4 and attempt 7). This may also be indicative of Cluster 2 students being more uncertain or confused about what their response to the task should be.

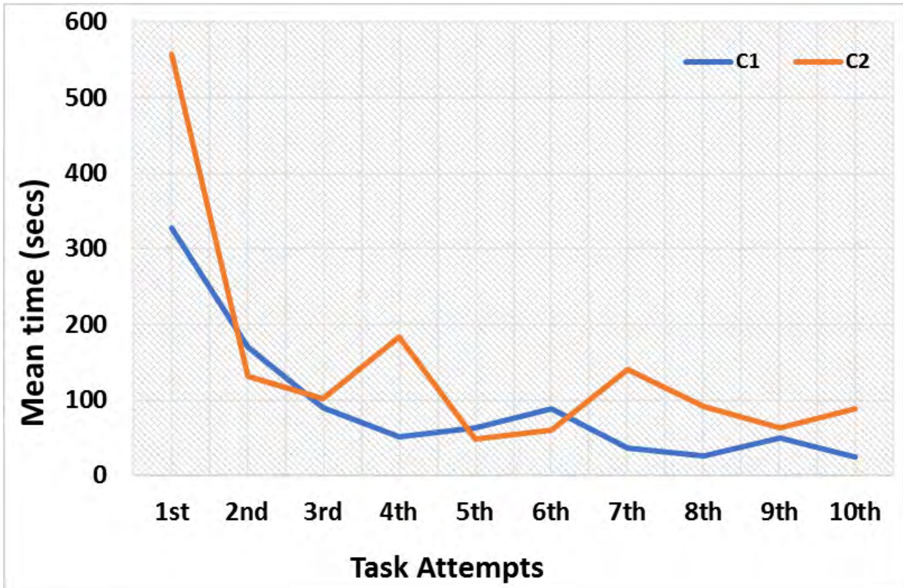

Figure 1: Analysis of mean response time per task attempt.

Task level patterns
The next set of analyses considered students’ interactions at the screen or task level rather than the module level.

Students’ initial predictions
The next set of analyses examined the nature of hypothesis being selected by students in the *Predict* phase of the module. Overall, it can be seen that there were no differences between the two clusters on their hypothesis

selections. Approximately two-thirds of students, regardless of cluster, chose an incorrect hypothesis. We anticipated that many students would have a common misconception about the relationship between the size of a star and its lifespan (i.e. they would intuitively believe bigger stars live longer). The results from Table 2 indicate this to be the case with large numbers of students in both clusters endorsing this lure (Cluster 1 = 42%, Cluster 2 = 49%). These results suggest that groups had similar levels of prior knowledge before beginning the simulation-based POE task, and many held a common misconception.

Table 2: Students' hypotheses during the *Prediction* phase (by cluster).

	Cluster 1	Cluster 2		
	N (%)	N (%)	T	p
Correct hypothesis	72 (34.0%)	41(31.5%)	0.46	0.65
Incorrect hypothesis	137 (64.6%)	87 (66.9%)	-0.46	0.65
Endorsing common misconception hypothesis	89 (42.0%)	64 (49.2%)	-1.32	0.19
Endorsing other misconception hypotheses	48 (22.9%)	23 (18.0%)	1.11	0.27

Students' detailed prediction behaviours

Next, a more detailed set of analyses considered students' responses to the prediction phase of the module. It can be seen from Table 3, that on average Cluster 1 students were spending a little over two and a half minutes on this screen, while Cluster 2 students were spending on average over 11 minutes. While not statistically different (most likely due to the high standard deviation for Cluster 2 students) this seems to represent a clear qualitative difference between the two groups. It can also be seen from Table 3 that when students were making their prediction about the relationship between stellar lifespan and stellar mass, students in Cluster 2 were making significantly more attempts at the hypothesis selection than students in Cluster 1. The most common reason was that the length of students' text response used to justify their hypothesis was too short and they were asked to resubmit it. This interpretation is consistent with number of words written overall, as the mean word count for Cluster 2 students was significantly lower than Cluster 1 students. Finally, when both the clusters were compared in terms of unique words per person, Cluster 1 students used more unique words per person.

Table 3: Students' engagement patterns during the *Prediction* phase (by cluster).

	Cluster 1		Cluster 2			
	Mean	SD	Mean	SD	T	p
Time (secs)	141.75	277.52	669.89	6114.57	-1.04	0.30
Attempts	1.06	0.25	1.13	0.36	-1.94	0.05
Word count	16.19	11.15	12.77	10.03	-3.78	0.001
Unique words (per student)	14.35	9.00	11.5	7.48	3.14	0.001

As described above, after students had made an initial hypothesis selection they were asked to justify why they believed their hypotheses to be true in a free-text response. Stop word elimination (i.e. eliminating words like "a" "it" 'the" "is") was completed for all student text responses and the primary keywords for each cluster were then determined through a content analysis. In order to compare the rank and relative frequency of keywords across clusters, the percentage of times these words appeared in each cluster were calculated. **Error! Reference source not found.** presents a bubble plot where the words are arranged in descending rank order of frequency. Such frequency-based analyses have been used in various other disciplines (Nawaz & Strobel, 2016; Nawaz, Usman, & Strobel, 2013).

Content analysis of students' justification of their prediction

Error! Reference source not found. shows clear similarity between the words used by Cluster 1 and 2 students to justify their hypotheses. For example, words such as "*star*", "*mass*", "*energy*" and "*long*" are the highest ranked and most frequently used words by students in both clusters. Beyond this, there are some differences between students in each cluster. While it is important not to overstate these differences, they are useful to note as a profile of students' interaction and engagement is established across the module.

First, while both Cluster 1 and Cluster 2 students use the word "*guess**", it is used more slightly more frequently by Cluster 2 students (1.38% of all words) than for Cluster 1 (0.84%). We assume the presence of the word "*guess*" means that some of the students in these clusters were unsure of their hypothesis or perhaps they were uncertain of why that hypothesis holds. In support of this conclusion the word "*guess**" consistently co-occurs with "*just*" and an analysis of raw text commonly revealed phrases such as "it's just a guess", "seems to make sense but it was just a guess", and "not sure, this is just a guess". The analysis also considered the occurrence of technical terms in students' responses so that a judgement could be made about the quality or clarity of students responses (DeGroff, 1987). While Cluster 1 students used a number of key terms (such as "*fusion*", "*fused*", "*hot*", "*sustain*", "*bright*") these words were largely absent from the word profiles of Cluster 2 students. Interestingly, these words also appeared in the lecture material explaining the relation between stellar mass and its lifespan. The use of such terms by Cluster 1 students could be indicative of more understanding or content awareness of these students.

The content of students' text-based responses suggests that while the most common words are similar across clusters, there tend to be differences thereafter. Compared to students from Cluster 1, Cluster 2 students tend use the word "guess" slightly more and tend to use technical terms slightly less.

Observation of events and change in hypothesis

The *Observe* phase provided a basic introduction to the stellar simulator and guided students on how to create and run stars of varying solar mass. The second part of this phase required students to create stars of specific mass range and then report on the associated lifespans. While several students found this difficult – entering their observed data – the adaptive feedback ensured that all students eventually entered the data correctly. The interaction patterns for this task, recorded via analytics, showed that students in Cluster 2 spent significantly less time on this task (Cluster 2: $M = 148.52$ (149.10); Cluster 1: $M = 252.34$ (477.11); $T(309) = 3.21$; $p < .001$) but made more attempts at the task before completing it (Cluster 2: $M = 1.58$ (1.18); Cluster 1: $M = 1.34$ (1.26); $T(406) = -2.04$; $p < .05$). This is difficult to interpret with confidence but could suggest that Cluster 1 students took a more considered approach to this task, particularly given students in Cluster 2 completed the task more quickly with more errors (which may be indicative of rapid trial and error behaviour).

Once the values were correctly recorded, students were then asked to report whether they would like to accept or reject their earlier proposed hypotheses. **Error! Reference source not found.** shows the percentage of students in each cluster who maintained or rejected their initial correct or incorrect hypotheses. While Cluster 1 students were more likely to maintain a correct hypothesis and to reject an incorrect hypothesis, there was a small fraction in both clusters who did not respond to this question on their first attempts.

While **Error! Reference source not found.** showed the percentage of students who rejected their incorrect hypotheses, it will also be useful to consider the new hypotheses proposed by these students and whether students subsequently proposed a correct hypothesis. We found that all students in Cluster 1 who had first proposed an incorrect hypothesis revised this so that it was subsequently correct. A large proportion of Cluster 2 students also did this, but it is worth noting that despite the program effectively directing them – using adaptive feedback – to the relationship between stellar size and lifespans, six students from the Second Cluster (6.7% of those who proposed an incorrect hypothesis) revised their hypothesis so that it still was incorrect.

Mean explanation errors

Toward the end of the module students were provided with an explanation of the concepts they were learning about in the module. Part of this section of the module asked students to complete a task that would demonstrate their understanding of the minimum and maximum lifespans of seven different classes or types of stars. In completing the task, a total of 14 different values needed to be entered and students could submit responses as many times as they wanted. Each time a response set was submitted students received adaptive feedback which guided them and helped them complete the task. If students did not enter any values this would result in the maximum number of errors for the task being recorded (reflected in a score of 7).

As students spent more time with the task and entered more responses, the number of errors would diminish (i.e. students would change their incorrect responses). It was expected that after a series of attempts students would gradually reduce their number of errors so that eventually there would be no incorrect responses.

The mean explanation errors for students in Cluster 1 and Cluster 2, at successive task attempts, are presented in Figure 2. Students in both clusters gradually reduced their errors over time. It can also be seen that students in Cluster 1 started with fewer errors than the students in Cluster 2. Moreover, it is clear that students in Cluster 1 reached a resolution to the task in fewer attempts than students in Cluster 2.

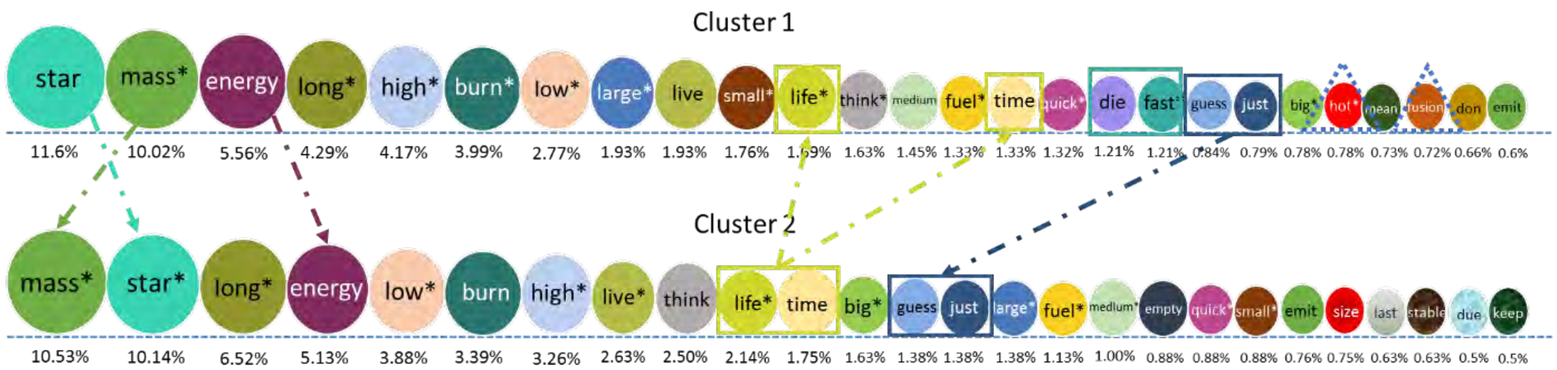

Figure 2: Keyword analysis for assessing students' text response for hypothesis justification.

Table 4: Maintenance and rejection of students' initial hypotheses during the *Observation* phase (by cluster).

	Cluster 1	Cluster 2
Initial correct hypothesis *maintained* (1st attempt)	70 (97.2%)	36 (87.8%)
Initial incorrect hypothesis *maintained* (1st attempt)	1 (0.7%)	8 (9.2%)
Initial correct hypothesis *rejected* (1st attempt)	2 (2.8%)	2 (4.9%)
Initial incorrect hypothesis *rejected* (1st attempts)	134 (97.8%)	78 (89.6%)
Initial correct hypothesis *untested* (1st attempts)	0 (0.0%)	3 (7.3%)
Initial incorrect hypothesis *untested* (1st attempts)	2 (1.5%)	1 (1.2%)

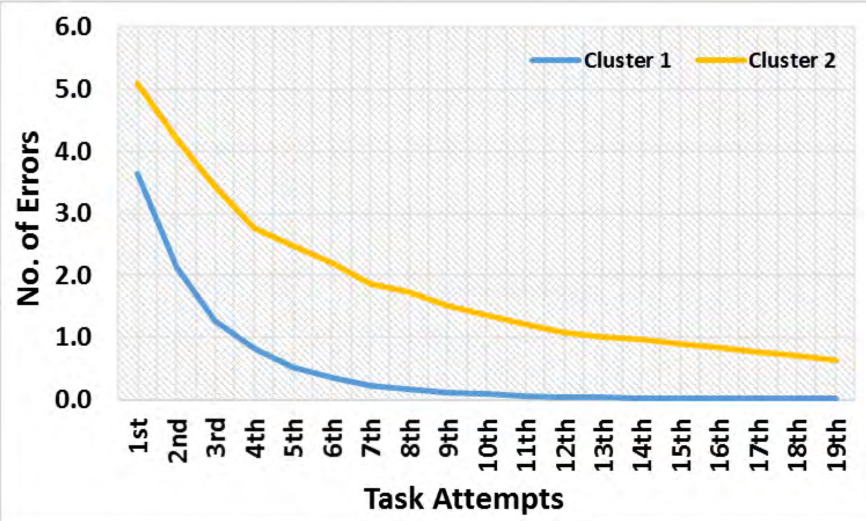

Figure 2: The number of student errors in the explanation task by task attempts

A final task in this section of the module asked students to make careful observations of how, when a star dies, it changes in luminosity, temperature and stellar classification. The tasks spanned three screen and on each screen the students needed to create and run stars of different stellar classes (types) and mass. For example, students might be asked to create a “red dwarf” with a solar mass between 0.08 and 0.49. Students were asked to indicate which of the four stellar class(es) the star went through as it aged (i.e. Giant Star, Super-Giant, White Dwarf and Supernova). The data from students’ interactions indicated that on 103 occasions, no response was provided by the students on submission. When analysed by cluster, it was clear that students in Cluster 2 were significantly more likely not to provide a response to this final activity compared to students in Cluster 1 (Cluster 2: 22.3%; Cluster 1: 7.1%).

Students’ conceptual understanding

The final set of analyses considered whether there were differences between clusters of students when it came to their conceptual understanding of the content of the module. While students’ initial hypotheses suggest that the two student clusters came into the module with more or less similar understanding (and misconceptions) about the relationship between star size and lifespan, we were keen to assess students' understanding at the end of the module. Conceptual understanding was assessed using a complex transfer task that was presented to students in a separate module of *Stellar Lifecyles* called *Stellar Applications*. In this task, students were asked to calculate the properties of six stars (properties such as luminosity, temperature, and mass) and identify the longest-lived and shortest-lived star. A total of 10 points were available for completely correct answers and students could complete the task multiple times but were penalised for incorrect attempts. A T-test that compared students’ scores on this measure of conceptual understanding indicated that students in Cluster 1 ($M=7.54$; $SD = 3.18$) showed greater understanding than students in Cluster 2 ($M = 6.61$; $SD = 3.67$) ($T(310) = 2.35$; $p <.01$).

Conclusion

The first empirical finding presented in this paper was that a module-level cluster analysis revealed two distinct groups of students who, broadly speaking, completed a simulation-based learning task in different ways. While both groups were successful – in part because the adaptive nature of the program ensured it – the learning process they went through to achieve this success seemed to differ on generalised metrics. Further analyses of students’ completion of all tasks in the module and their screen-based interactions showed a number of other differences between clusters. When viewed discretely many of these screen-based differences were only modest. However, when viewed collectively or in aggregate, these discrete screen-based differences revealed patterns of interaction that allow students from the two clusters to be distinguished and potentially characterised.

Overall, Cluster 1 students tended to respond to tasks more quickly, arrive at their hypothesis more quickly and tended to write more and more technically about it. Students in Cluster 1 spent more time observing the data from the simulation and made less errors in their observations. In contrast, students in Cluster 2 tended to take more time to respond to tasks, took more time to arrive at a hypothesis, and when they did, they seemed more unsure of it. They spent less time observing the outcomes of the simulation presented and they made more errors than those students in Cluster 1. While many students in both clusters rejected an initial incorrect hypothesis, students in Cluster 2 seemed less likely to do this. When it came to the final explanation of the phenomenon, students in Cluster 1 made fewer errors from the start and corrected their errors more quickly. Those in Cluster 2 started with significantly more errors and took longer to correct them, even with the adaptive feedback and support provided by the program. Finally, students in Cluster 1 understood the material covered significantly more than those in Cluster 2. It seems unlikely that these differences in the learning interactions and learning process can be attributed to students in Cluster 1 having greater prior knowledge as both groups made similarly poor predictions at the start of the task and had similar levels of misconception.

What the patterns of interactions do suggest is that students in Cluster 2, for whatever reason, struggled with what was being asked of them in the module. They seemed to find learning more difficult as a process – as measured by analytics markers of their various interactions with different tasks – and this was reflected in their learning outcome. These signs of "struggle" could also be interpreted as signs of confusion. While the pattern of interactions observed for Cluster 2 students – taking a long time to respond to tasks, not being able to quickly correct errors, finding it hard to explain responses – could be attributed to disengagement, we contend that this pattern could as easily be consistent with the profile of a student who is confused and struggling with the learning content and task. But it is, of course, not possible to be definitive about this, based on a single study.

The next steps in this program of research will be to consider the ways in which learning analytics may be used to generate markers of specific moments of student confusion in simulation-based POE environments. That is, it is likely that students would experience confusion when they realise there is a mismatch between their initial prediction or hypothesis and what they then observe in a simulation-based environment. The findings about students' general patterns of interactions presented in this paper – indicating that some students are struggling while others struggle less – provide an excellent context for these more detailed analyses.

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Re-thinking LMS change: Designing authentic learning environments to improve lecturers' digital literacy

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This paper reports on a qualitative evaluation of the first phase of an iterative, university-wide process of transitioning all units of study into a new Learning Management System (LMS). Lecturers in charge of the first group of units undergoing transition were interviewed, the goal of this being for their experiences of the process to inform its next stages, which would involve larger unit cohorts. The change process was designed with the principles of the authentic learning environment at its core and had academic professional development in digital literacy built in into its design, in hopes of enabling sustainable and scalable teaching transformation. The evaluation sought to ascertain how lecturers experienced the process of LMS change in the context of their teaching. Recommendations are offered pertaining to the change process design elements that promise to enhance lecturers' digital literacy and inspire teaching transformation.

Introduction

Timely upgrades and even complete renewals of LMS are necessary to keep these systems up to date, ensuring a consistently high-quality experience for all users. University-wide technology change, however, is a complicated endeavour. It needs to be approached with utmost care, and involve long-term planning and robust stakeholder consultation. This is especially important, considering there are reported instances of lecturers developing a problematic relationship with educational technologies and with wider technological change and innovation discourses (Blin & Munro, 2008; Liu & Pechenkina, 2017; Lokuge Dona, Gregory, & Pechenkina, 2017; Mahdizadeh, Biemans, & Mulder, 2008). These and other studies highlight how lecturers may, at best, be sceptical of various educational technologies and use them begrudgingly or be openly hostile toward them at worst. However, educational technologies and constant technological change are unavoidable aspects of academic experience today. Therefore, it is important to understand what works well and what does not work when a university engages in a large-scale change process involving such widespread technological platforms as LMS. Addressing the conference's sub-theme of "Improving Digital Literacy", this paper takes a reflective look at an institution-wide educational technology change process taking place in a mid-range Australian university.

Guided by the authentic learning environment principles (A. Herrington & Herrington, 2006), the first phase of the LMS change process described in this paper involved engaging a small group of university lecturers in a pilot, which comprised a series of training activities contextualised within the lecturers' teaching needs, and responsive to their experiences and expectations. The pilot brought together learning designers, educational technologists and technical transition officers to guide the participating lecturers in learning the functionalities and teaching affordances of the new LMS. The purpose of this pilot's evaluation was twofold. Firstly, as the process was iterative, it was tasked with identifying the effective elements, as well as drawbacks, of the change process before embarking on its next phases involving bigger unit cohorts. Secondly, it endeavoured to measure whether the process served as a catalyst for teaching transformation, and if yes, what forms did this transformation take. By placing the authentic learning principles at the core of this LMS change process, a special kind of professional development environment was created for the participating lecturers, ensuring their engagement in all stages of the process.

LMS and user experience

Used throughout universities to enable online and blended teaching and learning, LMS are also widely utilised as digital repositories of learning materials as well as interactive platforms, where self-regulated learning, assessment and collaborations can occur (Garrote & Pettersson, 2007). Despite LMS being widespread, some lecturers may not engage with these systems fully due to lack of time, insufficient training and support and other factors (Garrote & Pettersson, 2007; Lyall et al., 2017; Masterman, 2017). Moreover, lecturers may not want to engage with educational technologies as a whole, LMS included, for various reasons (Blin & Munro, 2008; Liu & Pechenkina, 2017; Lokuge Dona et al., 2017; Mahdizadeh et al., 2008). However, the use of educational technologies is an unavoidable part of contemporary academic experience. Because of that, there is a need to engage, train and prepare lecturers to embrace LMS capabilities fully.

Among the obstacles to lecturers' engagement with LMS is lecturers' perception of the "[required] initial amount of work compared with the expected benefits" (Garrote & Pettersson, 2007, p. 327), suggesting a pragmatic attitude lecturers may exhibit in regards to time they think is required to learn how to use LMS. This attitude persists even if lectures are overall optimistic about LMS benefits to teaching and learning. As Lyall et al. (2017, p. 304) finds, the LMS becomes "a site of tension that is not easily resolved" because a multitude of users, agendas and functions collide within an LMS, at times leading to confusions. Any inconsistencies in how lecturers use LMS may lead to dissatisfaction among students (Masterman, 2017). Developing such resources as minimum standards, best practice guidelines, and templates can be a solution, but sustainability of such approaches remains an ongoing concern (Masterman, 2017).

To help lecturers thrive during a major university-wide educational technology change, such as LMS renewal and replacement, Westberry, McNaughton, Billot, and Gaeta (2015, p. 101) argue that lecturers "need a clearly communicated plan that provides scaffolding through the transitional stages", while Zanjani, Edwards, Nykvist, and Geva (2016) urge to take into account lecturers' teaching preferences and habits when designing LMS training. The latter is especially important because even when lecturers' perceptions of LMS are positive, the lack of appropriate and ongoing training may negatively affect their acceptance and usage of the system's more advanced features (Coleman & Mtshazi, 2017).

Therefore, creating a productive learning space in which tailored and timely professional development supports lecturers through LMS change is important. Authentic learning principles emerge as a relevant framework to the change process's design and implementation of digital literacy for lecturers, as argued next.

Authentic learning and professional development for lecturers

The LMS change process described in this article was informed by the core elements of the university's new future student experience, which positions support for teaching staff as a principle underscoring all other organisational change. In practice, this entailed the change process be positioned as an opportunity for teaching enhancement, rather than simply a technical 'lift and shift' exercise. To provide an evidence-based rationale for the change process, authentic learning environment principles were drawn on when structuring the various stages of the process and designing learning activities for participating lecturers.

Defined by "real-problem contexts", authentic learning occurs in "real-life settings" and draws on "situated learning approaches" and similar pedagogies, with dynamic collaborations and experiential experiences at its core (A. Herrington & Herrington, 2006, p. 3). As proposed by J. Herrington and Oliver (2000), key characteristics of authentic learning include:

- Learning context reflects real-life knowledge
- Learners are given access to expert performances and exemplars
- Learning design allows learners to experience multiple perspectives on the same issue/problem
- Knowledge is constructed in collaboration
- Opportunities for reflection are built into the learning process
- Learners are empowered to articulate their knowledge
- There are opportunities for coaching and scaffolding
- All evaluation and assessment is seamless and aligned with learning activities

A subfield of scholarly literature focussing on the effective design of professional development for lecturers indicates that flexibility, customisation options and the relevance of the learning experience to lecturers' teaching needs have been instrumental to the successes of initiatives designed to upskill academic teaching workforce (Salmon, Gregory, Lokuge Dona, & Ross, 2015; Salmon, Pechenkina, Chase, & Ross, 2016). Given that the entire group of learners in the presented pilot were university lecturers, their unique expectations and needs had to be considered when designing an authentic environment for them.

At the same time, research into lecturers' experiences with university-wide change initiatives, specifically those involving educational technologies, showed that a change process can provoke resistance and even resentment in lecturers (Kehoe, Schofield, Branigan, & Wilmore, 2018; Liu & Pechenkina, 2017; Parker, 2014). What such studies have in common is the overarching narrative of lecturers' academic agency under threat, arguing that lecturers may feel anxious and disenfranchised when experiencing change if the process is perceived as stripping them of control and encroaching on their agency. Specifically, if lecturers feel their teaching or other important aspects of their professional identity are threatened by the change, they are likely to react negatively.

To assuage the concerns outlined above, authentic learning principles were used to inform the LMS change initiative at our institution. As authentic learning scholars advocate (A. Herrington & Herrington, 2006; J. Herrington & Oliver, 2000), when contextualised as an all-embracing, purposeful environment, authentic learning initiatives can be motivating and empowering for learners. To achieve such positive outcomes, lecturers partaking in the pilot were invited into the process as stakeholders as well as learners, meaning their experiences and concerns were considered and used to inform the change process in a cyclical manner. In addition to expert guidance and personalised support from learning designers, participating lecturers were provided with authentic exemplars, such as online unit templates and various self-guided online training and how-to resources. Lecturers' experiences with implementing these templates and using the available resources to upskill themselves in turn informed the next iterations of these elements, shaping the final artefacts based on real-life experiences and needs.

This article argues that creating an authentic learning environment for lecturers' digital literacy development can lead to teaching transformation as it allows lecturers to use the LMS change process to reflect on their teaching and consider areas of improvement. While various challenges occurring during the pilot phrase of the change process are outlined, ultimately findings show that in order to implement a large-scale institutional upskilling in staff digital literacy in a way that empowers lecturers to engage in self-directed learning and discovery and serves as a catalyst for meaningful teaching practice transformation, all aspects of the process need to be designed as authentic learning tasks for adult learners.

The Study

Nine higher education lecturers participated in the new LMS pilot in 2017. All participants were unit convenors and allocated 60 hours under the academic workload model to partake in the process, freeing up some of their time to allow them to engage. Sessional/casual lecturers who were involved in teaching these units were also allocated 10 hours each, but only convenors were interviewed for this evaluation. The primary criterion for unit selection for the LMS pilot was the expected cohort size: units attracting smaller student cohorts were deemed less likely to experience disruption to learning and student attainment during the transition process. The units were either to be transferred from the old LMS into the new one or built in the new LMS from scratch. All lecturers took part in this process as stakeholders as well as learners, where the functionalities of the new LMS were concerned. The study received ethical clearance from the university ethics committee, and followed the agreed protocols. At the conclusion of the pilot, 8/9 of participating lecturers agreed to partake in an evaluation interview. Of these 8, 7 were male and one was a woman. No other demographics about participating lecturers were collected due to the small size of this pilot cohort and the study's specialised scope. Interview schedule was semi-structured as the focus was on lecturers' in-depth experiences with the change process and the new LMS. The interviewer guided the process by engaging in a conversation with each lecturer and directing the narrative along four main topics of inquiry: lecturers' expectations of the transition experience and its desired outcomes; lecturers' instructional design philosophy concerned with the usage of LMS; challenges associated with the LMS change process; and professional development that lecturers deemed crucial to the LMS change success. Lecturers, however, were free to diverge from these topics and discuss what was of importance to them, as long as it was of relevance to the LMS change process. The resultant narratives were anonymised and referred to by a code (e.g. I1, I2, etc.). Thematic analysis performed with NVivo software allowed the researchers to dwell deep into convenor experiences, with two particular themes emerging as being of special significance, namely convenors' expectations versus actual experiences of the process, and how convenors' usage of the LMS for teaching transformed as a result of the change process. Both of these findings were directly related to the use of authentic learning environments to upskill in digital literacy.

Lecturer experiences of the LMS change

Expectations
Three aspects of the LMS change process featured prominently in interviews with lecturers, namely: the process itself; the new LMS and its features and capabilities; and, lastly, teaching and its transformation in relation to the LMS. For six out of eight of lecturers interviewed, at least two of these expectations overlapped.

Expectations concerned with the change process itself were the most commonly articulated, with all lecturers reporting at least one expectation pertaining to the process of change. Firstly, these expectations were concerned with the time and effort lecturers were expected to put in as part of their participation; secondly, with complexity of the change process; and, thirdly, with their unit's suitability for the pilot.

Only two lecturers (I3, I5) reported having no specific expectations about the change process, entering the pilot with an open mind. I3 said, "I wasn't really sure of what to expect coming in, but… it was quite flexible", while I5 noted, "I didn't [know] what the change would be, how long it would take and what the [new LMS] platform would look like." Two other lecturers reported expectations primarily concerned with time and effort required from pilot participants, while further two admitted they expected a simpler and more streamlined process. For instance, I1 "originally… believed it would take a lot of time [and] training", imagining "learning a new LMS" would be "time-consuming".

For I7 and I8, who expected the process to be less complex, the pilot was not a positive experience. I8, who expected the transition to be a "simple task", said there was "too many emails, too many communications", leaving them overwhelmed; while I7 did not expect to have to be involved in numerous decision-making activities: "We kept being given information we really didn't need. Like the technical side of it – academics don't need to know that." Reiterating this pragmatism, I7 specified: "What we need is… to be able to know how to put our stuff in, how to link stuff, how to email students, how to make an announcement, how to use the discussion board feature… Just the basic stuff!" While I7 agreed that some lecturers may be interested in learning more about the new LMS's technical aspects, "that's something they can do in another time, in another place."

The lecturers' LMS-focused expectations of the process focused on the new system's efficiency and capabilities. For example, I1 expected the new LMS to be "more efficient", elaborating that they "have heard good things about [it and…] believed there'd be more things [they could] do with the site and… student assessment and topics and so on." After trialling the new LMS, however, I1 concluded: "I like it. It looks nicer… neater, and, to be honest, it didn't take that long to learn." Others also pointed out how their LMS-related expectations were eventually met, often with help from their learning designer. For instance, while I7 expressed their initial disappointment due to having "not that much space for video", citing disciplinary expectations for video-enabled teaching in a "media and communications unit", the issue was resolved by using an embedding technique. Another concern I7 had with the new LMS had to do with the system's 'look and feel'. Because I7 "worked really hard to make [old LMS] site really pretty", they worried whether the new LMS would replicate the aesthetics. While this was eventually made possible, the process was not stress-free, and involved a significant learning curve.

Lecturers whose expectations of the process were primarily teaching-focused had the most positive experience with the transition. For instance, I2, whose main concern was to improve student learning experience, noticed how the new LMS shared many design and engagement similarities with Facebook, acknowledging how because of that, it would appeal to young people, and the learning curve for them would be minimal: "the young people are pretty good— [the new LMS is like social media], it's not much different." I6 was another lecturer whose expectations were mainly teaching-focused and who embraced the change process because its goals aligned well with their aspiration to transform their unit. In this regard, I6 emphasised the "fortunate timing" of the LMS pilot:

I've had the unit for three years and… I didn't have enough time really [go] over it—so we just carried on, ticking by… The effort of… re-designing the unit was always too much, but because [of the LMS change] I thought, well you're going to have to do changes anyway, you may as well do it all at once… So… it just accelerated the implementation, which has been good, it's been an impetus to make some changes so that's cool.

Lecturer's expectations of the process were instrumental in influencing their actual experiences of upskilling in digital literacy as part of the change process. Having the LMS change environment designed according to the principles of the authentic learning helped mitigate potential challenges emerging when expectations and realities clashed.

Realties of LMS change

Key pillars of an authentic learning environment state that knowledge is constructed in collaboration; opportunities for reflection are built into the learning process; and learners are empowered to articulate their knowledge (J. Herrington & Oliver, 2000). Taking this approach identified some interesting juxtapositions between lecturers' expectations, and their actual experiences of, change. The comparative analysis of the two sets of perceptions showed that while some lecturers thrived, finding the process flexible and enriching, others felt their agency was diminished and, as a result, they exercised their resistance to the change. The latter behaviours attested to the anxieties lecturers experienced over how much creativity or control they felt they could retain in the change process, and how much of their unit design/structure was to be mandated externally. As I3 stated, "[the biggest concern was] that someone would say, 'it has to be this way, it has to be that way'", worrying that this would diminish the effects of the flexibility and customisation options the new LMS promised. Some lecturers managed to resolve such conflicts by working with learning designers.

For those like I4 and I5 who ultimately had a positive experience with the process, "the transition's been good", leaving them feeling "over-serviced" and "very happy" (I5), also noting how the fact that the new LMS performed well also factored into this positive experience. Further, I4 pointed out the importance of the continuity of support (e.g. working with the same learning designer throughout the entire process) and of streamlined communications: "[You need to] have the same person doing it from start to finish and… you work in conjunction with that person." Speaking of the process continuity as a whole, I4 emphasised the importance of having the multiple check-in points built into its structure, allowing lecturers to touch base with their learning designers: "I would suggest… weekly meetings… even if it's just a notion of saying "hello, how are you…" Thus, the opportunities for coaching and scaffolding that were built in as core elements of the authentic learning environment proved both valuable and successful.

For those lecturers whose primary expectations of the process were focused on teaching transformation, an aspiration to improve their teaching persisted throughout the process. For instance, I3, who saw the LMS change as a catalyst for the long-overdue changes to their teaching, said: "[when re-creating the unit in the new LMS]… all of the changes I've made are just around trying to make it easier for students to find things", mirroring the dominant narrative of their fellow participant, I6 who also drew on the change process to transform their teaching.

When comparing lecturer expectations of the process with their actual experiences, several aspects of the process were highlighted as factors of successful transition which did not diminish their agency. These aspects were fundamentally located in the authentic learning environment that was created to support their upskilling, namely personalised support, encouraging learning by doing, designing effective professional development that aligned with the change processes, and allowing for self-regulated learning to occur throughout the duration of the change process. Pertaining to the personalised support aspect, lecturers were keen to not only receive it but also to deliver it to the next participant cohorts by acting as 'champions' of change and fostering peer learning. However, it was also understood that such a scalability of personalised support was not always feasible, especially with larger numbers of units scheduled to undergo transition in the next stages of the process (120 in the next stage, and 3,500 in the final one). Further, not all lecturers wanted to be involved as 'champions', cautious of their time and finite resources. As I7 said, "there is a real danger that people like me could become the… helpdesk for our colleagues… I could start getting people lining up outside the door asking how you use this or how you use that. [University] needs to have a really good think about the kind of support they can offer." These considerations were built into the next cycle of the project.

Learning-by-doing is an important aspect of any authentic learning environment. Thus, opportunities for self-regulated learning were an important factor shaping lecturer experiences of the change process. Those lecturers who referred to their existing digital literacy capability and overall educational technology usage level as comfortable or advanced were overall keen to try out the new LMS and experiment with it. For example, I6 recollected, "when I get new software or when I'm trying new things… I just start building and figure it out as I go along". Giving lecturers online 'sandpits' where they could experiment factored into their positive perception of the change process. This was especially critical to the pilot's success as lecturers have limited time to perform any tasks which do not directly relate to their teaching or research: "I prefer to self-learn. It's quicker... My days turn into piles of paper and meetings, so anything I do has to happen really, really [late in the day], and there's no-one to talk to then" (I5).

Inclusivity at the core of the process was also important. Lecturers were positive about the university decision to involve relevant sessional staff in the change process as well as account for this participation in the academic workload model or sessional hours pay. As I2 says, "sessionals are essential to this process because while convenors are involved in decisions dealing with the unit's design etc., sessionals are actually teaching and assessing student work…" While some (e.g., I7) felt that what was allocated was "quite generous", partaking in this process still meant "lo[sing] time from… research", which was perceived as a drawback, as research outputs are those most likely to lead to an academic promotion.

Lecturers who already felt anxious about the process were likely to find it overwhelming. For example, for I8 the process should have been simplified ("just talk us through key points, don't make it so complicated"), training and communications involving lecturers only “if it has direct relevance to teaching matters”. While I8 admitted that the process improved as the time passed, the “lack of stability in change management was a problem” and while “students don’t know the difference between LMS”, it is lecturers who were affected by what was perceived as a “too complicated” process. I7 who had similar experiences to I8, also at times felt overwhelmed and anxious. As the authentic learning environment allowed these concerns to surface, they were able to be taken into consideration when designing the next phase of the project.

Using LMS to enhance lecturers’ digital literacy

A. Herrington and Herrington (2006) have argued that authentic learning environments have their foundations in situated approaches to learning, which advocate that learning is best achieved in circumstances that resemble the real-life application of knowledge. With this as a framing concept, this evaluation explored the question of how lecturers used the LMS for teaching and whether, and how, their usage patterns changed with the introduction of the new system. Key findings that emerged through engaging these lecturers in an authentic learning environment that reflected the realities of their teaching experiences were that changes in their digital literacy was influenced by the: usage patterns; functionality; interactivity; customisation; and accessibility of the new LMS.

Many existing LMS usage patterns were determined by a discipline and/or subject matter; however, the reverse was also true, as some lecturers believed the LMS affordances shaped their teaching. For example, for I4 the LMS usage was curriculum dependent: “engagement in part [is] shaped by… certain aspects of the LMS”. This attitude illuminated the way lecturers saw the role of LMS in their teaching: some recognised the transformational potential the LMS held for teaching, while others (e.g., I2) felt that “it’s… academic content that’s important, not the learning system.” Another lecturer (I8) who shared the belief that the LMS usage was shaped by the course/unit of study, said “student requirements are different, so the teaching is different. For example in [a] Law [unit], the way LMS is used is minimalistic because the material is hard and dry, so it needs to be made easier for students to study this subject,” while a subject involving ethnographic type work “doesn’t need much LMS presence”.

In terms of an LMS’s functionalities, lecturers valued its digital storage capacity, interactivity, accessibility and customisation. Alluding to the digital storage aspect, I5 termed LMS “data warehouse”: “I put up all my notes… a lot of readings… interactive activities [and] podcasts.” Others (I3, I7) echo these usage patterns: “it all comes back to storage. If we’ve got plenty of storage, we can do pretty much what we need to do, but as soon as you take away data storage from us, it really does restrict what we can do” (I7). Interactivity is another aspect of LMS that lecturers identified as important. I6 and I2 found the new LMS superior in that regard, appreciating its “really intuitive interface” which made all interaction easy, giving it “a social media feel” (I6). For those like I2 who used collaborative digital documents to engage students, the new LMS presented further new opportunities: “it’s easy to embed working documents, [e.g.] Google sheets… allow[ing] to talk to each other and share and collaborate at the same time.” I2 acknowledged that perhaps the old LMS also allowed for this type of collaboration, but they did not know how to do it; the LMS change process allowing for them to learn new digital skills, facilitating teaching transformation in the process.

Accessibility for students was third most valued aspect of the LMS. For example, I3 found that the new LMS “ma[de] it easy for students to find stuff” which matched their unit design goal to make it “blatantly obvious to [students] where [to find things]”. I3 noted, “in the [old LMS], sometimes… I’d be saying to students, “Go here, then into this folder, and then in there…” whereas now, I feel relatively confident saying to them, “Go [to the LMS and] follow the buttons”—it’s easy to find.”

The customisation the new LMS allowed was seen as another important way to build on lecturers’ digital literacy. For example, I3 highlighted customisation as important, specifically “the ability to do what works for your unit.” I4 who modernised their unit in the new LMS reported that “it’s very easy to assemble pages [and]… to compartmentalise knowledge”, which was especially important for the unit this lecturer was teaching. However, I4 warned that such a modularisation may not be appropriate for all types of units, but only for those better suited for the “linear progression” type learning.

Thus, it can be seen that the authentic learning environment that was established to facilitate this change saw the participants fully engaging in a professional development learning context that reflected their real-life knowledge of teaching on digital platforms. In being empowered to articulate their knowledge of the existing system as a building block to engage with the learning designers’ coaching and scaffolding their own expertise of the new system, knowledge was collaboratively constructed, which led to both increases in individuals’ digital literacy and the positive adoption of this broader organisational change.

An authentic LMS change process and teaching transformation
For roughly half of lecturers in this pilot, the LMS change enabled teaching transformation, ranging from self-directed, targeted upskilling to adopting a completely new approach to teaching with LMS that embraced enhancing their digital literacy. For example, inspired by the new LMS's advanced HTML editor tool, I4 and I6 learnt more about HTML coding and used their new skills to customise their units and streamline their learning design. Others (I2, I6, etc.) progressed from using the LMS as a digital repository to exhibiting a more interactive approach to their teaching, by embedding working documents and spreadsheets into the LMS rather than heavily relying on static files.

Further, I6 took advantage of the new LMS capabilities to introduce "in-class data gathering", "voting", and other elements enabling student collaboration and real-time feedback cycle where student feedback was immediately "inject[ed]… back into the teaching." While I6 was using the elements of these tasks before, the new LMS presented an opportunity to "go a little bit further", ending up transforming their unit into "a standalone walkthrough guide to the course," rather than a digital repository with limited interactive elements. The overarching goal of I6's new LMS usage pattern was to better "support the student" by organising their learning in a more engaging and logical way. This pivoted on the growth in their digital literacy to engage in teaching transformation: "each week's got an intro to it and it's got the materials… to [keep students' attention] on what they should be learning that week before they come to the classroom and to reiterate some points through videos". As far as these changes went, I6 noted how "[the new LMS was] … like a catalyst."
Another convenor (I2) who used the change process to transform their teaching quickly learnt how to use the new system's interactive/responsive learning features and included those into their unit's transformed design. Specifically, I2 used the new LMS learning analytics function to gather timely feedback from students and use it as an indicator of students' learning progress:

In each of our weekly modules we have two areas where students can give us feedback and then support each other. So, every week we have a [non-graded] quiz where we … list the array of topics we have covered and they simply tick the one they found most difficult, about which they want more clarification. And then, at the end of the week or the class, you can hit analytics and see immediately that 17% had trouble understanding the lecture or 35% want more clarity around the brief. Then we give them that next week.

I2's usage of analytics within the new LMS showed how this feature could be adapted to enable an embedded student feedback tool cycle. The effective use of this feature could be instrumental in boosting student retention, which is especially critical in the first few weeks of study. Targeted feedback collected in a timely manner is also an important, and well established, factor of student success.

As the authentic learning environment entailed, lecturers were experiencing the new LMS by engaging in real-life examples, first as learners, then as teachers, they felt empowered to transform their teaching. By using their enhanced digital literacy to make their units more interactive, and by engaging their students in feedback cycles, lecturers capitalised on the LMS change process by improving their teaching.

Conclusions

A university-wide LMS change process can be challenging for lecturers, at times causing resistance and stress (Blin & Munro, 2008; Liu & Pechenkina, 2017; Lokuge Dona et al., 2017; Mahdizadeh et al., 2008). Because of that and other reasons, many lecturers only use some aspects of LMS and generally do not engage with it fully, these inconsistencies in turn affecting student experience (Garrote & Pettersson, 2007; Lyall et al., 2017; Masterman, 2017). However, if LMS change is accomplished in a way that positively builds digital capability, does not diminish academic agency and allows lecturers to retain control over their teaching, such a process has the potential to be well received, and even inspire lecturers to personal upskilling efforts and teaching transformation.

This evaluation showed that for at least half of the lecturers in the pilot the change process served as a catalyst to rethink their teaching, mainly thanks to the enhanced digital literacy skills they gained while learning how to use the new LMS. While another half of the lecturers in the pilot did not feel particularly inspired to transform their teaching, recommendations based on their experiences helped shape the next iteration of the change process in a way that affects a higher percentage of participants.

Using authentic learning environment as a central frame of this change approach meant that training and upskilling of academic staff in using the new LMS occurred simultaneously with enhancing their digital literacy skills. This combination proved to be crucial to inspiring many lecturers in the pilot to consider transforming their teaching in a mindful and sustainable way.

Specifically, the following recommendations have emerged as a result of this evaluation:

- Authentic learning environment principles need to inform the change process, with all its aspects and activities designed for its specific cohort of learners
- Such process's overall complexity needs to be reduced, only engaging lecturers on a need-to-know basis, while creating enough outlets to hear and act iteratively on their feedback
- All support needs to be personalised and flexible in response to the real life knowledge of lecturers as learners
- The change initiative needs to be aligned with the existing organisational needs, e.g. academic professional development can be built into the change process, so that lecturers are trained, coached and enabled through expert performances and exemplars, in how to use the new LMS more effectively for teaching
- Time allocation is to be carefully considered and managed so as not to encroach on lecturers' research allocations and other multiple responsibilities
- Digital literacy development for lecturers must ideally be aligned with the authentic requirements of their teaching environments.

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Actionable recommendations for redesigning a pre-clinical dental course: Simulations and students' perceptions of epistemic setting

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Simulations are increasingly used in dental education for developing students' dexterity skills and improving the effectiveness of pre-clinical practice and assessment. The challenge is to embed these technologies into larger instructional frameworks, and to make contemporary teaching and learning practices and environments effective. This study focuses on investigating current simulation-based practices in a pre-clinical laboratory course in a Thai dental school. The purpose is to identify the aspects of the course design that need improvement. Ethnography is used to explore the current situation while an activity-centred analysis and design (ACAD) framework is used to analyse the design of arrangements in the laboratory setting (Goodyear & Carvalho, 2014). This paper reports some results from the students' interviews after the simulation-based laboratory practice. It focuses on epistemic affordances and constraints and shows that these affordances and constraints are not solely embedded in the design of the simulation system, but emerge with the activity from the interaction between the students' personal resources that they bring to the situation and design of the broader learning environment. We illustrate how these results could be used for offering actionable recommendations for improving the course design.

Keywords: professional practice, simulation-based learning, design for learning

Introduction

Simulation-based learning is used to help students learn in close-to-real-world situations. It is implemented in many areas of professional education and training. For example, flight simulators are used to simulate cockpit activities in pilot training (Rosen, 2013), manikins in simulated wards are used instead of real patients in nurse education (Levine, DeMaria Jr, Schwartz, & Sim, 2013), and business simulation games are used in management education (Bell, Kanar, & Kozlowski, 2008). Similarly, dental education is currently experiencing growth in the use of simulation technologies for learning. This includes the use of computer-assisted 3D dental simulations to help dental students develop their manual dexterity skills (Buchanan, 2004; LeBlanc, Urbankova, Hadavi, & Lichtenthal, 2004). These technologies also have the potential to help dental instructors evaluate students' learning more accurately and effectively.

Despite the widespread use of simulation technologies in dental education, there is little research-based evidence to guide:

(1) how dental simulations are best embedded in a complex learning environment,
(2) how to integrate the use of simulation technologies within current pedagogical structures, and
(3) how to modify teaching and learning when necessary in order to get the best results.

This study focuses on creating actionable knowledge for improving designs of simulation-based courses by researching students' practices and experiences within one such course. The data presented in this paper are gathered from students' interviews after a pre-clinical Prosthodontics course that used a computer-assisted 3D simulation system for developing students' practical knowledge and clinical skills. Results from these interviews are used to show how students experienced affordances and constraints of the current design and they inform actionable recommendations for redesigning the dental laboratory course. This paper focuses on illustrating actionable recommendations based on students' perceptions of embodied epistemic experiences of dental practice.

Background

Dental education and pre-clinical embodied practice

Dental education is complex. Its curriculum often combines both theoretical knowledge and practical skills and uses a range of teaching and learning approaches (Gerzina, McLean, & Fairley, 2005). Dental students have to learn how to integrate theoretical knowledge with the perceptual and motor skills required for safe, effective and efficient practice (Ali, Tredwin, Kay, Slade, & Pooler, 2014; LeBlanc et al., 2004). Clinical skills are among those core competences that students must have when they graduate (Ali et al., 2014; Gerzina et al., 2005). Theoretical knowledge is mostly taught using direct teaching approaches that combine lectures and readings with problem-based tasks and small-group discussions. Manual dexterity skills are developed through practical hands-on activities during pre-clinical laboratories and clinical work. Pre-clinical laboratory courses aim to simulate situations in close-to-real clinical environments, allowing students to experience different situations and explore different aspects, such as diverse patient-dentist positions and various hand-body postures.

Simulation in dental education

Before the availability of manikins or technology-based simulation systems, students learnt manual skills using artificial teeth—known as 'Dentoform' (Figure 1). Students practiced their manual dexterity skills by placing the 'Dentoform' on a flat surface (e.g., a table) and working on the plastic teeth from a 'birds-eye-view' position. However, this posed considerable challenges when students later attempted to perform similar dental work on actual patients within the clinic. With real patients, students had to adopt different hand and body positions from the one practiced in the laboratory, and they often found it very difficult to perform this clinical work proficiently (Ali et al., 2014; Kikuchi, Ikeda, & Araki, 2013; LeBlanc et al., 2004). These challenges evoked the need to improve the quality of dental simulators and to design simulation systems that afford more authentic experience (Kikuchi, Ikeda, & Araki, 2013).

Figure 1: The Hard Gingiva Jaw Model called 'Dentoform'

At present, there are many computer-assisted products for dental education that aim to simulate aspects of the real-world environment, such as the dental unit or the oral cavity. Some of these simulation-based learning devices and systems have been developed with the aim of supporting more realistic practical experiences and also improving feedback and facilitation. There are currently two main kinds of such simulators: 3D augmented reality and haptic systems.

The system used in the observed dental school is a 3D augmented reality simulation, called DentSim® (Figure 2). The dental unit includes four main parts: (1) a manikin head integrated with seven tracking light emitting diodes (LEDs) on the upper and lower jaw; (2) a standard turbine with sixteen tracking LEDs; (3) a dual charge coupled device infrared tracking camera; and (4) a computer-assisted learning environment that includes a monitor and software for tracking the prepared tooth (Buchanan, 2001; Kikuchi et al., 2013).
DentSim® depends on the use of infrared sensors to track the LED light on the manikin and the turbine. The software then records data about hand movement, position and configuration of the tooth being prepared. An image of the prepared tooth is shown on a monitor, with an evaluation button which learners can press if they

want to analyse their work and get augmented feedback. Students can request such evaluation and feedback at any time.

Figure 2: DentSim® learning system with monitor screen showing preparation area and evaluation

Key issues and practical significance

The question that educators encounter is how to integrate new simulation-based technologies like this with existing instructional frameworks, to make learning environments more effective for students. As Schleyer, Thyvalikakath, Spallek, Dziabiak, and Johnson (2012) argue, educators need to know what are the suitable technologies and instructional approaches for their students. Educators need to choose those combinations that are most appropriate for specific learning goals in the learning environment. Schleyer et al (2012) suggest using a holistic methodology for instructional design, considering a wide range of aspects, such as characteristics of the students and properties of the technological devices.

Focusing on dental education and simulation-based practice, most research has set out to compare outcomes from virtual reality-based technology with traditional methods of teaching psychomotor skills (Buchanan, 2004; Kikuchi et al., 2013; LeBlanc et al., 2004; Quinn, Keogh, McDonald, & Hussey, 2003). In general, results indicate more positive outcomes for dental students who use virtual reality: they learn manual skills faster, and benefit from augmented feedback and real-time evaluation (Buchanan, 2004; Kikuchi et al., 2013; LeBlanc et al., 2004). While there are a number of findings on the comparative effectiveness of simulation, dental educators are often more uncertain about instructional approaches that are suitable for their students. In particular, dental educators tend to raise questions about how to embed these devices within the current curriculum (Kikuchi et al., 2013; LeBlanc et al., 2004; Quinn et al., 2003). In other words, there is a gap between the benefits of the technology demonstrated in the literature and knowing how exactly one should combine technology with instructional approaches in a specific setting within the learning environment.

Advances can be made by focusing on two key questions:

- What is actually happening in the current learning environments when students learn in simulation-based laboratories?
- How could we use the above knowledge to decide what changes to make in the curriculum design?

Analysing this complex learning environment more closely is the first step in understanding how this environment functions and could be improved. The focus needs to be on what students are actually doing when they are practicing their manual dexterity using a simulation system. This activity needs to be understood as situated within a complex physical-digital, social and epistemic environment (Carvalho & Freeman, 2016; Goodyear & Carvalho, 2013).

Analytical framework

There are numerous approaches to designing for complex learning, but very few of these approaches integrate both the analysis of complex learning environments and the process of redesign. Many approaches to design for learning assume that designers are creating a new system, not analysing and improving an existing one (Goodyear & Dimitriadis, 2013). The approach to analysis and redesign that we use in this study is called 'Activity Centered Analysis and Design' or ACAD (Figure 3).

The ACAD framework places students' *emergent activity* at the centre of both analysis and design: the most important thing to know about, and to influence, is what students actually do (Goodyear & Carvalho, 2013). Especially in situations where direct supervision of students by teachers is limited, students' activity emerges through a mixture of self-direction and influences from the *physical and social design* of the setting. It is also influenced, though not determined, by the *epistemic design* of tasks that students are given. In short, students' actual learning activity is emergent and physically, socially and epistemically situated.

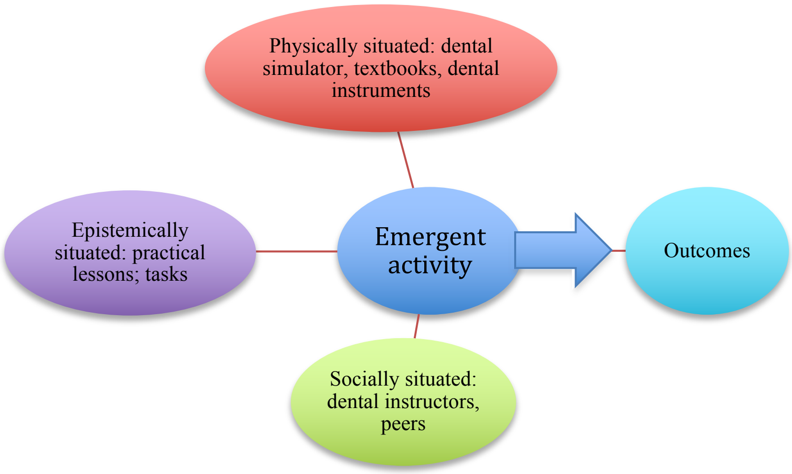

Figure 3: The Activity-Centered Analysis and Design (ACAD) framework, adapted from Carvalho and Freeman (2016)

The ACAD framework is used in cycles of analysis— analysing how the current system works— and redesign— proposing new (versions of) tasks and/or changes to the physical setting and/or ways people work together (Carvalho, Goodyear, & de Laat, 2016; Goodyear & Carvalho, 2013; Goodyear & Dimitriadis, 2013). In other words, the ACAD framework looks at how the epistemic, physical and social become entangled in the emergent activity at 'learntime'. The ACAD framework will periodically, temporarily and artificially separate these three kinds of designable components in order to work out what combinations of changes might be both beneficial and achievable for student learning. Students' perceptions of the simulation-based pre-clinical practice can be used as the first step to generate actionable "knowledge for design" (Carvalho & Goodyear, 2014). This actionable knowledge is approached in a holistic way—connecting physical, social and epistemic aspects of design within an emerging learning activity (Carvalho & Freeman, 2016; Carvalho & Goodyear, 2014; Goodyear & Carvalho, 2013; Markauskaite & Goodyear, 2017).

In this paper, the focus of analysis is on students' perceptions of embodied epistemic experiences of dental practice—in terms of affordances and constraints—after participating in simulated laboratory practice. We also extend the ACAD framework to show that students bring to the learning situation diverse, partly embodied, personal mental resources, such as knowledge, beliefs, skills, habits, emotional qualities, and dispositions. Consequently, new epistemic affordances and constraints emerge as a result of the interactions between what students bring to the situation and what is (epistemically, physically and socially) pre-set for them.

Ideas from the 'Activity-Centered Analysis and Design' (ACAD) framework are used to create actionable knowledge and make suggestions about redesigning the system for better alignment between technology, curriculum and intended outcomes.

Methodology

Setting

In 2013, the dental school used as the site for this research set up a dental simulation centre using the DentSim® system for practicing manual dexterity skills. The faculty believed that introducing the DentSim® system would enable students to improve learning of clinical skills. The Prosthodontic department installed this system, hoping to integrate it within its existing course structure. In addition, the department wanted to introduce self-directed learning as a new competency for dental students. However, problems have arisen from a mismatch between the DentSim® system's intended purpose and the course design.

Participants

Thirteen students enrolled in the Prosthodontics laboratory course volunteered to participate in this study. All participants were third year dental students who had no prior experience using dental simulations and no previous preclinical laboratory courses in prosthodontics.

Procedure

The course lasted 7 weeks; and was divided into 7 periods. Each period had 3 hours of simulation-based practice with the DentSim®. Students' practice in the simulation laboratory was observed and video recorded. The interview sessions were set up at the end of each period to investigate the students' experiences during their practice. Each interview took about 30 minutes and was audio recorded. During these interviews we used episodes from video recorded observations of their pre-clinical practice in the DentSim® lab as prompts and asked questions about those episodes.

Data analysis

Applied thematic analysis (Guest, MacQueen, & Namey, 2011) was used to analyse the interviews and identify categories representing affordances and constraints experienced by the students during simulation-based learning in the DentSim® laboratory. These categories were then grouped into larger themes by using key elements of the ACAD framework (Carvalho & Goodyear, 2014; Goodyear & Carvalho, 2013; Goodyear, Carvalho, & Dohn, 2016). The identified categories and themes represented the relationships between the three aspects of the design—epistemic, physical and social—and students' embodied experiences. In this paper we focus on students' epistemic experiences (i.e. experiences of learning and knowing) and identified epistemic affordances and constraints.

Results: Students' experiences of learning and knowing during simulation-based practice

An epistemic setting is structured by students' experiences or perceptions of learning and knowing during practice (Carvalho et al., 2016). The term 'epistemic affordances' is used to refer to students' perceptions of the enablers that facilitate professional learning and knowing during the simulation-based practice (Gibson, 1979; Markauskaite & Goodyear, 2017); whereas the term 'epistemic constraints' is used to refer to students' perceptions of the limitations or obstacles that restrict the development of their professional knowledge and skills.

Our results show that students' learning within the simulation-based settings cannot be separated from the epistemic affordances and constraints that emerged from interactions between personal resources that students brought to the situation (e.g., knowledge, skills, emotional characteristics) and what was presented within the simulation-based learning environment. This distributed system of epistemic affordances and constraints – distributed between the learners and the environment – was not intentionally designed as such. Rather, it emerged dynamically from students' embodied interactions during the learning activity. The affordances and constraints relied heavily on what students brought to the situation and their embodied experiences.

Epistemic affordances

Students' learning within the simulation-based environment resulted in the students' perceptions of increasing growth from mere declarative (or explicit procedural) knowledge—knowing what needs to be done in order to perform the task ideally—to the knowledge and skills that allowed them to perform the task flexibly and well.

The students mentioned various ways in which they practiced, self-taught, monitored, and evaluated their work and by doing this they gradually gained more experience and understanding of how to perform well and how they could improve their hand and body postures. The students perceived that they developed their practical knowledge and skills, not so much because their learning environment offered special instructional affordances, but because they had possibilities to engage in self-learning processes and develop this embodied knowledge and skills by themselves. These processes reveal examples of emergent embodied epistemic affordances; they rely hugely on students' personal resourcefulness (e.g., knowledge and skills for self-regulation) that they bring to the situation. We found four main categories of such affordances. These were affordances for: learning from experience, self-instruction, self-monitoring and self-evaluation. Each of these categories is described and illustrated in Table 1. Quotes from the students' interviews have been edited for clarity. Text in the brackets explains the meaning of those quotes.

Table 1: Embodied epistemic affordances

Category	Examples from the interviews
Learning from experience Simulation-based laboratory setting creates affordances for development of practical knowledge and skills through repeated practice (e.g., by preparing the same tooth several times and practicing similar clinical skills on multiple teeth).	S1: **"I think it's proper for me** because the first time I always fail about the tooth that I did especially for the occlusal surface and I don't know how to do that. I don't know how to put my hand in the right position but **when I use system like time-by-time and then I know how to change my position.**" [The statement shows that the student did not do well on the first tooth preparation. However, repeated practice with DentSim® helped develop needed knowledge and skills.] S3: "because it's [tooth preparation] very new and we're kind of didn't know which direction we should like do and it's very new experience, new thing, so we didn't catch what is the next step or how and why we have to do like this [how and why to place dental instruments or position hands and body] and what is it for but **once we've done several teeth already it's ok**, understandable." [The statement shows that the student had insufficient understanding and no experience of tooth preparation at the beginning of the session—as she said 'it is very new experience'. However, she developed initial understanding and competence by preparing several teeth and gaining some experience.] S13: "because like **we've already done the posterior and I can adapt knowledge a little bit from the preparation on anterior tooth**." [The statement shows that student's experience preparing one tooth (posterior teeth) helps them gain knowledge and skills needed for preparing a different tooth (anterior teeth).]
Self-instruction Simulation-based laboratory setting creates affordances for self-guided practice. This intentional learning process helps students develop critical professional thinking, independence, and practical knowledge and skills.	S6: "But like now **it's good there's no instructor** looking at us all the time or telling us what to do. So I feel like **I'm doing tooth preparation almost like 95 percent by myself**." [The statement shows that the student can learn by herself. She is learning the preparation by finding out what to do independently without direct guidance from dental instructors.] S12: "And I have to **think critically by myself that it like the proper ways to find out** the way that best for me to use the dental instruments, something like that." [The statement shows that the student is learning to do the preparation independently and deliberately searches for correct ways to use instruments, etc.]
Self-monitoring Simulation-based laboratory setting creates a feeling of authenticity and affordances for developing professional	S6: "you don't get that much practice but **it does make you very careful and I always imagine like this is a real patient. I have to be careful.** I can't go back. I can't buy new teeth. So, it's good that they give us only one tooth because you will be **very careful. We work really hard and concentrate** so that it's like the last tooth."

responsibility and self-control during practical sessions (e.g., awareness, concentration, caution).	[The statement shows the student did her work with careful monitoring of her actions and awareness of the need to avoid mistakes.] S9: "**I'll try to prepare it first on the other area that is not over-preparation yet and I just keep on going and then I reach my limit.** I have to prepare on the region where I say that in the system it said over-prep because it's not smooth." [The statement shows that the student realised what is going on with her work and stopped working on it when there was over-preparation. This shows her awareness, concentration and caution she has in relation to her work.]
Self-evaluation Simulation-based laboratory setting creates for students affordances for assessing their work (e.g., sensing sharpness, observing invisible areas).	S5: "For me, I'm very worried about the sharpness. So, for me if I **use my hand like touch it, I think I can sense the sharpness of my preparation**." [This quote shows the way the student evaluates a tooth preparation by using her hands (i.e., touching a tooth surface to sense sharpness).] S6: "I will **look [at teeth] directly because I feel like there are some blind spots like a point angle that I cannot see** even use a mouth mirror or use the light. And when I **take it [the teeth] out, I will realize that there's a ledge at the point angle everywhere is unsmooth. That's you can see clearly when you take it out**." [This quote shows the way the student self-evaluates her work by using her vision.]

Epistemic constraints

The students also indicated various epistemic constraints that emerged during their pre-clinical practice. Similar to the affordances, a number of these constraints did not directly involve the epistemic, physical or social design of the DentSim® system, but primarily were related to the students' earlier experiences and resources that they brought to the laboratory setting. We found three main categories: lack of initial knowledge, lack of vicarious experience, and reaction to stress (Table 2).

Table 2: Embodied epistemic constraints

Themes	Examples from the interviews
Lack of initial knowledge The students lack of knowledge of how to prepare a tooth correctly before starting the practical session.	S3: "At the beginning, I think it's not... oh! I don't know. **Maybe I didn't understand at the very beginning. I mean like the first period.** [The student means she has not understood how to prepare a tooth structure since the demonstration session.] DI: on 36, right? [The researcher confirmed the student's statement that the term 'the first period' indicates the demonstration session on tooth number 36 where the instructor demonstrated the preparation on a lower left first molar.] [In this statement, the student mentioned her misunderstanding of practical procedure of tooth preparation at the beginning of the practical session and this became the obstacle.] S6: "Like we only learn in one hour or two hours for one preparation so **we don't have that much knowledge and we don't have that much time to read the textbook.** So it's hard to expect that we always have knowledge." [The statement shows that the student did not have enough of the initial knowledge needed to prepare the teeth before using DentSim®]
Lack of vicarious experience Simulation-based laboratory setting does not allow students to see what should be done and how (e.g., how to place a dental	S2: "**I don't really get the clear picture of how the hand should be moved** or the clarifying explanation like how to do it correctly**. I haven't seen like an ideal preparation like the real one** but not in the book or on the computer." [The statement shows that the student did not know how to move her hands and perform the tooth preparation because she did not see an

instrument, how to place their hands).	exemplar of a prepared tooth and preparation procedure before the practical session.] S5: "I think at the first time that I did this. I don't think the instruction is clear because **we only hear the instruction. I didn't like see and I can't imagine what is going on.** So may be like a video of how to pose the angulation of the burr or a demonstration will be very helpful in the first period." [The statement shows that the student had verbal instructions, but lacked vicarious experience and was not able to imagine the preparation process]
Reaction to stress The students experience stress in a simulation-based laboratory which does not allow to learn productively (e.g., in reaction to a negative judgment on their work).	S6: "I feel like if you work someone under stress you don't work it well. Like **I actually feel my hand skills drop if I'm stress."** [The way instructors provide judgments on the student's work affects her skill development – e.g. when the instructor uses a loud voice or is particularly negative.] S6: "Like, I understand this department is like that but some department I feel like I work better in their environment because they don't push us under pressure. Because **when you work under pressure, your hand will be shaking and you try to rush to hand-in in time and then your work is not good as the first hour.**"

Discussion and Conclusions

Relational nature of epistemic affordances and constraints

These insights into the students' perceptions help us understand what kinds of epistemic affordances and constraints they encountered during their dental practice with the DentSim® system in the simulation-based learning environment. These results show that these affordances and constraints were not inherent features of the DentSim® system or of other designed aspects of the learning setting. Rather, they relied on, and emerged from, the interaction with the personal resources that the students brought to the laboratory environment. Further, these affordances and constraints were inseparable from the embodied students' practices with the DentSim® system.

The studied design of the simulation-based learning with the DentSim® system specifically resulted in the epistemic affordances for independent learning by letting the students learn through practice, enabling their agency and activating their self-regulatory processes. However, the overall course design also resulted in some epistemic constraints that restricted students' productive learning. Initial knowledge and vicarious experiences were seen by the students as preconditions for their successful learning through practice and they felt they lacked this.

These emerging epistemic affordances and constraints give us an insight into the process through which the students develop clinical skills. While authentic embodied practice is critical, the success of this practice is inseparable from students' personal resourcefulness for regulating their learning and their initial knowledge of how to perform clinical procedures. The emerging relationships between the students' resourcefulness and features of their learning environments help us see the problematic areas and offer actionable recommendations for re-design. For example, lack of initial knowledge and vicarious experience could be alleviated by improving students' preparation for laboratory practice or offering additional instructional resources that students could use during their practice. Further, the productivity of their learning through practice could be improved by designing instructional scaffolds that help students develop their self-regulation and other meta-cognitive skills.

Markauskaite and Goodyear (2017) argue:

> Understanding the instructional and psychological principles underlying the effectiveness of a tool or technique may allow one to adapt them flexibly to different situations. (Markauskaite & Goodyear, 2017, p. 90)

Similarly, dental educators could benefit from better understanding of what makes various simulation-based technologies and instructional approaches productive. This study further highlights that educators need to know what personal resources their students bring to a particular learning situation and what kinds of affordances and constraints emerge. This knowledge could help them better prepare students for pre-clinical laboratory practice and adjust the existing design of the simulation-based learning environments and courses to match students' needs: allowing for greater learning to take place.

Actionable recommendations for improving learning through embodied practice: some illustrations

Greater understanding of the emerging relationships between the students' resourcefulness and features of their learning environments helps us see the emerging benefits and problematic areas in the current design of the simulation-based learning and offer some actionable recommendations for course re-design.

Firstly, the students indicated that one of the main affordances of DentSim® is a possibility to gain experience and develop knowledge and skills through physically situated, independent and embodied practice. However, the students often needed to draw on various mechanisms for autonomous, self-regulated learning in order to learn via practice successfully. These independent learning mechanisms were not scaffolded by the course (epistemic) design and relied on the students' personal resourcefulness. This finding suggests that the productivity of independent learning for all learners, including those who don't have sufficient independent learning skills, could be enhanced by embedding instructional scaffolds for self-regulation into the design of instructional materials. For example, this could be done by explicitly asking questions that help students monitor the quality of their work or by pointing out typical 'blind spots' and making practical suggestions about how to avoid them. While we did not explore the design of social aspects of the learning environment (e.g., peer-tutoring and peer-feedback), social design could also be used to help enhance students' learning through practice.

Secondly, information about the epistemic constraints needs to be taken into consideration. The evidence about the students' stress invites the instructors to consider new approaches for feedback and evaluation. For example, they could consider changing the evaluation process in a way that reduces students' fear of negative feedback and failure. The students' lack of initial knowledge and vicarious experience could be addressed by offering learning resources that the students could use before practical sessions, and by adding instructor-led demonstrations to the sessions. In particular, the demonstrations could help students see the way professionals place the dental instruments in the oral cavity and ask questions; while later the instructors could provide focused one-to-one guidance for individual students when needed.

To summarise, we can use the results about students' experiences of epistemic affordances and constrains for developing actionable knowledge for course re-design. These experiences show the emerging relationships between the students' learning and knowing processes and their learning environment. The results could be used by the dental educators who work in the simulation-based laboratory to improve the design of the course in order to maximize learning benefits in the existing laboratory environment. Finally, the approach could be used to improve dental teaching knowledge in this area more generally.

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Inclusive design in a virtual world serious game to improve adult literacy: Problems, possibilities and tensions

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Use of theoretical frameworks can be powerful reflective thinking tools when developing new digital tools for learning. For maximum utility, digital learning tools should be designed to be inclusive of human difference. The purpose of this paper is to provide a case study on the application of an inclusive design framework in the development of a virtual world serious game designed to improve the literacy of learners in tertiary education. This paper provides a critical perspective on applying an inclusive design framework including problems, possibilities and ongoing tension in the project involved in deploying the game to both mobile devices and via head mounted display. Understanding both the strength and potential fallibility of theoretical frameworks such as inclusive design is important in developing impactful technological solutions to enduring social and educational problems.

Keywords: serious game, literacy, inclusive design, virtual reality, mobile learning, learning

Introduction

The purpose of this paper is to provide a case study on the application of an inclusive design framework in the development of a virtual world serious game intended to improve the literacy of adult learners in tertiary education. The literacy game, *Robo WordQuest*, can be deployed to smart phone, tablet and via virtual reality (VR) head-mounted display (HMD) (it has yet to be released and will be available free of charge). The game's main audience is tertiary students who have poorer literacy proficiency, an aspect of academic preparation often related to lower socioeconomic status, Indigeneity and rurality in the Australian context (Lamb et al., 2015). This paper provides a critical perspective on applying an inclusive design framework (Inclusive Design Research Centre, n.d) to the area of serious game development by identifying problems, possibilities and tensions in the project. The paper seeks to contribute to a more nuanced and empirical understanding of the strength and potential fallibility of theoretical frameworks such as inclusive design in developing impactful technological solutions to enduring social and educational problems. Firstly, the literature on adult literacy and serious computer games is briefly reviewed, before the principles and processes of inclusive design are outlined. A description of the serious game follows, including the processes used to inform its development. The application of an inclusive design framework to the development of a serious game is then detailed in terms of teasing out problems, possibilities and tensions. The paper concludes by suggesting that an inclusive design framework provides thinking tools and a road map for design; however, more fine-grained case studies of the approach are required to resolve problems and tensions.

The problem of adult literacy and computer games for language learning

Literacy is defined as 'as understanding, evaluating, using and engaging with written texts to participate in society, to achieve one's goals, and to develop one's knowledge and potential' (OECD, 2013, p. 59). Large scale international surveys conducted by the Organisation of Co-operation and Development (OECD) indicate that around 18.5% of adults have poor reading skills and this affects their ability to function effectively in everyday life (OECD, 2016b). This result is supported by the Program of International Student Assessment (PISA) which shows that the percentage of 15-year olds who have low reading literacy proficiency is 19% in the United States; 18% in Australia; and 18% in Britain (Thomson, De Bortoli, & Underwood, 2016, p. 5).

Generally, literacy proficiency increases with years of formal education; however, research indicates that a not insignificant proportion of students enter tertiary (vocational and higher) education with poorer literacy and that some graduate without this being rectified (Moon, 2014; Wingate, 2014, 2015). Poorer literacy proficiency impedes learning and academic progress (Moon, 2014; Wingate, 2014) and feelings of shame and stigma can create a reluctance to seek help (Nicholas, Fletcher, & Davis, 2012). Tertiary students with poorer literacy proficiency do not necessarily come from linguistically diverse backgrounds; they can be native speakers with research highlighting how widening participation policies in higher education have presented challenges for universities who can no longer assume younger or mature age students commence study academically prepared (Klinger & Murray, 2012; Murray, 2013).

Research has been conducted on the efficacy of computer games for improving language proficiency, particularly in the area of second language acquisition (see Peterson [2013] for an overview). This includes computer games specifically designed for educational purposes, also known often called 'serious games'. There is some evidence that serious literacy games can be highly motivating and effective in meeting learning outcomes (Smith, et al, 2016) and that the effectiveness of serious games can generally can be enhanced if games are selected by educators according sound pedagogical principles and curriculum alignment (Southgate, et al, 2017). Research has documented how recreational 3D virtual game worlds can assist in language acquisition through multimodal communication through situated or embodied cognition and via the affordances of the technology especially online interaction (Pasfield-Neofitou, 2014; Peterson, 2013; Rama et al., 2012).

While there are some serious game virtual worlds designed for children's second language acquisition (Sørensen & Meyer, 2007), we have been unable to identify similar serious games for adult language learning. This gap in the market, along with the relatively recent advent of highly immersive virtual reality, mediated through more affordable HMDs, offered a unique opportunity to develop an engaging serious game that tertiary education students could play to improve their literacy. The literature suggests that for increased uptake and learning effectiveness such a game would need to be inclusive and respectful of students' socio-cultural diversity, be gender inclusive, and integrate gaming and aesthetic features that appeal to a variety of users (Scott et al., 2003; Barab et al., 2005). Hence, the interest in identifying an appropriate inclusive design framework to guide the development of the literacy serious game.

Inclusive design

Historically, inclusive design has its roots in ensuring that designers respond to the needs of the widest possible audience irrespective of age or dis/ability (Clarkson & Coleman, 2015). It is increasingly used as a framework for understanding and engaging with a broad range of user diversity including dis/ability, age, language, culture, gender, and other forms of human difference (Inclusive Design Research Centre, n.d.). Its importance is captured by Waller et al. (2015) who remark: 'Every design decision has the potential to include or exclude customers' (p. 297). The interrelated dimensions of inclusive design are represented in the following theoretical framework (see Figure 1):

According to the Inclusive Design Research Centre (n.d), these dimensions entail:

1. *Identifying broader beneficial impact* of design decisions by realising that inclusive design decisions can have positive benefits beyond their immediate target. This is called the curb-cut effect (Blackwell, 2007) named after the action of disability advocates in the 1970s who poured illegal concrete ramps to create access for wheelchairs, an action that prompted the major redesign of pavements and improved pedestrian access for all. By recognising the interconnectedness of users and systems and increasing the diversity of user perspectives, designers can make changes that facilitate a 'virtuous' (rather than an adverse) series of changes that can have far reaching positive impacts on people's lives.
2. *Using inclusive process and tools* involves an open, participatory approach involving individuals who have lived experience of the issue having direct involvement in the framing of the problem and its possible solutions. This means respecting the edict 'nothing about us without us.'
3. *Recognising diversity and uniqueness* from the hypothetical 'average' to include those who are considered at the margins. This is undertaken to better understand the needs and goals of an individual or group. Solutions should be flexible or adaptable but rarely includes specialized or segregated options. Autonomy, self-determination and self-knowledge are key to this.

Figure 1: Dimensions of inclusive design (Inclusive Design Research Centre, n.d).

Overview of the game *Robo WordQuest* and the development process

An interdisciplinary team, with expertise in software engineering, education and Indigenous culture, worked in consultation with students and staff at X university to design *Robo WordQuest*. In all 16 staff (5 Indigenous, 10 non-Indigenous) with a minimum of 2 years teaching experience participated in staff focus groups. Forty-two students (12 Indigenous, 30 non-Indigenous), who were undertaking enabling and undergraduate study, participated in student focus groups. Focus groups were facilitated by two members of the research team and were guided by a schedule of questions on: key areas for literacy improvement; type of game and design preferences; and experience using games for learning. Focus groups were between 1-1.5 hours in duration with students receiving a $30 supermarket voucher for their time. The project had institutional ethics approval (approval number H-2017-0115).

During the focus groups, students and staff identified the preferred literacy foci for the game as punctuation (apostrophes, commas and full stops, and colons and semi-colons) especially to ‘fix run-on’ sentences, and basic paragraph structure. The focus group with Indigenous staff guided the team to explore inclusive approaches to design as this group expressed a preference for the subtle weaving of Indigenous cultural elements into the gameplay (for example through the integration of Aboriginal art) and the use of side missions or quests. The issues raised in applying an inclusive design process are discussed later in this paper in Table 1.

Figure 2: Screenshots of the interior of spaceship with its life support system panel with a collectable pop-up (left) and the yellow dimension with a diving board to access a floating platform with the literacy exercises (right).

Robo WordQuest is a based on a science fiction scenario, a preferred genre amongst undergraduate students we spoke to as in the focus groups we held as part of the design process. The narrative is that a spaceship has crashed on an alien planet. The player, in first-person view with their friend (a non-player character robot dog), must explore different dimensions of the planet so that they can gather ‘energy cell’ collectables that can repair the ship. From a design perspective, the game has three zones: (1) the spaceship which the player can teleport to and from and which houses the energy and life support systems that populate with energy cell collectables as the player completes literacy exercises, exploration and item collection side missions; (2) a planet with three different coloured dimensions (blue, green and yellow) which consists of hills, lakes and ravines to be freely explored; and, (3) floating platforms within the dimensions which comprise training videos and literacy mini-games that can be accessed by jumping off diving boards that propel the play upward (see Figures 2). Player monitor their progress through the display of energy cell collectables on achievement boards, represented in game as the energy and life system panels. The game was developed using the Unreal Engine 4.

The three dimensions of the planet are accessed via portals located in different parts of the spaceship. Each dimension is dedicated to a different set of literacy content: The green dimension is for playing games related to apostrophe use; the blue dimension is for games related to other types of punctuation (full stops, commas, colons and semi-colons); and the yellow dimension is for paragraphs. Mini-games are on floating platforms in the virtual world (see Figure 3) and are organised according to different levels of difficulty, except for paragraphs which are divided into three groups of exercises of similar difficulty.

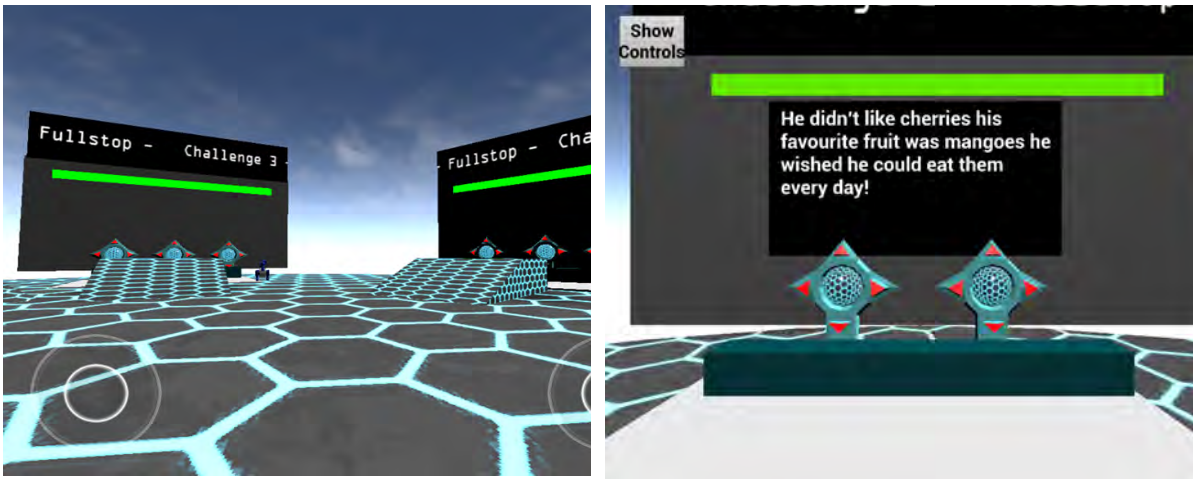

Figure 3: Screenshots of the literacy exercise platform for full stops (left) with sample exercise (right).

Upon completing all the literacy mini-games on each platform and after side-missions, the player is offered a choice of three collectable energy cells which plug into the ship's broken energy and life support panels (see Figure 4). Game customisation was highlighted as desirable in the student focus groups. In *Robo WordQuest* the player gets to customise the look of the life support system panel by selecting energy cell design of choice. A third of the energy cell collectables are designs from Aboriginal artist Saretta Fielding featuring Australian fauna and Aboriginal designs (Figure 4 right).

Figure 4: Example collectable energy cells: circuit (left), gem (middle), and Aboriginal design for koyiyoong or campsite (right).

Using an inclusive design framework in the development of *Robo WordQuest*

The role of any theoretical framework is varied. Theoretical frameworks can generate hypotheses, are lenses for interpreting phenomena and can be a guide to action. Powerful theories operate as explanatory tools at micro, meso and macro social and systems levels (Bronfenbrenner, 1979). The inclusive design framework from the Inclusive Design Research Centre (n.d) functions are both a set of principles for generating social good based on valuing and recognising diversity and as a means of acting in the world to do this. When applying the inclusive design framework in developing the literacy serious game both its strengths and limitations became apparent, particularly in relation to pragmatic issues such as time constraints and authentically engaging with gender diversity for design. Table 1 maps some the problems, possibilities and tensions that have been encountered during the project.

Table 1: Use of the inclusive design framework in the development of *Robo WordQuest*

Inclusive design dimension and project approach	Problem, possibility, tension
1. Broader beneficial impact • interconnectedness of users and systems • virtuous cycle of inclusion • impact beyond intended audience The project has the potential to a broad beneficial impact on a major issue, lower literacy proficiency and how this impedes academic success and life opportunities. It recognises that students of all ages will have gaps in their literacy knowledge and that a free mobile learning tool could allow students to improve their skills.	*Problem*: Societal induced shame about low literacy proficiency. *Possibility*: Mobile learning tools such as serious games enable students to improve their literacy in privacy and at their own pace, alleviating feelings of shame. *Tension*: Digital inclusion - Many students affected by lower literacy proficiency come from economically disadvantaged backgrounds. While most have mobile devices, these may be older models with lower specifications, and these students often have very limited data plans. The game would need to run offline and on older devices. The economic circumstances of students would mean that those wanting to use the HMD version may not have access. *Possibility*: Developing curriculum material and case studies on the pedagogical potential of the HMD version of the game may prompt institutions to invest in HMDs for classroom and learning support use. The game development platform Unreal Engine 4 provides a build-once-deploy-many approach to support a VR version for HMD smartphone hybrids, for example Samsung Gear VR. This may provide increased opportunity for students or institutions to purchase an affordable HMD.

	Possibility: As literacy proficiency is not necessarily age related, there is potential for the game to make an impact beyond its intended audience in the tertiary education sector; schools may be interested in including it as part of English and specialised literacy programs, especially as it is free of charge and attractive to Indigenous and non-Indigenous children alike. Promotion of the game to the school sector will be the main challenge.
2. Using inclusive processes and tools • diverse participation and perspectives • accessible design and development tools The project used a participatory design process to seek input and feedback from potential users. User input was facilitated through focus groups with university students and staff from Indigenous and non-Indigenous backgrounds. The leads on the project are from Indigenous and non-Indigenous backgrounds. Students from rural areas were specifically targeted during focus group recruitment.	*Problem A*: Inadequate gender representation. While there was good participation of staff and students from Indigenous and non-Indigenous backgrounds, gender diversity amongst student participants was lacking. In all 27 identified as male, 14 as female, and 1 as other. Gender representation was best amongst Indigenous students with 6 participants identifying as male, 5 as female, and 1 as other. *Possibility A*: There was originally an opportunity to recruit more female students for focus groups however, the time limited nature of project funding meant that much of the game mechanics and interface preference decisions had already been made by the time additional focus groups could be organised. Instead, the female researchers on the project made informed decisions regarding the aesthetics and narrative of the game in the hope of making it appealing to women (e.g. having a non-phallic shaped space ship, having gender-neutral first-person perspective, having the main non-player character be female and the captain of the space ship, and eschewing violence in gameplay). *Tension A*: Funding stipulations and the compressed nature of the academic year affected initial decisions on responding to gender inclusivity in the design process. This raises the question of how to best avoid essentialism in the design process. Essentialism refers to the attribution of fixed or essential characteristics or qualities to binary categories of gender (i.e. girls are innately caring, boys are innately tough) (Heilmann, 2011). Making design decisions without appropriate gender representation (and beyond binary gender categories) in the consultative process can potentially result in the perpetuation of stereotypical understandings of gender design preference. *Problem B*: Potential for cultural appropriation. Cultural appropriation is defined as the taking of ideas, cultural expressions, ways of being, symbols and artefacts from another culture and uses these to further one's own ends (Rogers, 2006) and it is present in some recreational computer games (Nash, 2016). *Possibility B*: Weaving Indigenous perspectives into game design is possible if there is respect for Indigenous ways of knowing, doing and being (Martin & Mirraboopa, 2003) and the team authentically includes and involves Indigenous people. This is vital because only Indigenous people will know or have the cultural connections to inquire about what can be respectfully, rightly and correctly represented in a game including cultural symbols. This also involves the right of Indigenous people to protect knowledge (see Principle 4 https://aiatsis.gov.au/research/ethical-research/guidelines-ethical-research-australian-indigenous-studies/rights-respect-and-recognition). *Tension B*: Non-Indigenous game designers need to undertake ongoing Indigenous consultation throughout the process to ensure that cultural appropriation does not occur, and respectful relationships are built and maintained. While ongoing consultation fits with agile or participatory design models, there are often project time constraints which, if not properly managed, have the potential to circumscribe cultural consultation processes. Building in ongoing consultation processes need to be considered early in the project planning stage.

	Problem C: At present the complexity of coding and other technical aspects for an open world game environment, even with game engine and internet-related support (e.g. YouTube instructional videos), limits the general accessibility of development tools. This will undoubtedly change in the future. However, participants were limited in this project to providing initial input on content and game design preferences, with Indigenous students also providing feedback on art choices for the energy collectables.
3. Recognising diversity and uniqueness • one-size-fits-one • adaptive design • self knowledge A virtual world, where autonomous, fun and flexible exploration is encouraged, offers an ideal environment for uniquely individual self-paced learning, provided that appropriate feedback and 'just-in-time' scaffolding can be incorporated in the game. Learning theory suggests that scaffolded guided discovery coupled with the visual and doing (non-verbal) affordances of a serious game in both mobile device and HMD experience, will allow learners to dual code (Clark & Paivio, 1991) new literacy knowledge and refresh previous (self) knowledge.	*Problem*: The decision to deploy the game to both smart devices (phones and tablets) and HMD VR raised the question of duty of care towards potential users in relation to the issue cybersickness (also known as simulator sickness or VR sickness) and other potential hazards such as eye strain, dizziness or loss of balance etc. There appears to be no clear predictor for who will become adversely affected or cybersick when using a HMD, although it is possible to design movement techniques in order to minimise it (LaViola et al., 2017). Whatever the engineered solution, the highly individual nature of cybersickness make it incumbent upon developers of social and educational technologies to provide clear, accessible information on risks. *Possibility*: Building cybersickness information and warnings into the game deployment platform or as an in-game pop up may educate on cybersickness and mitigate risk. There needs to be explicit age-related warnings regarding deploying the game to HMD VR: this need to be in line with current hardware warnings (not suitable for under 13 years) and research recommendations (Southgate, 2018). *Tension*: Commercially available, affordable HMDs are now easily available, however VR mediated through HMDs are still a novel technology with public knowledge about cybersickness not widespread. Even with educational material and warnings, users may not understand or heed this.

Conclusion

The inclusive design framework (Inclusive Design Research Centre, n.d) was valuable in theoretically framing the inclusive intent of *Robo WordQuest* within a broader context of stigma related to lower literacy proficiency and for considering the range of potential users including university staff who might recommend or use it in their teaching, students from diverse equity groups, and, potentially (when considering a virtuous cycle of inclusion), school students. With its three dimensions and ten sub-dimensions, the framework provided a road map (dimensions) with check-points for action (sub-dimensions) in what was a complex development process involving culturally sensitive respectful interaction. Moreover, the framework also delivered a set of powerful reflective thinking tools that could be deployed during and at the end of game development. Its utility as a framework was tested when the team encountered a range of situations that required a pragmatic response especially time constraints which impeded the recruitment of addition female and non-binary gendered students to inform the design, and a lack of time to properly enact cycles of participant input and product feedback during the project. Advancing the use of inclusive design in the field of serious games and in the creation of other digital learning tools will require more fine-grained case studies which systematically detail and reflect upon its usefulness and limitations in the complexities of design and development.

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Extending video interactions to support self-regulated learning in an online course

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Although self-regulated learning (SRL) is essential part of learning, students often commence studies with poor SRL skills. This places much emphasis on course design to foster SRL. In online education, this is a complex undertaking. The present study examines how online technologies can be harnessed to promote SRL. This study of an online first year course (*N*=138) investigates how student use of a video annotation tool incorporating in-video quizzes can predict learning outcomes and foster SRL. The study found that students were more likely to complete the in-quiz self-assessment questions than contribute to socially-shared resources such as annotations or summaries. This finding may be a result of the higher cognitive load associated with writing tasks versus responses to in-video questions. The findings also revealed a strong positive association ($R^2=0.45$) between student completion of the in-video quizzes and course grade. It is not surprising that quiz attempts reflect performance. However, it is important to consider the interaction between the correct and incorrect responses. Above a certain threshold of positive answers, the association between incorrect in-video quiz submissions and final grade becomes *negative*. The study has implications on how analytics are interpreted and how instructors can frame feedback to foster SRL skills.

Keywords: self-regulated learning, video interactions, in-video quizzes

Introduction

Self-regulated learning (SRL), is fundamental to educational research (Butler & Winne, 1995; Panadero, Kirschner, Järvelä, Malmberg, & Järvenoja, 2015; Winne, 2017). SRL involves key processes known to effectively facilitate learning (Coulson & Harvey, 2013), and stimulate autonomy and confidence (Carey, Devine, Hill, & Szűcs, 2017). The development of such regulatory strategies, including self-monitoring, and self-evaluation have been noted to be improved through self-assessment practices (Butler & Winne, 1995). Indeed, as outlined by Sadler (1989), self-assessment is a fundamental facet of learning, as it is ultimately the individual student that must adjust any observed difference between their current performance (as revealed by the assessment answer), and the desired or required standard. Thus, the adoption of self-assessment strategies into curriculum are beneficial for productive learning (Panadero, 2017). In essence, the integration of self-assessment into the curriculum provides a scaffold for students to develop the skills needed for effective SRL (Dixon & Hawe, 2016).

While self-assessment practices have long been known to aid SRL (Sadler, 1989), their effective integration into course learning activities is still contingent on student motivation. That is, students with high levels of intrinsic motivation and course interest are likely to complete all set tasks. In contrast, students with little intrinsic motivation may require further enticement or a higher level of SRL proficiency to undertake the learning activities (Boekaerts, 2011). As education increasingly transitions towards distance and online modes, incorporating appropriate scaffolds to support SRL is now especially pertinent (Harasim, 2000; Joksimović et al., 2015). The online context and associated technical innovations have allowed educators to become increasingly creative in their approaches to prepare and design content for learning (Garrison, 2011; Goodyear, 2014). Various student-centred pedagogies (e.g., problem-based or active learning) have been shown to aid student engagement with the learning process and enhance the overall educational experience (Borokhovski, Tamim, Bernard, Abrami, & Sokolovskaya, 2012; Darabi, Liang, Suryavanshi, & Yurekli, 2013). However, motivation and self-regulation of learning remains as a challenge for many online students, often resulting in frustration and anxiety that can further lead to disengagement and dropout (Cho & Shen, 2013). There is a need for developing novel online instructional approaches that increase teaching effectiveness and improve student self-regulatory skills (Cho & Shen, 2013). One such approach gaining increasing traction is the use of video related technologies.

This study builds on an established innovative instructional approach designed to promote the development of students SRL skills through the use of an online video annotation software (Gašević, Mirriahi, Dawson, & Joksimović, 2017; Mirriahi, Joksimović, Gašević, & Dawson, 2018). While the use of video or film has a long history in education settings, the growth of online courses has seen further reliance on video as the dominant medium for content delivery and an associated rise in the number of video related tools such as video annotations, embedded discussions, quizzes and concept summaries. These video-based technologies are often used to develop SRL proficiency (Hulsman & Vloodt, 2015). The present study investigates students use of a video annotation tool incorporating in-video quizzes and annotations. Specifically, the study examines to what extent students' engagement with the annotation tool can predict learning outcomes. In so doing, we first explore how students engage with the course learning activities to regulate their learning and how they utilise the products of learning (annotations and comments) created by their peers.

Background

SRL and learning online

Self-regulated learning (SRL) is a key conceptual framework in which the construction of knowledge is developed through the use of a wide range of cognitive, physical and digital tools, where learners observe, compare and regulate their learning behaviours (Panadero et al., 2015). Zimmerman (2000) defined SRL as 'self-regulated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals' (p.14). Due to the wide range of variables influencing learning encompassed under the framework of SRL, several models have been developed to explain the concept (Pintrich, 2000; Winne & Hadwin, 1998; Zimmerman, 2000). Zimmerman (2000) developed the cyclical phases model of SRL including the three phases; (1) *forethought*, including goal setting and planning; (2) *performance*, in which learners execute the task, self-monitor and self-control; and (3) *self-reflection*, where learners assess their performance, influencing later learning strategies (Zimmerman, 2000). While similar, Winne and Hadwin's (1998) model of SRL involves a greater emphasis on metacognition and expands on the forethought phase, with four phases: (1) *task definition*, (2) *goal setting and planning*, (3) *enacting study tactics and strategies*, and (4) *metacognitively adapting studying*. In addition to these four phases, the Winne and Hadwin (1998) model includes five facets of tasks within each of the four phases; (1) *conditions*, available resources and constraints; (2) *operations*, cognitive processes and strategies; (3) *products*, learning outcomes (e.g., new knowledge); (4) *evaluations*, external or internal feedback about the interaction between standards and products; and (5) *standards*, criteria used to monitor products which can be internal or external (Panadero, 2017; Winne & Hadwin, 1998). The focus on metacognition in Winne and Hadwin's (1998) model is particularly relevant for the self-directed and complex nature of online learning environments, which often incorporate a variety of learning tools and a stronger emphasis on student autonomy (Kovanović, Gašević, Joksimović, Hatala, & Adesope, 2015; Shen, Cho, Tsai, & Marra, 2013). In this environment learners must apply metacognitive monitoring, to evaluate the effectiveness of the tools available in aiding their learning process (Mirriahi et al., 2018). This is reflected in recent studies where SRL strategies were found to be a significant predictor of academic performance (Broadbent & Poon, 2015). Broadbent and Poon (2015) noted that SRL strategies, specifically metacognition, time management, effort regulation and critical thinking, were significantly associated with academic achievement in an online learning context.

A further critical component of self-regulation is the social context in which learning is situated (Hadwin & Oshige, 2011). Socially shared regulation, the processes by which collective activity is regulated by individuals, involves the construction of common goals and standards resulting in socially shared cognition (Hadwin & Oshige, 2011). This social influence on SRL begins with observational learning, such as modelling behaviours on those of peers, social guidance, and feedback (Hadwin & Oshige, 2011). The inclusion of feedback in courses has been shown to strengthen the relationship between self-assessment and learning (Sitzmann, 2010). Self-reflection in a social context can thus provide additional opportunities for feedback from both peers and instructors and assist with task motivation and persistence (Dawson, Macfadyen, Evan, Foulsham, & Kingstone, 2012).

Research Questions

The present study adopts Winne & Hadwin's (1998) model of self-regulated learning to investigate the extent students utilise the available tools to regulate their learning processes, such as constructing or evaluating the products of learning. In so doing we extend previous research in the use of fine-grained scaffolds embedded within a learning task to promote the development of effective SRL strategies (Panadero, 2017). For the present study, the fine-grained scaffolds are operationalised through the use of in-video quizzes and the associated feedback obtained after submitting a quiz answer. Students receive detailed guidelines on how to use the features available within the online learning environment to regulate their learning. In contrast to the earlier related work by Gaševic and colleagues (2017) these activities (e.g., creating, viewing video annotations, or submitting an in-video quiz) were not graded and were established for formative purposes only. Finally, in the context of this study, students are also able to view the products of learning created by other students, thereby embracing the notion of socially shared self-regulation to examine how the social context influences an individual's self-regulation. In the first part of the study, we focus on exploring students' patterns of self-regulatory learning strategies. Specifically, we explore the extent students utilise the available features of a video annotation technology called OVAL - Online Video Annotations for Learning. The tool includes features for students to create or view video annotations, create comments on the associated videos, as well as attempt in-video quizzes as a process of self-assessment. Therefore, we defined our first research question as:

- **RQ1:** How do students engage with OVAL's features to regulate their learning strategies?

The second part of this work contributes to the further understanding of the importance of various self-regulatory learning strategies for supporting learning outcomes. The existing research almost unequivocally argues for the importance of developing robust self-regulatory learning strategies for effective learning processes (Hulsman & Vloodt, 2015; Zimmerman, 2000). In this study, we aim to explore the elements of Winne and Hadwin's (1998) COPES model (i.e., creating products of learning and evaluating learning strategies) that predict final course grade. The second research question is conceptualised as:

- **RQ2:** To what extent do different aspects of students' self-regulatory learning (e.g., creating products of learning or evaluating learning strategies) predict final course outcome?

Study Context

Course Design

The research was undertaken in a fully online first-year course in Health Sciences at a large public Australian university. The foundational human biology course runs for ten weeks where the learning tasks for each week included an introductory video by the coordinator explaining the expectations of the week and the relevance of the course topics. The content is primarily delivered in video format, with several ~10-minute videos embedded within the OVAL tool which is integrated into the institution's learning management system (i.e., Moodle), with multiple choice questions appearing at specified intervals throughout the videos (in-video quizzes). Each video contains between 1–4 quiz questions, depending on the length of the video. The completion of these in-video quizzes is optional, with students having the ability to skip each question and continue watching the video. If the student chooses to answer the question, they are provided with immediate feedback on their answer. In the first week of study, a video is provided to orient and support students in their use of OVAL. The video explains all of the functions of OVAL and students are told that the use of annotations is beneficial to their learning, however, direct instruction is only provided for the in-video quiz function. The content videos are delivered by two different academics, most as voice-over PowerPoint or a combination of face to camera with animations and voiceover, with very few external YouTube videos used in the course. In weeks 8 and 10 no videos are used to deliver content, instead an interactive (non-video) tool, Anatomy TV is used. Because of these differences, weeks 8 and 10 were excluded from the analysis. Every two weeks there is a summative multiple-choice quiz (total of 5 throughout the course), comprised of 20 questions that is focused primarily on previous two weeks but also includes cumulative questions for any of the previous weeks' content. Students have one attempt to complete the quiz, and 30 minutes to answer the 20 questions. Each quiz comprises 12 percent of their total grade, with the other 40 percent of the grade being comprised of a poster presentation.

OVAL - supporting SRL

The Online Video Annotation for Learning (OVAL) software was developed from the open source collaborative lecture annotation system (CLAS) (Gašević et al., 2017; Mirriahi et al., 2018). OVAL is an interactive video tool designed to support self-regulated learning through the use of user-annotations and in-video quiz functionality (Mirriahi et al., 2018). The software effectively allows students and instructors opportunity to annotate a video, by making time-stamped annotations corresponding to a specific point in the video or adding general comments that are not time-specific. Time-stamped annotations serve as video bookmarks, allowing users to return to a specific segment of the video for the revision of content and to encourage self-regulated learning (Dawson et al., 2012). Students have the option for annotations to be "private", and therefore visible only to the individual student (and instructors), or tagged as "public", when they are shared with peers and instructors for review and feedback.

The present study adopted OVAL to support student self-regulated learning skills in two ways. The first relates to the use of video annotations and comments to enable students to engage in the creation of shared products of learning. Specifically, as students "*operate* on raw information" (Gašević et al., 2017, p. 208), that is watching a content video, OVAL enables them to recall the information introduced in the video by labelling parts of the video they find particularly relevant (time-stamped annotations). Moreover, such created content can be made public (within the same class) and available to other learners. This way, OVAL supports socially shared self-regulation where what seems valuable to one student shapes the development of SRL for their peers, defining specific conditions for learning tasks and also providing a specific form of feedback on the content of learning (Hadwin & Oshige, 2011). The second area where OVAL aids the development of self-regulation is via the provision of the in-video quizzes. Using this form of formative self-assessment, instructors are able to define a set of multiple choice or short answer questions that appear at specific time points in the video. Students can choose to answer the question and receive immediate feedback and the video continues; or exit the question and the video continues to play. Also, there are no visual indicators where the in-video quizzes appear, so students cannot skip them by fast forwarding. By using in-video quizzes, our goal was to provide fine-grained scaffolds, defined at the task level and focused on providing formative feedback on students' understanding. That is, in-video quizzes are utilised as a tool that enables students to evaluate the effectiveness of their learning strategies, according to the external standards (Gašević et al., 2017).

Data & Analysis

The initial dataset of 148 students contained all OVAL interactions, including creating and viewing video annotations, comments, and in-video quiz attempts. For each of the in-video quizzes, we collected if students answered correctly or decided not to answer the questions. The majority of students, (approx. 80%), were part-time students (*N*=109) and 71% (*N*=105) female. The most represented age groups were 25–29 (*N*=24), 30–39 (*N*=45), and 40–49 (*N*=29) years. Finally, as 10 students withdrew from the course before the census date, our final dataset consisted of **138 students**. The majority of students passed the course with approximately 16% (*N*=22) of students receiving a fail grade. It is important to note that none of the students enrolled in the course under study had any previous experience with OVAL. To address the first research question, we provide weekly summary statistics that show usage patterns of various tools designed to support students' self-regulation (RQ1). This broad overview provides general insights into how students engaged with these non-graded activities, designed primarily to support students' operationalisation of various learning strategies, such as note-taking or self-assessment. We also provide an overview of the number of strategies each student undertook.

To investigate the second research question, we performed a multiple regression analysis with final course grade (mark between 0 and 100) as a dependent variable and metrics of student engagement with OVAL as independent variables. More precisely, we used the average number of students' annotations created and viewed per video, average number of comments created, as well as average number of quizzes answered correctly, incorrectly, or not answered as independent variables in our regression model. We also conducted model selection procedure to remove irrelevant predictors. However, given that traditional stepwise model selection procedure is sensitive to the ordering of variable execution (Field, Miles, & Field, 2012), we use *glmulti* instead - an R package for automated model selection to find an optimal regression model (Calcagno & Mazancourt, 2010). All the statistical analysis were conducted using R software for statistical analysis (R Core Team, 2014).

Results

Research Question 1

Descriptive statistics for the variables used in the study show that students adopted different strategies associated with the available OVAL features. Figures 1 and 2 show students had a relatively high engagement with video annotations in terms of both creating and viewing annotations in the early stages of the course, despite it not being a critical component of the course design. Specifically, before the teaching started, students created more than 30 annotations on average (*M*=32.25, *SD*=47.70) and viewed those created annotations more than 300 times on average (*M*=351.85, *SD*=1063.55). However, the level of engagement drastically dropped from the first week of study onwards. While there were still more than 100 annotations created and over 1000 annotation views in weeks 1 and 2, the average number of the respective activities was considerably lower (M=5.53, SD=8.09 for creation and M=16.40, SD=11.40 for viewing annotations). Table 1 highlights the number of students that were active per week of the course. While a relatively small number of students created or viewed annotations prior to the first week of the course (eight and thirteen respectively), a considerably larger number of students engaged in these activities in the first week (19 and 62 for creation and viewing of annotations). These numbers decreased throughout the course. A similar pattern was also observed in the case of in-video quiz submissions each week. Finally, a rather small number of students engaged in the creation of the video comments (Table 1).

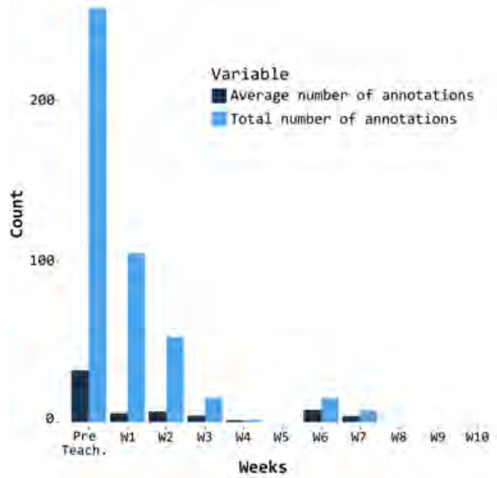

Figure 1. Overview of created annotations per week

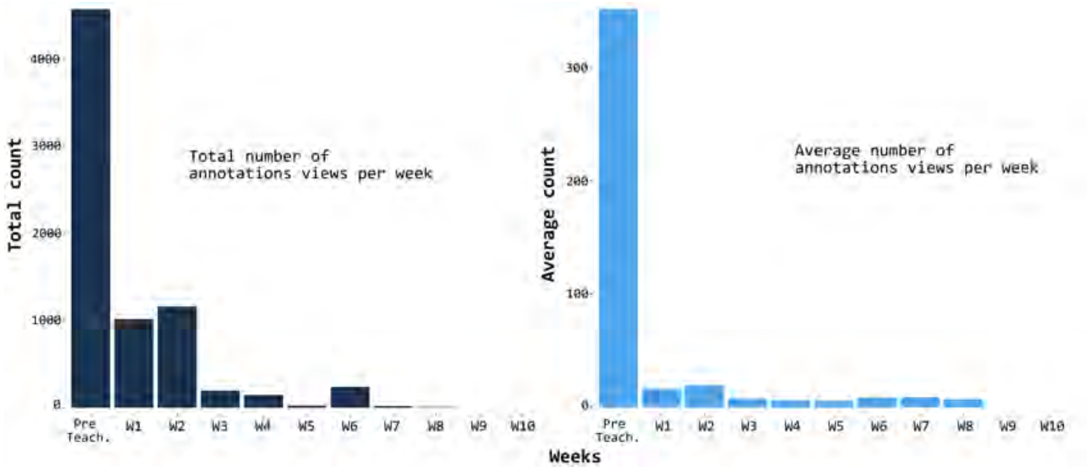

Figure 2. Overview of the total (left) and average (right) number of annotation views per week

Figure 3 further supports the statistics presented in Table 1, showing the rather substantial level of student engagement with the in-video quizzes. Overall, students seemed to have more correct answers when self-assessing the concepts learned throughout the course. However, the relatively higher number of correct answers was also followed by an increase in the number of incorrect answers. Moreover, except for week 5, which included a single video, students tended to have comparable number of submissions throughout the weeks. It is noteworthy that the number of students engaged with the in-video quizzes declined in the second half of the course (Table 1). Such decline further reflected on students' engagement with the self-assessment that was considerably higher in the first half of the course, having the peak in week 3 with more than 2,500 correct answers on in-video quizzes.

Table 1. The number of active (unique) students per week for each of the activities and the total number of unique students engaged with the given activity

	Pre	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	Total
Create annotation	8	19	8	4	1	0	2	2	0	0	0	32
View annotation	13	62	60	25	24	4	27	2	3	0	0	97

Create comment	0	3	1	2	1	0	1	0	0	0	0	6
In-video quiz	61	122	126	101	106	57	100	67	62	62	41	138

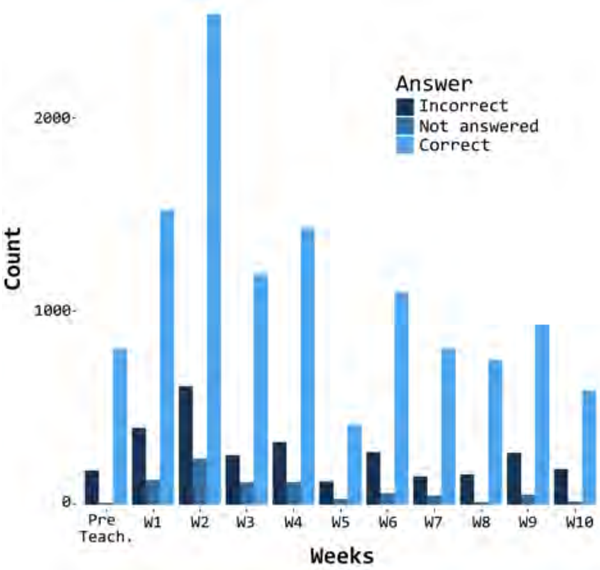

Figure 3. Total number of quizzes answered (correctly and incorrectly) or not answered.

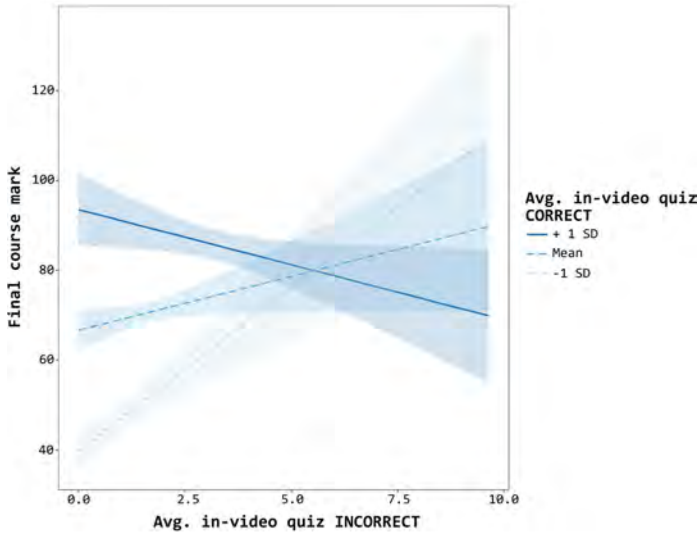

Figure 4. The interaction effect between correct and incorrect in-video quiz submissions.

Research Question 2

Although all variables were included in the initial regression model (i.e., average number of annotations viewed, created, average number of comments created, and counts of in-video quiz submissions), only the interactions relating to the in-video quizzes were included in the optimal model. After running the model selection process, the model that yielded the best fit included four variables –average number of correct in-video quizzes, the average number of incorrect in-video quizzes, the interaction between these two variables, as well as the interaction effect between correct and no answers (Table 2). The model explained 45% of the variance (R^2=**.45**, $F(4,133)=28.60$, $p<.001$) in the course grade, having almost all variables (except for the interaction between the number of correct and no answers) being significantly associated with the final course grade.

It is not surprising that the average number of correct answers to the in-video quizzes is the strongest, positively associated predictor of the final course grade (Table 2). Moreover, the effect of the average number of incorrect in-video quiz submissions was positive and statistically significant. However, it is important to consider the effect of the interaction term between these two variables (correct to incorrect in-video quiz submissions). Table 2 and Figure 4 suggest a complex association between the final course grade and interactions with in-video quizzes. Specifically, the effect of the interaction term between the average number of correct and incorrect in-video quiz submissions was strong, negative, and statistically significant. Hence, interpreting the association between the incorrect submissions and the final course grade depends on the level (or the amount) of the correct in-video quiz submissions. As depicted in Figure 4, when students have one standard deviation above the average number of correct submissions, the higher number of incorrect submissions would be associated with a lower course grade. On the other hand, for those students who have on average or less than average correct submissions, having a higher number of incorrect in-video quiz submissions is positively associated with course success. The interaction effect between the number of correct in-video quiz submissions and the average number of in-video submissions without an answer was not statistically significant. The assumptions of independent errors (Durbin-Watson value = 1.85, p=.39) and multicollinearity between predictors (VIF values in Table 2) were not violated in the regression model.

Table 2. The results of multiple regression analysis between the indicators of SRL and course final grade

Variable	R^2	B	β	VIF	p-value
Average number of in-video quizzes (correct)	.45	**4.21**	**1.14**	5.46	<.001
Average number of in-video quizzes (incorrect)		**8.04**	**0.51**	4.85	<.001
Interaction between avg. corr. and incor. answers		**-0.75**	**-1.16**	6.69	<.001
Interaction between avg. correct and no answers		-0.09	-0.05	1.61	.51

Discussion & Conclusion

Engaging with OVAL

Videos are a rapidly growing replacement to lectures in online education (Breslow et al., 2013). However, a key limitation of such videos is that the learning opportunity is reduced to a passive information transfer in contrast to more active learning processes (Cummins, Beresford, & Rice, 2016). To overcome the potentially negative impact of passive learning, the current study re-structures content videos to facilitate user engagement and support learning. Many studies have previously demonstrated that the act of retrieving information from memory is a very short-term activity. Longer term recall requires information to be regularly recalled through multiple and variable practice iterations (Roediger III & Butler, 2011). Studies have also shown that interpolating video recordings with memory tests substantially improves learning and information recall (Szpunar, Khan, & Schacter, 2013). The present study demonstrates that the inclusion of quiz questions embedded in videos can improve student academic performance. The OVAL tool and its associated features were widely used by the students. All students who completed the course attempted the in-video quiz questions. Vural (Vural, 2013) observed that online lecture videos with interactive elements such as quizzes increase engagement with learning materials and improve learning. This finding was supported in the present study.

Although all students attempted the quiz questions, the use of annotations was less well utilised (approx. 23% of the cohort). The reduced uptake in annotations may relate to the course design and instruction. While the course did not directly instruct students to use the annotation tool in OVAL, it was explained to students that it was there for them to use if they so wished. Further it was noted that the annotation process was beneficial to their learning, and instructions on how the tool worked were provided. Winne (2006) explains that an educational tool will only be adopted by students if students are made aware that the tool is useful for their learning, can be applied to their task at hand, and they have sufficient skills to use the tool effectively. While these three facets were addressed, no specific task was allocated to the use of annotations. This lack of direction or task may explain the limited use of annotation by the students. It has previously been shown that central to the scaffolding of self-regulated learning, is the integration of appropriate instructional tasks (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013). This may explain why the annotations were not positively associated with final grade despite their use being reported as an approach to promote self-reflective learning (Hulsman, Harmsen, & Fabriek, 2009). Furthermore, the cognitive load associated with creating annotations is higher than simply completing quiz questions. The lower cognitive effort needed to answer in-video quiz questions could explain why students created a considerable number of video annotations very early in the course, which later dropped off. This trend has been noted in previous studies (Gašević et al., 2017). As the majority of online students are mature age students who work full time in addition to their studies, the effort needed to create annotations may outweigh the perceived benefits by the students (Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013).

OVAL use and predictive modelling of course outcome

While many forms of self-assessment have been shown to impact on student learning, when combined with feedback, the effect is enhanced. Indeed, the provision of timely feedback to students has been described as of particular importance (Rowe & Wood, 2007). Sitzmann (2010) conducted a meta-analysis which highlighted that the correlation between self-assessment and learning is far stronger when the assessment also includes feedback. For the self-assessment outlined in the investigated course the feedback is embedded in the questions within OVAL videos. Completion of the in-video questions provided students with immediate feedback including prompts to review sections of the video as required. Unsurprisingly, the results from the present study indicated that the correct answer in the in-video quiz is the strongest predictor of the final course grade (R^2=.45). It is interesting to note that the effect of the average number of incorrect in-video quiz submissions was also positive and statistically significant. The use of immediate feedback in this self-regulated learning tool may begin to explain why the in-video quizzes were positively associated with final course grade. The integration of immediate feedback allows the students to self-evaluate the product of their learning (i.e. their answer) against pre-conceived standards (i.e. the question). The literature suggests that students have weaknesses in judging the effectiveness of their learning (Bjork, Dunlosky, & Kornell, 2013), and self-regulated learning without appropriate scaffolds tends to result in student adoption of ineffective learning strategies (Azevedo, Moos, Greene, Winters, & Cromley, 2008). As discussed by Butler and Winne (1995), feedback from the instructor (which in this instance is embedded in the question responses) are helpful in guiding students to monitor and adapt their learning strategies rather than relying on their internal feedback which may not necessarily be adequate nor accurate. The scaffolded approach in Human Biology, where students are prompted with questions to aid reflection on their learning as well as incorporating immediate feedback, effectively allows students to rapidly evaluate understanding and determine their learning needs (Hulsman & Vloodt, 2015). When formative feedback is offered to students, despite the task not being graded, it can help promote understanding of the purpose of the learning task and act as a catalyst for SRL by affecting students' motivations, thinking, and actions and contribute to improved meta-cognitive self-monitoring and self-regulation (Dixon & Hawe, 2016).

The second part of the association between correct and incorrect in-video quiz submissions with the final course outcome aligns with the existing literature on assessment for learning. Specifically, for those students who tend to have on average or less than average correct answers on in-video quiz submissions, any interaction with self-assessment is potentially beneficial. The existing literature on assessment in general, and assessment for learning in particular, highlights the importance of providing students with the opportunity for frequent, formative testing. Indeed, cognitive psychology literature demonstrates that answering test questions at repeated intervals during an educational activity improves knowledge gain by encouraging active information retrieval, focusing attention on the content presented, promoting task-relevant behaviours, and reducing overall cognitive demand (Szpunar et al., 2013). Therefore, the results of the present study indicate that for those students who might be struggling to understand course content, it appears beneficial to continue engaging with this form of formative assessment.

The observed association between correct and incorrect in-video quiz submissions is, perhaps more complex than noted in previous research. Our findings indicate that the interaction between correct/incorrect in-video quiz answers could be detrimental to the final course outcome. Such learning strategies could be associated with a behaviour that is defined as "gaming the system". Essentially, students exploit the properties of the learning environment (feedback on in-video quizzes in this case) to obtain a correct answer instead of learning the course content (Baker, Corbett, Koedinger, & Roll, 2005; Ruipérez-Valiente et al., 2017). This learning strategy has been commonly associated with poorer learning outcomes (Baker et al., 2005). While there might be various reasons why students engage in such behaviour (e.g., students have performance goals orientation rather than focus on deep learning), what is interesting here is that gaming the system becomes negatively associated with the final course outcome after students showed a specific level of understanding of the content under study. This further suggests two plausible interpretations of the association between students' response to the in-video quizzes and the final course outcome. On one hand, it might be the case that, for various reasons, good students are not able to engage with the course at the same level they were able to early in the course. Whereas, on the other hand, it could be the case that the course content was (a) relatively easy to understand, (b) students were familiar with the content, or (c) they were simply able to guess the correct answer. Either way, this finding warrants further research and practical considerations about how to identify this particular group of students and what the feedback mechanisms would improve their learning should be considered.

Limitations and future directions

Many of the findings of the present study support that seen in the literature, however, it should be considered that this research was conducted in a single institution for a single course. Hence, a generalisation of the results beyond the current context should be made with caution. The present study demonstrated a strong positive correlation of in-video quiz questions on improving student achievement, as measured by course grade. However, the question of how, or what elements of the in-video quiz questions actually impact student achievement remains to be answered, and a number of variables should be investigated. The question arises of whether the students that are completing the in-video quizzes are conscientious students regardless, and hence are likely to engage and do well in the course irrespective. This should be the subject of future research. Additionally, it is unclear whether it is the quiz question itself that improves student performance, or if it is merely the presence of questions within a video that keep the students engaged with the video. In addition, the effect of the type of question (e.g. remember-, apply-, analyse- or understand-type questions) has not been explored in the present study. Further investigation of student motivation may also be the focus of future research. Cummins and colleagues (2016) previously identified four motivations that drive distinct behaviours of in-video quiz questions, namely, completionism, challenge seeking, feedback and revision. An understanding of student motivation may help with designing content in the future. Regardless, this study supports that learning opportunities that encourage engagement with the content in interactive ways are likely to be more effective than passive information transfer approaches (Chi, 2009).

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The potential for artificial intelligence in the educational sector: Service automation of assessment at Copenhagen Business School

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Artificial intelligence is revolutionizing the way in which technology is conceived in society. While previously, its purpose was to simplify rule-based activities, it is nowadays a mean to aid humans in complex and unstructured data intensive decisions. The process of assessment in higher education, for instance, is an activity that can be improved through artificial intelligence as it consists of data intensive decisions, and at the same time, requires the teacher to focus on the performance of each student's writing, thinking and knowledge of a topic.

This research uses a case study approach to look at the opportunity for Automated Essay Scoring (AES). As the current literature on AES has focused on primary and secondary education, the paper aims to expand the topic to higher education. The paper draws on a case study from Copenhagen Business School which analyses current resources and the experience of stakeholders (teaching staff, students and university management). The theoretical framework adopts a Service Dominant Logic and a human centred design approach to investigate the jobs, gains and pains of introducing AES. The research identifies a clear need from teachers and students for improvements in assessment feedback and the benefits and drawbacks of AES are outlined.

Introduction

In the education sector today, class enrolments are on the rise. Since the mid 1990's it has been observed that occupational satisfaction rates of academics are decreasing (Ramsden, 1996), in part because of increased time preparing for classes and examining assignments. In addition, governments are cutting budgets on public expenses, including the education sector. With these dynamics in place, the impact on the quality of higher education is negatively affected. Students have become pre-occupied with advancing their grades rather than mastering the content of the subject matter (Ramsden, 2003) and there is a questioning of what learning is – both from the teacher and for students.

Assessment plays a central part in the quality of learning (Boud & Associates, 2010) and the distinction between how students learn and the teacher's perspective is critical. Students' perceptions of the education system are based on three main criteria: the curricula, teaching methods, and assessment procedures. Rowntree (1977, p.1) states, "if we wish to discover the truth about an educational system, we must look into its assessment procedures". According to Ramsden (1996), assessments are: a method to help students learn, a method to analyse students' progress, and a method for teachers to alter ways of teaching to better assist students. In order to help students to learn and evaluate their progress, there is an inevitable link between the two forms of assessments: formative and summative. Furthermore, assessments are defined as the activity of collecting information on the knowledge depth of a student that has attended an educative and formative course. This process is carried out by examiners and entails the evaluation of the learner's performance and instructional outcomes. However, at the end of each formative and summative assessment, students should receive feedback in order to improve their performances and to better appreciate why they received a specific score or evaluation. Feedback has a twofold purpose: it is the consequence of performance and, at the same time, it is an integral part of learning. Feedback is a constructive and valuable comment that, if provided with responsiveness, has the capability of helping an individual to correct their mistakes or increase their skills in performing a specific action (Boud, 2007). Moreover, feedback is said to support learning, instead of merely giving a final score on the performance and indicating what is right and wrong, by focusing on explaining to the student the what, the how and the why of their mistakes and poor performances (Evans, 2013).

Automated Essay Scoring

Currently, AI in education is implemented and focused on the purpose of freeing academics from routine-based activities. This can reflect tasks such as the marking process, to let teachers focus on more valuable and productive activities like teaching, researching and assisting in individual students' needs. In 1966, even before the time when the concept of AI was first introduced, and even before students used computers to write essays, such a solution as Automated Essay Scoring (AES) was already being tested by Ellis B. Page (Potts, 2005).

Page (1996) came up with the idea of using a computer program to examine essays, as he realized that there was a lack of English writing evaluation in essays. He believed teachers were not promoting writing quality, instead focusing on the subject's learning objectives. He was reflecting on the multiple-choice test, a popular way of testing subject-matter knowledge in a cheaper and more objective way than essays. It was, however, a weak knowledge test as it only implied the recognition of information by the student and, as Page (1966) argued, could not test the ability of students to synthesize theories in their own words and analyse facts. To address the sceptical comments of other colleagues on letting a machine correct essays, Page responded that his solution was "a way to measure essay quality with the same reliability, validity and generalizability - with the same "objectivity" - which they enjoy in multiple-choice items" (Page, 1966, p. 239).

Today, AES tools are computer programs that are able to analyse the text of an essay on the basis of several writing qualities and content variables that are defined a-priori by a human rater. AES tools are already implemented in the examination of high-stakes written tests. In addition to examining summative assessments, they are also used in formative assessments and, as an instructional tool that is able to provide feedback to students (Nathawitharana et al, 2017). These tools are typically web-based and include two components: an electronic portfolio and an AES engine. The electronic portfolio component is the platform and graphical interface where students assess essay prompts, use specific writing tools, upload their essays and receive feedback. The feedback they receive are in two forms: qualitative and quantitative. Qualitative feedback is given as suggestions to the students regarding improvements of their writing and in order to meet specific writing qualities. Quantitative feedback, on the other hand, either takes the form of a single numeric score, or of different scores that rate the essay on specific writing traits such as content, creativity, style, mechanics (spelling, capital letters and punctuation) and organization (essay structure quality) (Shermis, 2010). The AES engine is the component that scans the essays and uses statistical algorithms that are built on the concepts of Machine Learning (ML) and Natural Language Processing (NLP) and then evaluates them.

Having touched on the research field of AES, it is important to analyse the potential of AI opportunities for institutions. In this paper we use a case study of the Copenhagen Business School (CBS) to explore the potential benefits and issues associated with adopting AI as part of the assessment system.

Theoretical framework

As the basis for undertaking this research, a Service Dominant Logic (SDL) and Value Proposition Design (VPD) approach was used to provide a framework to explore the use of AI on written examinations. It is believed this approach will assist in analysing the service proposition and value obtained by the stakeholders involved in the process.

The emergence and evolution of a SDL perspective was introduced in 2004 by Vargo and Lusch (2004) who based it on the idea of the role of service in regard to exchange and value creation. For decades, the dominant logic was based on the exchange within a Goods Dominant Logic (GDL) view, focusing on tangible resources, embedded value, and transactions, predominantly of manufactured goods (Vargo & Lusch, 2004). However, Vargo and Lusch argued for a new perspective that focused on the economic exchange of more service-oriented offerings, that are embedded within intangible resources, the co-creation of value, and relationships (Vargo & Lusch, 2004). Although the perspective has emerged from Vargo and Lusch's work, the importance of services in the marketing literature has existed for over two decades (Gummesson, 1995).

As the world economy has shifted to a service orientation view, Constantin and Lusch (1994) classified two types of resources: operand and operant resources. Operand resources are those resources that have been produced through an operation or act, such as a physical tangible good. Whereas, operant resources are often invisible and intangible. Action is normally taken to create operant resources such as using the skills and knowledge of teachers. In a GDL centred view, operand resources are the primary source of factors of production. In contrast, in a SDL centred view, operant resources are the primary source of producing effects which are then used by students for their own value creation. This creates a world in which humans can create additional operant resources, by adding value to the natural resources (Vargo & Lusch, 2004). As a result, a market that is customer-centric involves collaboration with customers (Sheth, Sisodia, & Sharama, 2000). This reflects back to the world being more customized and personalized for individuals, in order to create additional value.

The VPD canvas, developed by Osterwalder et al (2014), is a theory that is used in human-centred innovation processes for improving or developing new products and services. Its main contribution lies within the idea that an organization can create real value only after understanding the individuals to whom they are offering a unique solution. This is accomplished by creating a solution that fits perfectly with their profile. The framework consists of two distinct parts: the customer profile and the value map. These parts have to be mapped out for every distinct customer segment that an organization or firm wants to serve. The mapping process provides insights into the customer's needs that can then be used in any service design.

Value Proposition Design Canvas

The VPD framework was used in this research as a way to understand the two most important stakeholders of the assessment process, teachers and students, and to identify a solution that incorporates the two. As teachers and students have very different needs and experiences, the value creation process started with mapping out two different customer profiles, one for each stakeholder. Even though the two different customer profiles are created separately, it can be observed that both of the stakeholders, students and teachers participate in the assessment process: teachers as "active" users; as they are the ones that evaluate the performance, and students as "passive" users; as they receive the grade and feedback. Therefore, a single value proposition can be examined by looking at the interconnection between these two different stakeholders.

The goal of mapping out the value proposition canvas is to guide the creation of value as a response to the customer profile. As a result, the entries of the value map are named "gain" creators, "pain" relievers and "product and services". Pain relievers explain how the product or service solution aims at resolving and reducing specific customer pains. Gain creators, on the other hand, tackle the outcomes that are already mentioned in the gains part of the customer profile that a customer will get out of the solution offered. Lastly, the product and services section helps to disclose the final solution and it includes all of the different products and/or services that are included within the entire value proposition.

The last stage is to find a "fit". Osterwalder et al (2014) suggests that there are three stages of fit that are related to the level of maturity of the solution from prototype to final product/service: problem-solution fit, product-market fit and business model fit. Problem-solution fit is achieved when it is proven that customers' most relevant jobs, pains and gains are the ones tackled by the solution, even though at this stage it is not yet proven that they will in fact use the solution. Product-market fit is created when customers start showing interest in using and buying the designated solution and see the real value they can get out of it. The final stage of success is then reached when the solution has a business model fit and, hence, when it is proven that there is a stable business model that can be profitably sold, in a sustainable way.

When looking at a SDL approach, for the purpose of this research, it was important to understand this view in a customer centric world. In order to do so, the selection of the VPD canvas was chosen to analyse the nature of the process of the innovation that is being created- in this case the assessment system is seen as a service. The process of assessments has been, so far, an extremely human related activity that has always been a subjective process for the experts performing the task and the different performances of students. Furthermore, as each educational institution has a different approach to undertaking assessment and as CBS has been selected as the case study of this paper, prior to this research, it was not clear how CBS academics carried out the activity. Consequently, there was a need to find a framework that could be used to gather an in-depth understanding of the specific customer segment, aligning it with the service era of today's education sector.

Introduction to the CBS case study

Established in 1917, CBS is an international business school teaching over 21,000 students and employing 1,500 employees. Since 1917 until 1971, there were no standard marking schemes, thus individual departments created their own. Introduced in 1971, a 00 to 13 grading scale was used, whereby grades could be placed within 4 different groups according to the performance of students; (1) where 13,11,10 are excellent (2) 9,8,7 are average (3) 6 are just acceptable and (4) 5, 03, 00 are marginal or fail. Then, in August 2007, Denmark enforced a new 7-step grading scale, to create more compatibility within an international context, specifically the European Credit Transfer System (ECTS) grading scale (Eng.uvm.dk, 2018). This 7-point scale is based on the overall performance of a student and on the academic requirements. The grade of 02 is the lowest used in order for a pass. Students are graded at the end of each course through oral and written exams. Written exams can either be sit-in-exams where the student has to write an exam at the university, take-home exams where the student has a limited period to write the exam outside of the university (24, 48 or 72 hours) and projects where the student works individually or in groups on a theoretical problem (Copenhagen Business School, 2018). In total it is estimated that over 30% of the Schools resources are dedicated to the process of setting and marking assignments and exams. Subsequently, some observers believe there is potential for AI to take some of this burden and reallocate resources which would provide more consistency and provide a better experience for students.

After reviewing the relevant literature, it became apparent that research in the field of AI and education have yet to adopt a SDL approach. Thus, based on the research question: *What is the potential for AI to be used for feedback and grading at CBS*? the research method of a single case study was adopted. As identified by Yin (2013), a case study examines an existing experience whereby the analysis of a real-life context is conducted in order to identify and analyse the knowledge gaps that are unexplored, with no clear evidence. Qualitative research was undertaken in order to obtain an insight into the examination process of exams at CBS. As Kvale (2007) explains, qualitative research helps to understand the views and experiences of the stakeholders of the social phenomena studied in their natural context. The collection of stakeholders' insights was carried out by conducting 29 face-to-face interviews with AI experts, university management, teachers and students. This process is supported by the premise that interviews are an effective way to appreciate personal insights of the subjects interviewed, as interviewees have the possibility to explain their own experience and opinions in their own words. Most interviews were conducted face-to-face, to create a more personal dialogue, but also to observe the interview in a different perspective by respondents' body language and emotions throughout the responses.

The interviews consisted of a list of open questions regarding the examination topic, and, depending on the insights that the interviewee introduced, further follow-up questions were asked during the interview (Kvale, 2007). When talking to students, a short dialogue was held using an unstructured interview model based on their experiences concerning their satisfaction (or dissatisfaction) with different aspects of CBS while observing their behaviours when talking to gain answers in divergent ways. This was done in order to obtain both a factual and meaning (Kvale, 2007). The factual level was achieved when the students talked about something that had happened and what they thought about a specific topic. The meaning level, on the other hand, consisted of the researchers probing for further explanation and detail (Kvale, 2007).

Findings from the interviews

The insights from the interviews with teaching staff and students have then been analysed and grouped by using the customer profile canvas (Osterwalder et al, 2014). It has to be noted that only the insights that were mostly recurrent among teachers and students are represented. As shown in Figure 1 and Figure 2, there are two patterns that connect the pains, gains and jobs of students with the ones of teaching staff. These patterns are time and feedback. From the teacher perspective, the lack of time and management is a major issue as it dictates their availability in being part of determined activities, such as teaching. From the teaching staff interviews the lack of time seems to be connected with the fact that there are some repetitive and time-consuming activities, such as administrative tasks and marking. This lack of time is echoed by the students, as having to wait one month to receive a grade was considered a "pain". The lack of time also triggers the pain of students of not receiving any feedback or explanation for their final performances (assessments), which ultimately results in a decrease in teaching quality. This pain is also reflected in the teachers' profile as they feel they are not being respectful towards students by not providing students with prompt feedback. Even though teachers admit that, according to the university rules, they have to be open to providing feedback at any time it is requested by a student. However, teachers state that they are not given an allocated time for this activity and this leads to arbitrary decisions as to whether, and to what extent, feedback is provided. Referring back to the literature review for this study and looking at the data from the interviews with teachers and students, it is evident that CBS is missing an important part of the learning process by not providing feedback as a support for learning (Evans, 2013).

By looking closely at the teaching staff profile (Figure 1), some additional considerations can be observed. A common point in the customer job section was of "creating an exam format that allows other teachers to grade the exam". This is mentioned by 5 out of 13 teachers who report that, in some cases, they have to either create a solution guide to the exam so that it can be graded by another teacher (or external examiner) and to collaborate with other teachers with whom they teach in the same course on how to grade the exam in a consistent manner.

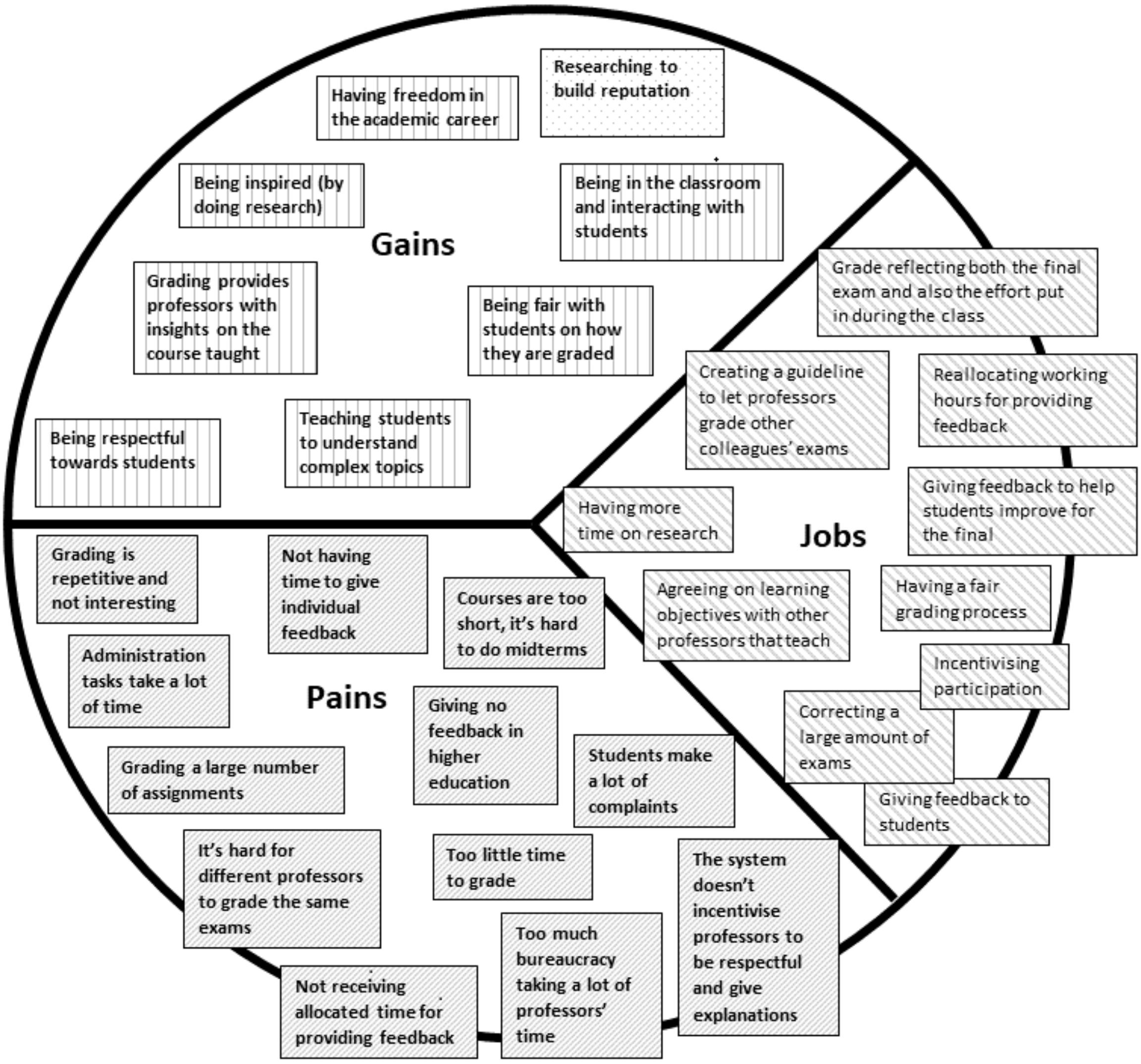

Figure 1: Value proposition Design Canvas: Teaching staff profile

It follows that, even though the examination activity of teachers is very subjective, according to the teachers, there is an expectation that exams are designed so that they can be graded in an objective way. In addition, "incentivizing in-class participation" was also a shared customer job for 6 out of 13 teaching staff. Some said they would like to have a percentage of the final grade based on student participation.

Moving to the students' profile (Figure 2), besides receiving prompt feedback, a shared request was having a more transparent examination process that is based on answers that are partially decided a- priori even for essay-based assessments, as standardized solutions are already being used for quantitative exams. This would mean that when a grade is received, it would be easier for a student to understand how different their answers are in comparison to what the teacher is looking for. Related to this point is the need for more standardization of the exam for the teachers. Another relevant observation was the desire for students to have an examination process that can consider the different cultural and educational background of each student. For instance, according to one respondent, Danish students are very good at presentations and oral exams, as they are taught public speaking and argumentation techniques from the beginning of their education, while in other countries the knowledge and depth of understanding of the student are considered more important.

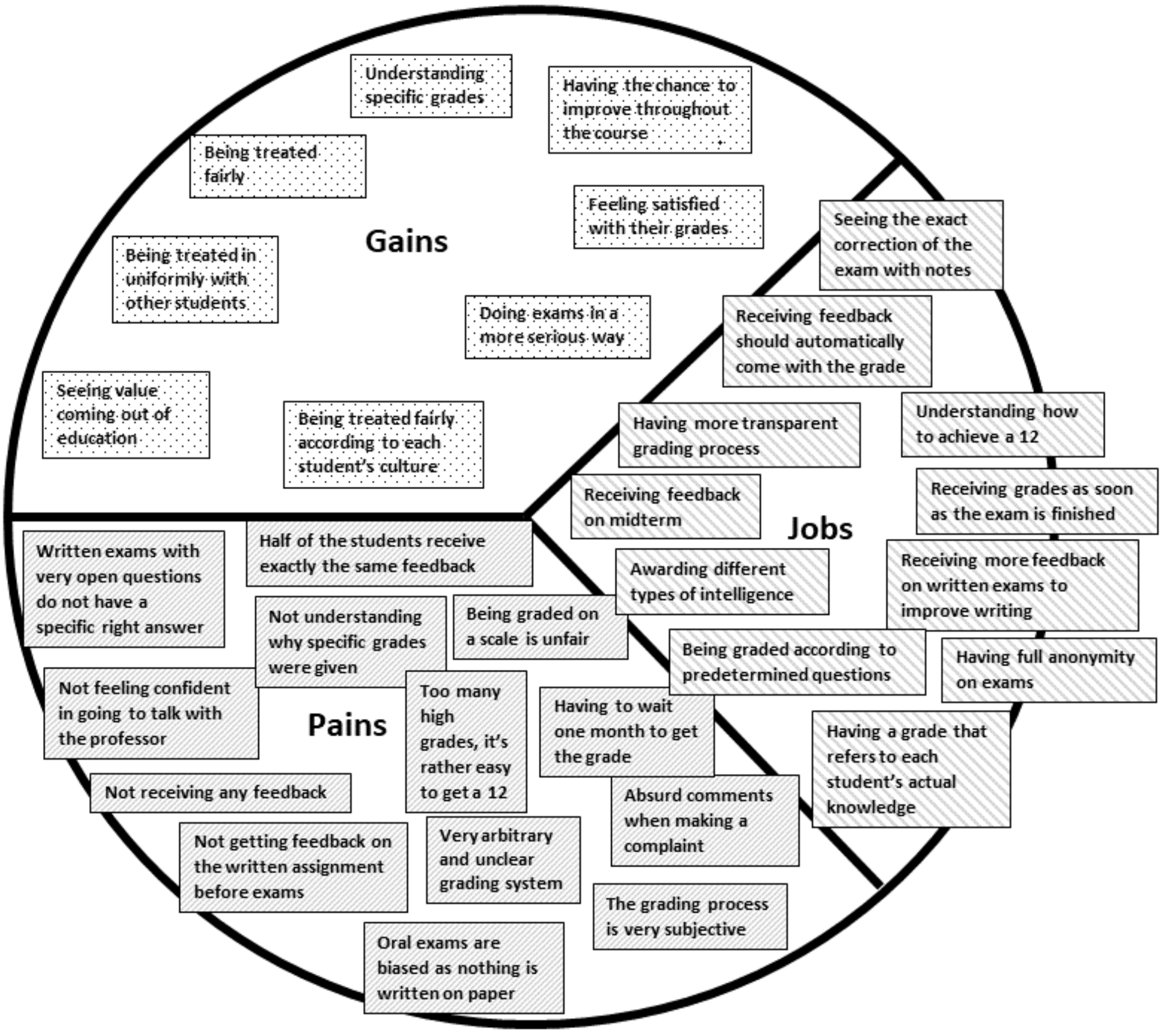

Figure 2: Value Proposition Design Canvas: Student profile

A common point that emerged from teachers and students' discussions was the inconsistency that resulted from the newly introduced 7- point Danish grading scale. From the teachers' side, it was felt the scale does not allow them to award a grade of excellence, which was previously possible with the grade of 13 in the previous scale. The scale was also considered a pain for teachers when having to decide between the grades 4 or 7 and 7 or 10. The large gap that these new marks represented was thought to provide a poor differentiator between students with very different performance levels (for instance a very poor 7 and a very high 7) receive the same grade. This is one reasons why students made complaints, as they feel their better performance is not awarded fairly compared to others. Additionally, as one teacher explained referring to essay exams, this type of grading scale does not allow exceptions and students' extra effort or knowledge to be rewarded. According to the grade descriptions in the scale, teachers have to look for how many mistakes the students made in order to decide on the grade. This makes the examination process an activity that is based more on negative scanning of exams than looking for positive points. Similarly, from the students' perspective, the scale divides the students into good and bad performance with low grades seen as having a more negative impact than a high one for the final GPA.

Discussion

Based on the data collected in this study and a review of the value proposition canvas' for the teaching and student profiles it would appear implementing AES would allow CBS to increase efficiency in the examination system, however it is acknowledged there are drawbacks to such implementation.

From the interviews with teachers, it was revealed that many teachers did not do formative assignments because they felt there was no time available to mark them. At the same time, however, it has resulted in some departments starting to look for new ways to increase the use of formative assessments as a “pass or fail” or requiring the student to send a minimum number of completed assessment in order to be admitted to the final exam. Additionally, as one teacher explained, the university has a contract with the Ministry of Higher Education that aims at increasing the study intensity of students as they believed to show a low study effort during classes. By cutting out time spent on examinations, teachers will have the opportunity to dedicate their time to more valuable activities like teaching and researching. Reflecting on the literature from higher education and the students’ gains pinpointed in the canvas as “seeing value come out of education”, this will have a positive impact on the quality of teaching (Ramsden, 2003). From the extra time saved from marking, teachers will be able to add additional valuable lectures that would incentivize students’ participation. For instance, in-class participation can be stimulated by following Säljö (1979)’s view that creating more in class students’ discussions that incentivize students to compare different types of learning and assigning in-class practical or case study exercises to make students interpret knowledge and understand reality in a different way.

The other important point to note is that these tools will allow students to receive rapid feedback on formative assignments so that they have time to improve their knowledge in advance of the final exam. Besides feedback on formative assessments they will also be able to get feedback on their final exams which is one of the “jobs” that students want from the examination system.

By using AES, the examination process will become more standardized as teachers will have to design their assignments by developing a standard solution beforehand or a specific rubric on which the software will be trained to grade the exam and provide feedback. In relation to this, the examination process will become more objective. Having a more objective examination process will enhance transparency and fairness of the examination method as students will be able to work toward consistent predetermined assessment criteria.

AES will also provide feedback to each single student, as well as provide a general overview of the students’ performances and knowledge level to the teacher. This will help the teacher investigate whether there are topics that have to be explained further during the rest of the course, and at the end, after the final exam, understand whether their teaching requires improvement or changes.

There are some potential drawbacks that might result as a consequence of the implementation of AES, some concerning the assessment process itself and others concerning ethical matters. The first is that students, after learning how to use these tools and knowing what these tools are looking for when assessing, may figure out how to deceive the system in order to receive a higher grade. Another point that requires consideration is the legality of using AES and to ensure that in the formal examination process teachers will still have the role of signing off on the grades and acknowledging that the software is only an aid and not replace the teacher (Ministry of Higher Education 2018). A further concern would be if teachers do not read all of the written assignments which students are required to submit to CBS as a part of their preparation for the oral discussion. When oral examinations are used the teacher usually starts by asking questions related to the students’ written production and that requires the student to further reflect on what they have written. On the basis of the students’ answers, the teacher will then move to other topics in the syllabus. When a written production is assessed by an AES tool, it may be harder for the teacher to come up with questions that are related to the student’s paper as they were not able to read it fully. A further concern is the amount of work required in order to train the software for different courses. Teachers will need to put time in, firstly, finding out the content on which to train the software and, secondly, developing the solutions that they want their students to come up with together with listing predictable mistakes in the system.

Issues may also arise when students get low grades through AES. As, Wind (2018), co-founder and CEO of Peergrade, states, such a new technology will take time to meet the trust of students and hence students might be very satisfied when they get a good grade but feel angry and not treated fairly when they get a low grade. This trust issue means that students may end up questioning their machine marked grades than the ones provided by a teacher. In such a case, the teacher will have to come into place to evaluate the complaint and establish whether the grade given was the right one.

One of the ethical concerns has to do with the difference between humans and machines. By reflecting on the use of AES, a teacher brought up the “pain” of facing the trade-off of having to give up authenticity in order to achieve standardization. This is because, on the one hand, AES would increase the fairness and objectivity of examinations creating an important benefit to the students that feel that they are not treated equally with respect to the others and on the other hand, it will decrease the value of authenticity. Three teaching professors during the interviews said that, even though examining more than 100 papers is a struggle, they actually learn new things from what the students write in their papers and this is something that amuse and excite them. Writing essays that have to be graded by a scoring engine might turn out as a low value activity for students as there will no longer be a human behind the process that would be able to appreciate the pieces of writing. In relation to this, Yonck (2017) said that no matter how much human-like these tools become, the question will still be on how authentic its thinking processes and responses will be.

Notwithstanding the ethical drawback raised by teachers, it is important here to consider that the value of education is not lost. While students will be graded by a machine, as already stated among the benefits of AES, teachers will spend more time in class interacting with them through engaging exercises where the students have to bring in their own perspectives and thoughts. It can be argued that, with AES, the value of education and teaching will shift from the moment after the final exam and after receiving the grade to the moment in which the class is actually being taught. If students were to see this value added throughout the course of a class, they would be more incentivized to participate and, by actually participating, might increase the chances of getting a higher grade in the final exam.

In looking to the future, the research has revealed some additional features necessary for AES to be valued for formative and summative assessment. One feature is the ability to test the content and validity of the points made by the student in written papers. Even though ML and AI capabilities are increasing, it is important to be able to predict new content that may be introduced by the student. Finally, in relation to the future of AI where emotional intelligence will be eventually reproduced by machines (Yonck, 2017), AES will have to be able to understand the tone of writing in order to better analyse whether the arguments that are made are logical and have valid reasoning. An analysis of teachers and student's contributions, benefits and drawbacks of an AES solution are summarized in Table 1.

Limitations and recommendations for future work

This research was based on a single case study of a Danish Business School, CBS. It is important for future research to analyse other educational systems before directly applying it to other learning realities. In addition to consideration of the feedback system, it is believed that future research should include consideration of the customs of other countries and how feedback is provided. Consideration should also be given to differences in course levels. This is because master's students tend to be more experienced in academic writing than bachelor's students and, assessments might require different weights for the writing abilities and styles of students.

Table 1: Benefits and drawbacks of an AES solution

Benefits	Drawbacks
• Less time spent on examining • Less time for students to receive a grade • Possibility of doing both formative and summative assessments • Increasing students' study effort during courses by using formative assessments • More time for teachers for focusing on teaching and researching • Students will receive feedback both on summative and formative assessments • Standardized and objective examination process • More transparent and fair examination process • The teacher will have an overview of the level of the entire class	• Students might learn how to deceive the system to get higher grades • Teachers have to trust the software giving the grades to students • The teacher will not be able to know enough about the students' written composition that is prepared for the oral examination • Teachers need to spend time on setting up the software • Students not trusting the grades that were given through automatic examining and filing more complaints • Losing human authenticity • Losing the value of written composition

Conclusion

AI is considered one of the major breakthroughs of the Content - Centric Era (2005-2025) where technology is said to be conceived to enhance customization of products and services (Willcocks & Lacity, 2016). Having an assessment tool that functions as a service for teachers and students, implies a standardization of the examination process. By observing the EU context, in line with The Bologna Accord (2005) which aims at standardizing the educational system of all the different EU countries, AES, if implemented, would help achieve harmonization between different higher education systems and make it easier for a member country's student to move from one system to another while having the same examination process.

Our research contributes to a gap in the literature of AES in the specific context of higher education. Moreover, by interviewing stakeholders of the process, we have adopted an innovative approach. This consisted of applying human centred design through the value proposition design framework (Osterwalder et al, 2014) and by investigating knowledge and value creation with a service dominant logic approach of serving the examination process (Vargo & Lusch, 2004).

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PASS Online assisting first year psychology and social science students in statistics: A 360-degree view

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Traditionally difficult subjects, such as statistics, offer a substantial learning challenge for students in their first year of university. Supplemental instruction or Peer Assisted Study Sessions (PASS) can provide students with benefits including increased confidence and grades. This project sought to compare face-to-face (F2F) sessions of PASS for the first-year psychology statistics subject PSYC123 with an online version. Employing a mixed-methods approach, including feedback from both students and PASS leaders, results indicated that online students found the platform easy to use and navigate, believing they had benefited from the sessions. All PASS students achieved higher mean grades compared to students who did not attend. PASS Online students also saw increased grades compared to F2F, although this difference was not statistically significant. PASS Leaders found that more time was needed in the online version compared with F2F, but felt that the online sessions allowed for similar interactions as those in F2F. Results indicated that online SI can be successful, however traditional activities need to be adapted and specific training is required for PASS Leaders. Time allocations, and skills development in students and leaders are required for a successful online PASS.

Keywords: Peer Assisted Study Sessions (PASS); Supplemental Instruction; online learning; first year university

Statistics subjects in university are often seen as difficult and challenging, especially for students in their first year of university study (McKenzie & Schweitzer, 2001). This transition year is challenging for many students where new types of learning are engaged in, external time pressures are experienced, and new technologies are employed (Biggs, 1999). Students often struggle with the necessity for studying statistics, being ill-prepared to tackle such a challenging subject (Simson et al., 2012). In the Social Sciences students find it difficult to marry the concepts of hard maths with human-based subjects such as psychology, social science, and social work. Mature-age students, in particular, find statistics difficult as they have not dealt with formal maths for many years, whilst other students doubt their own abilities to successfully navigate the subject (see Ramsey, 1999).

Programs such as Peer Assisted Study Sessions (also known as Supplemental Instruction: SI) offer students the opportunity to learn from each other and put into practice the equations and concepts introduced in their subject (Topping & Ehly, 2009). Traditionally held for challenging first year core subjects (Hurley, Jacobs, & Gilbert, 2006), sessions are led by student leaders, who themselves have succeeded in the subject in previous years. Leaders facilitate learning and student interactions rather than engaging in traditional teaching methods. Students lead the focus of the sessions, spending time on those areas students feel they have the most need.

As student numbers increase, time and space availability to hold face to face (F2F) sessions decrease. Today's students also face increasing time pressures, both internal and external to university study, driving the demand for out of hours classes and flexible learning opportunities (McKenzie & Schweitzer, 2001). For these reasons, more SI programs are making their way into the online space, however the unique stimuli and cues that come with F2F learning may be lost in the virtual world (Beaumont, Mannion, & Shea, 2012). Therefore, research investigating the effectiveness of online versions of PASS-type programs compared with F2F versions is necessary: in particular, multi-method approaches encompassing a range of data that is not limited to student grades but also includes student and leader perspectives. This will allow for a more in-depth investigation into the challenges facing online learning modes and help in identifying the strengths and weaknesses of moving a collaborative learning model into an online format.

Peer Led Learning Programs

PASS at University of Wollongong

Peer Assisted Study Sessions (PASS), was first launched at UOW in 2002. PASS is traditionally run in parallel with first year, core university subjects that students find difficult. These include subjects from Business, Nursing and Psychology, with currently over 40 subjects being facilitated at UOW each year. Over the years, students have reported many positive benefits from participating in the program, including increases in grades and confidence.

PASS leaders are themselves students who have successfully completed the subject they lead. Leaders facilitate the sessions encouraging student led interactions, guiding students through various learning activities designed to help students gain appropriate study strategies. Activities can vary depending upon the subject. F2F activities may include concept lists; group brainstorming; identifying missing equation elements; or labelling diagrams. Students work individually or in small groups to come up with answers to problems. They are then encouraged to discuss their answers and their approaches with the rest of the group. In this way, students engage in peer teaching and learning.

Difficult subjects in first year

STEM (science, technology, engineering & maths) subjects are traditionally considered difficult subjects, particularly for first year university students. Dawson, van der Meer, Skalicky and Cowley (2014) point out that although the definition of difficult or ‘high-risk’ subjects vary they have common characteristics such as high volumes of reading, large classes, and require higher cognitive abilities. These subjects cover a range of disciplines and include subjects such as statistics (business; psychology), calculus (Maths), and general information technology, biology, chemistry and engineering subjects. Kennedy, Hefferon, and Funk (2018) reported that 52% of American students believe that STEM courses are too difficult to study. Whilst the ABC (Beech, 09/07/18) has reported that in Australia, student enrolments in high school advanced maths subjects is in decline. In particular women and ethnic minorities are less likely to be attracted to STEM subjects and courses (Malliris, 2012). Research has revealed that high school academic success, and life/work/study balance can impact student success (Whalen & Shelley, 2010). Kokkelenberg and Shina (2010) also identified maths preparedness as a predictor of student success. Attitudes toward STEM subjects can be changed, as evidenced in Tseng, Chang, Lou, and Chen’s (2013) study, however the reality is that students still feel inadequate and lack confidence in tackling many first year STEM subjects.

Combined with this is the difficulty some students face in transitioning into first year university study. As well as increased demands on time, with students undertaking more work and family commitments (McKenzie & Schwietzer, 2001), some students lack the skills to adequately engage and benefit from the type of study that is required at the tertiary level (Simson et al., 2012). Blended and active learning models that encourage deeper learning, are unfamiliar to many students who do not know how to best take advantage of the flexibility offered, or how best to learn from these models (Biggs, 1999). Self-drive and motivation are needed as students are held more responsible, but less accountable, for their own learning compared to high-school learning (O’Flaherty & Phillips, 2015). Students also need to acclimatise to large classes (in the form of lectures), new technologies in the form of subject websites (such as Moodle or Blackboard), and be responsible for their own enrolment, subject selections, and timetabling. Given these issues, it is important to offer students as much support as possible to aid their successful transition into university study.

Findings in SI research suggests students who attend achieve higher average grades compared to those that do not (Dawson et al., 2014; Beaumont et al., 2012). PASS-like programs can also increase retention rates with fewer withdrawals (Dancer, Morrison, & Tarr, 2015; Smith, Wilson, Banks, Zhu & Varma-Nelson, 2014), decreased sense of isolation (Evans & Moore, 2013) and increased student interest and engagement (Dekhinet, Topping, Duran, & Blanch, 2008). Student feedback reveals that they enjoy the flexibility of online sessions (Lim, Anderson, & Mortimer, 2016) and the collaboration with other students (Bone & Edwards, 2015; Edwards & Bone, 2012).

In the online space, findings are more varied, with little standardisation of the definition of ‘online attendance’ (Dawson et al., 2014). Some studies have found no differences between the F2F and online learning environments (Spaniol-Matthews, Letourneau, & Rice, 2016) suggesting that both modes have equal benefits, however, other research has found no grade increases for online cohorts (Taylor & Kelly, 2014). Lack of student uptake for online modes (Nikolic & Nicholls, 2017); lack of student engagement in feedback (Spaniol-Matthews

et al., 2016); and technical issues experienced by some students (Rourke & Anderson, 2002) may explain the variation in results.
Online delivery of supplemental instruction requires the development of a different set of skills compared to F2F modes (Beaumont, et al., 2012; Wang, Huang, & Queck, 2018). Activities traditionally suited to a classroom environment need to be adapted in the online space (Stout & McDaniel, 2006). Leaders also need to train students in the tools and communication modes available in online platforms and battle against students' reluctance to interact. (Nikolic & Nicholls, 2017). The online space can be challenging for students and leaders alike, with no guarantee that an online format can adequately or successfully emulate the F2F student experience (Fetner, 2013).

PSYC123 – Research methods and statistics.

This subject is core for both psychology and social science students at UOW. The subject, therefore, caters for a wide variety of students in terms of ATAR (65 for Social Science; 75 for Psychology) and background. Many social science students are mature-age and have not experienced formal study for many years and more than half the total cohort travel long distances to attend UOW. This is a large cohort with student numbers averaging around 600 in a session.

PSYC123 is an introductory statistics subject designed to expose students to various research methodologies and statistics. All statistics are calculated by hand, with students learning which statistics can be applied to different research designs and questions. Students are taken through several steps including analysis of the research question, selection of appropriate statistic, hypothesis generation, calculation of degrees of freedom and critical values, statistical calculation, and finally evaluation of statistical significance and interpretation of the result.

It is a fast-paced subject, taking students from calculations of the descriptive statistics including mean and standard deviation, through to inferential statistics including z-tests, Pearson's correlation, chi-square and three types of t-test. It is a challenging subject, throwing students headlong into basic algebraic concepts to more complex constructs of distributions and probability. Each week the students learn a new statistic, at a pace many students find difficult. Although the fail rate for the subject is quite low, students often begin the session with a lack of confidence and skill. Many students find basic calculations, such as square and square root, difficult without calculator assistance, and concepts of probability, hypothesis testing, and different statistical theoretical distributions are particularly problematic.

The subject has many supports in place to help students. Basic maths workshops are held in Orientation Week before the commencement of session. Whilst a mid-semester drop-in session allows students the opportunity to ask questions and get more specific help in areas they are struggling with. PASS has also been part of the supportive framework offered to students, however, places fill up fast, with many students missing out. Student demand was one of the impetuses behind bringing PASS into the online space.

The current project: PASS Online

PASS Online was funded by an ESDF UOW grant in 2017. The aim of this project was to emulate, as much as possible, the F2F experience for students in a synchronous online setting. PASS Online was not seen as a replacement for F2F sessions, but rather as a means of offering students who may not be able to attend F2F PASS with a more flexible and time-friendly option. This also meant increased access to regional students. One major consideration of PASS Online is that it needed to meet the core values and practices of traditional F2F PASS versions.

In keeping with the PASS model, student leaders were recruited to explore and test various online platforms, with Blackboard Collaborate being the final choice. The platform can be embedded directly into Moodle, meaning ease of access for students, and allows for synchronous online interactions via inbuilt tools such as break out rooms, whiteboard, chat function, 'raising hands' and file sharing. Leaders workshopped the online environment, swapping roles between leader and student to best prepare them for the session. This gave PASS Leaders an opportunity to anticipate student questions and adapt exercises that would be more suited in the online environment. PASS Leaders contributed to a PASS Online training manual as a result of this training and workshopping. In session 2, 2017, PSYC123 was chosen to be one of the subjects piloted for the online version of PASS. These sessions were promoted by both PASS and the subject coordinator to encourage student enrolment.

It was hypothesised that students would gain similar benefits in the online version, as those students who attended F2F PASS, and that PASS students would gain higher mean final grades compared to those who did not attend a session of PASS. It was also predicted that students' perceptions would reveal positive attitudes towards the PASS Online format, and that leaders, too, would find the online experience similar to F2F modes.

Method

Participants

Participants were 527 first year university students studying PSYC123. As well as a core subject for Psychology and Social Science students, PSYC123 is also a general elective subject at UOW. Those students who obtained a final mark of zero were excluded from analysis bringing the total to 514 students.

A total of 169 students attended PASS programs. Students were deemed to be PASS participants if they had attended a minimum of one, 1 hour session. In F2F only mode (PF2F) 137 students attended, whilst PASS Online only (PO) totalled 15 students, and 17 students attended a combination of both online and F2F sessions (PO+F2F). Four PASS Leaders took part in facilitating the PASS Online sessions.

Procedure

Students were briefed regarding the pilot nature of PASS Online and were asked for consent to be part of the study. Student participants were asked to complete surveys via Survey Monkey in weeks 6 and 13 of session. The survey included both Likert and open-end response sets asking a range of questions including "I have benefitted from attending PASS Online classes" and "Can you give examples of how the online version of PASS was similar to the face to face version of PASS?" PASS leaders also completed surveys at the end of session Several questions were similar to the student surveys with additional questions specific to the Leader experience, involving both Likert and open-ended responses. Questions included "the system allowed for class interactions between students and Leaders', and "the system was easy to use for Leaders". All Likert responses were analysed via quantitative methods, whilst open responses were investigated via qualitative methodology. Qualitative data and analysis were used to help elucidate quantitative results.

Results

Quantitative

Descriptives
PSYC123 students obtained an average mark of 69.71% (sd = 16.74). Average final marks, and hours attended, by PASS mode and No-PASS are displayed in Table .1. below.

Table .1. Mean and standard deviation of final marks achieved in PSYC123 across all PASS modes and No-PASS.

	PASS mode	n	Mean Final Grade	SD	Mean hours attended	SD
PSYC123	No-PASS	345	68.00	17.80	-	-
	PO	15	73.00	20.23	4.13	3.78
	F2F	137	73.26	12.83	5.86	4.04
	PO+F2F	17	72.82	15.04	9.88	5.40
	Total n =	514				

PASS vs No-PASS
Students who attended any PASS mode achieved higher average marks compared to those that did not attend PASS (see *figure* 1. below). A One-Way ANOVA revealed that this difference was significant ($F(3,510)=3.69$, $p=.012$). Post hoc analysis showed that a significant difference was found only between No-PASS and F2F Only ($p=.010$). There were no significant differences between any other PASS modes, nor between F2F only and the other PASS modes. It should be noted that PASS mode average marks represented a range of only 0.44 marks between them. The lack of significant difference between the other PASS modes and No-PASS may be the

result of small sample numbers. The small difference in PASS mode marks should be taken as an indication of potential significant differences if sample numbers were to be increased.

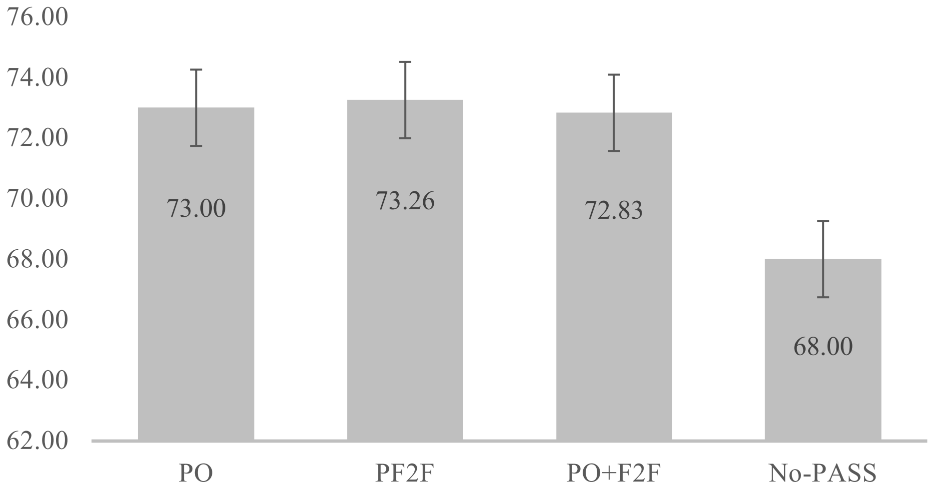

fig .1. **Average % Mark Achieved - PSYC123**

Likert Responses

The same Likert scale was used for the survey responses from 1 Strongly disagree to 5 Strongly agree. Student and Leader responses will be discussed separately. Table's 2 and 3 below gives an overview of the questions and mean responses. Overall students responded positively to most of the questions. Some students did experience some technological difficulty as evidenced in their responses, however at the end of session survey when asked if students would attend PASS online again, only one student answered 'no' from the 14 students that responded.

Table .2. Likert mean responses from student surveys: week 6 and end of session.

	Q.1. I have benefited from attending the PASS online classes		Q.2. The system worked as expected?		Q.3. system allowed for class interactions between Leaders and Students		Q.4. The system allowed for class interactions between Students		Q.5. technology was easy to use		Q.6. The technology ran very smoothly		Q.11. IF you attend both face to face and online PASS classes, indicate how much you agree with the following statement: Attending PASS online classes is a similar experience to the face to face version of a PASS class	
	m	sd	m	sd	m	sd	m	sd	m	sd	m	sd	m	sd
Week 6	4.22	.44	4.11	.78	4.56	.53	4.22	.67	4.67	.50	3.67	1.00	4.00	1.00
End of Session	4.33	.83	3.78	.70	4.22	.47	4.00	1.05	4.33	1.04	3.78	0.99	3.80	1.19

Table .3. Likert mean responses from Leader survey: end of session.

Q.1. The system worked as I expected		Q.2. The system allowed for class interactions between Leaders and Students		Q.3. The system allowed for class interactions between Students		Q.4. The system was very flexible for Leaders		Q.5. The system was very flexible for Students		Q.6. The online experience was very similar to the face to face version of PASS		Q.7. The technology ran very smoothly		Q.8. The technology was easy to use for Leaders?	
m	Sd	m	sd	m	sd	m	sd	m	sd	m	sd	m	sd	m	sd
3.50	1.00	3.75	.50	4.00	.00	3.75	.50	4.00	0.82	3.25	.96	3.25	.50	4.75	.50

Q.9. The technology was easy to use for Students		Q.10. Students benefited from the online form of the PASS classes	
m	sd	m	sd
4.00	.82	4.25	.50

Leaders were more conservative than students in their responses, with many means near the 'neutral' area of the Likert. Some leaders had technical issues which caused problems during some of the sessions (which will be discussed shortly). This had the effect of lowering their Likert responses.

Qualitative

Qualitative data was transcribed from survey responses verbatim. A lack of response rate and depth of this data did not allow for in-depth qualitative analysis, therefore responses were investigated for common types of responses, as well as uncommon responses to help elucidate quantitative results.

Students
The convenience of after-work hours and being able to attend from home were the most common reasons students cited for attending the PASS online. Students who had to travel long distances or had ongoing health issues also stated that the online sessions were easier for them to attend. Most students found the system easy to use although some technical issues were experienced. Students indicated that PASS Leaders were able to fix most of these. Some students expressed difficulties in working with computers, stating that their skills were lacking.

Students conveyed many benefits including increased confidence in the subject material: "*The PASS leader has expanded my understanding of the content covered in lectures*". PASS leaders were said to be helpful and encouraging. The ability to break off into smaller groups with other students to work on problems and then share answers helped students to understand they were not alone. Students enjoyed the interactive nature of the platform saying " *it's really easy to ask questions and get clarification".* Functions such as chat were used often, allowing students to ask questions in private. Students believed that the online version was very similar to F2F, although more time was needed to cover the same content.

Leaders
The feedback from leaders demonstrated their varied experiences. Some revelled in the online space, adapting activities to suit the medium and successfully encouraging students to interact with each other: *"There is always a new way to approach the activity, and it has a broad range of resources that you can access because you're already online."* Other leaders seemed to struggle with technical issues including internet speeds and connections. The fact that some students chose or could not use their computer webcam made the sessions impersonal and interpersonal connection difficult. Leaders all agreed that activities generally took longer in the online space compared to F2F modes, suggesting that the online session times be longer than the traditional 1 hour. Of the four Leaders who ran online sessions, only one said they would not like to do online again, as they preferred the interactions provided by F2F modes.

Some limitation of the platform itself were particularly challenging in a statistics subject. Formulae were not easy to write up quickly and students had difficulty writing symbols and equations on the whiteboard feature.

This could be overcome by having students sharing documents, but again there was the problem of students knowing how to construct formulae using the equation tool in word or excel. Internet connection problems also meant that some files, particularly power point slides, were slow to load. Leaders communicated that these were not significant issues, however, with their feedback being positive about the online experience for both themselves and their students: *"As good, possibly better than face to face"*

Discussion

PASS, whether online or F2F, provided students with many benefits including increased grades and increased confidence in PSYC123. Students who attended sessions of PASS achieved higher mean grades than those that did not attend any PASS. Although not all PASS modes demonstrated significance in terms of final grades, all attendees achieved higher grades regardless of the PASS mode attended. This aligns with previous research finding that SI facilitated increases in grades for attending students (Beaumont et al., 2012; Dawson et al., 2014)

Students believed that the online version of PASS had benefited them and that it was similar to a F2F experience. Students enjoyed the flexibility of the online mode and the collaboration with other students, in line with previous studies (Lim et al., 2016; Bone & Edwards, 2015; Edwards & Bone, 2012). The only time students did not report this was when technological issues interfered with their online experience. Students liked the flexibility of the online mode. Some students attended both F2F and online versions of PASS, and reported that, although slightly different, that each version offered benefits for the students. A stable internet connection and basic computer skills are both necessary for the successful running of PASS online. Students should be made aware of this when making the decision to attend online sessions.

PASS leaders reported overall success for their online sessions. They noted that some activities required more time compared to the same activities in the F2F space. This was mainly due to slower interactions between leaders and students in the online space, and, at times, a lack of response from some students. PASS leaders learned how to adapt to students who were reticent to contribute to the online sessions, using control of microphones and private messaging to either control or encourage student participation. In the online space, there were instances where students were distracted by events happening at their own location, or who left the session briefly without communicating their intentions. This had the potential to disrupt sessions, however PASS leaders quickly learned to adapt to these situations. It was suggested that students of the online sessions make a contract of understanding with each other regarding online etiquette and participation. Setting up these expectations at the beginning of session, as is done in the F2F sessions, would help students understand their responsibilities to the rest of the group.

Attendance to the online sessions was sometimes very low, making some usual PASS activities difficult to run. PASS leaders, again, were able to adapt, encouraging the few students in the session to engage in activities. Nikolic and Nicholls (2017) faced similar low participation rates in their study. It may be that, although students push for more flexible modes of learning and support, motivation, time commitments, or a lack of confidence in the online space make students hesitant to take up the opportunity when presented. Further research into the characteristics and specific circumstances of students may help elucidate how best to encourage uptake in the online learning and support spaces.

It should be noted that self-selection bias is a common problem in the SI research space. Often the most diligent students are the ones that engage in extra assistance (see Dawson et al., 2014). Although students may feel that online study of this type will give them more flexibility and be more convenient, some students may struggle with the self-driven motivation that is required (Fetner, 2013). The allure of an online learning platform that requires only a computer and time, does not always translate to good time management and/or commitment skills that students need to succeed. This is particularly pertinent in the first-year space where students are still learning how to learn and study effectively (Smart & Cappel, 2006). The self-reliant nature of online learning is sometimes met with resistance from students (O'Flaherty & Phillips, 2015), which suggests these students do not yet know how best to take advantage of online learning. More research is required into the characteristics, factors, and skills students require to be successful in the online space, and in helping them develop appropriate strategies and motivations.

Limitations

The low numbers in the online modes of PASS made quantitative statistical comparisons difficult. Results, however, revealed trends demonstrating PASS students obtained higher mean grades, regardless of the mode attended. Increased sample numbers in future will be able to clarify if these differences are statistically significant.

Low response rates for the surveys also made in-depth qualitative analysis impossible. Not all students who responded to the surveys answered the open-ended questions, and so some opinions and insights into how PASS online ran for students may be lacking. Again, larger sample sizes in future may help elucidate this.

Conclusion

Online versions of supplemental instruction are becoming more popular. Student time demands mean that out of hours sessions and the ability to work from home are increasingly appealing. Overall, students and leaders found the online versions of PASS to be of equal benefit as F2F sessions. Computer know-how and stable internet connections, however, can detract from the student experience. Not all leaders were able to adapt to the challenges posed by the online environment, highlighting the need for good Leader training in this space. Online sessions should also be longer, as activities took more time online compared to F2F.

As demands on student time increases, more students will turn to the online environment to gain access to learning resources, such as supplemental instruction. Platforms need to be easy to use and navigate and be efficient in terms of internet load. Specific training is required for online Leaders, as well as short tutorials for students to help them learn the system. Online versions of PASS allow more students to benefit from this peer-led learning model. The skills necessary to Lead these sessions will be developed over time as Leaders gain more experience in the online space. Training and research will need to continue to identify those factors that will help students achieve consistent benefits and outcomes in the online format of PASS.

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Exploring digital literacy as a graduate learning outcome in higher education – an analysis of online survey

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This paper explores the notion of digital literacy as a learning outcome in the context of higher education. As the world becomes increasingly digital and technologically connected, the ways in which universities support the development of student digital literacy are critical in order to equip graduates with the knowledge and skills to engage in society meaningfully and productively. Regardless of its importance, given the current landscape where numerous digital literacy frameworks can be found in the literature, the task of effectively teaching and assessing digital literacy within higher education becomes rather complex and challenging.
As such, through the preliminary analysis of an online survey conducted at a large Australian university, we investigate academics' perceptions of digital literacy as one of the graduate learning outcomes. With a successful application to the university's Central Research Grant scheme, the year-long research was conducted in 2017. This project integrated the online survey as well as Change Laboratory as part of the activity theory framework informing this research. Findings discussed in this paper include understandings about the perceived enablers that potentially allow academics to better teach and assess digital literacy in the future.

Keywords: digital literacy, learning outcome, higher education, academics, perception study

Introduction

With the rapid development of technology and proliferation of an increasingly digital world, digital literacy is considered to be one of the essential 21st century skills that university graduates must demonstrate not only to survive but to thrive beyond university (Pangrazio, 2016). As access to digital technologies improves across the world, the fluency in connecting, communicating and creating digital engagement and content has become more of a focus in the discourse around digital literacy (Alexander, Adams Becker, & Cummins, 2016). As students' learning needs become more complex and diverse, the higher education sector has faced the criticism that university curricula ought to provide more opportunities for authentic learning which equip students with transferrable skills outside of formal learning related to the disciplinary knowledge and skills (Jorre de St Jorre & Oliver, 2017). As a response to such criticism, and with a focus towards outcome-based approaches to curriculum, numerous tertiary institutions have created a set of graduate attributes and/or learning outcomes that explicitly touch on developing generic and transferrable skills. Digital literacy therefore is a key graduate learning outcome among these essential skills.

However, when it comes to the reality of teaching and assessing digital literacy as a learning outcome in tertiary curricula, the landscape is much more complex. On the surface, it may seem reasonable to assume that academics and students have an intuitive understanding of what digital literacy is, and subsequently apply particular skills associated in relevant contexts. As we reveal below, this assumption proves to be unrealistic. Looking back on the history of digital literacy it is apparent that there has since evolved an abundance of frameworks that outline the multi-faceted nature of digital literacy (Brown, 2017). These represent attempts to conceptualise the evolving phenomenon of digital literacy while also being responsible for teaching it to students. Put differently, on one hand, teachers in higher education are faced with the problem of understanding and navigating through the complex nature of this concept alone. On the other hand, they are tasked with also developing digital literacy skills themselves and applying the notion to teach and assess students' digital literacy.

Given this backdrop this paper does not aim to provide yet another digital literacy framework, but rather, aims to explore the university educators' perceptions about digital literacy in the context of teaching and learning practices.

Theoretical frameworks of digital literacy

To date, there is no single agreed-upon definition for digital literacy (Bawden, 2008; Pangrazio, 2016) or digital literacies (Knobel, 2008). In fact, there are currently over 100 models and frameworks attempting to capture the various dimensions of digital skills, literacies or competencies (Brown, 2017). The definitions of digital literacy have ranged from a focus on skills and capabilities (Martin & Madigan, 2006) towards more socially critical and politically active conceptions seeking to increase agency and addressing the growing social and cultural gaps (Ávila & Pandya, 2013). Avila and Pandya (2013) note the following aims of their critical digital literacy framework - “to investigate manifestations of power relations in texts, and to design, and in some cases redesign, texts in ways that serve other, less powerful interests” (p. 3). Alexander et al. (2016) also reported in their study that the interpretation can be disciplinary specific - academics in humanities view digital literacy differently to those in computer science, for example. As Brown (2018) noted, the varying degrees of capabilities and access to digital devices can limit people’s full participation in universities and society. This gap is not only often overlooked by educators and employers, but also puts many students and employers at a clear disadvantage in their participation in the (knowledge) economy. The notion of ‘digital natives’ can also mislead the critical engagement with the university and society more generally for the diverse cohort of students (Ng, 2012).

In this study, we draw on the Joint Information Systems Committee (JISC) framework as “one of the most cited efforts to develop a comprehensive framework for digital literacy” (Brown 2017, p.2). This particular framework defines digital literacies as “those capabilities which fit an individual for living, learning and working in a digital society” (JISC 2014, p.1). Through some iterations, the JISC framework (2014) outlines six dimensions of digital literacy - i) ICT proficiency, ii) information, data, media literacies, iii) digital creation, innovation and scholarship, iv) digital learning and self-development, v) communication, collaboration and participation and vi) digital identity and wellbeing. This framework constitutes a useful conceptual framework for our analysis as it provides a current broader view of digital literacy as opposed to a traditional narrow view strongly associated with information literacy.

The research design and methodology

DigiHub project – Change Laboratory

The aim of the research project was two-fold: i) to explore university teachers’ perceptions and practices of teaching and assessing digital literacy as part of a suite of graduate learning outcomes and ii) to facilitate transformation in the conception and practices of digital literacy for teachers and practitioners through a Change Laboratory, underpinned by activity theory (Engeström, Virkkunen, Helle, Pihlaja, & Poikela, 1996). Change Laboratory is a well-known interventionist approach, which emerged through a school of activity theorists (Virkkunen, 2013). It is an approach to social and constructivist transformation by bringing a group of people with diverse backgrounds and talents together so as to identify a gap/challenge in the activity systems and generate solutions to this gap as a collective of dynamic change agents.

In our research project we explored digital literacy as a concept that brings challenges in the learning and teaching communities of higher education. We then facilitated three Change Laboratory (group) sessions called DigiHub with an aim to establish a hub of educators that brought diverse expertise together to discuss and work through this problem in 2017. Each Change Laboratory session was 2-3 hours in length and all the interactions were video/audio-recorded and transcribed for text and thematic analysis with NVivo. A research ethics approval was sought and granted by the university’s ethics committee (HAE-17-124).

Online survey

As part of this research, an online survey was also conducted. Data from this survey were used as ‘mirror’ devices or ‘stimuli’ (Engeström & Sannino, 2010) to initiate and facilitate discussions in our DigiHub Change Laboratory sessions. The analysis of this online survey data is the focus of the current paper while discussions and analysis of the DigiHub sessions will form another paper in the future.

The online survey had 16 items stemming from a literature review with both open and closed questions. The primary aim was to quickly scan the insight on the attitudes around digital literacy from educators and practitioners at the university. The invitation for educators at the university to participate in the survey was sent via Faculty newsletters during May to December 2017. A total of 37 participants from all four faculties, as well as the Library and Divisions, agreed to complete the survey. Responses were gathered and subsequently formed a basis for our thematic analysis and discussions in this paper. The participants in this research included associate professors, (senior) lectures, librarians and academic developers.

Table 1: Number and demographics of the participants

Faculties/divisions	Arts and Education	Business and Law	Health	Science Engineering Built Environment	Others (L&T unit and Library)
Number	5	5	8	7	12

In the survey, questions were asked about participants' previous experiences with digital literacy in their teaching. The table below outlines that firstly, 65% of our participants had listed digital literacy in their unit/subject as one of the graduate learning outcomes (GLOs) and secondly that most of those who answered the questions (24 out of 37) in fact taught (75%) and assessed (70%) digital literacy in their practice.

Table 2: Participants' previous experiences with teaching and assessing of digital literacy

	Have you had DL listed as one of the GLOs in your unit? (Answered: 37)	Have you taught DL in your unit? (Answered: 24)	Have you assessed DL in your teaching? (Answered: 24)
Yes	25 (65.57%)	18 (75%)	17 (70.83%)
No	7 (18.92%)	4 (16.67%)	5 (20.83%)
Don't know	5 (13.51%)	2 (8.33%)	2 (8.33%)

Discussion

Demystifying digital literacy

In the online survey there was an explicit question that asked participants to provide their own definition of digital literacy (no more than 200 words). Unsurprisingly, some participants described it with more focus on ICT and information literacy only. This could be easily understood as an influence by the University's articulation of digital literacy as a Graduate Learning Outcome – i.e. "using digital technologies to find, use and disseminate information" (GLO3: Digital Literacy). However, as a whole, our participants generally conceptualised digital literacy more broadly, typically including the creation of digital media and engagement with digital tools that are socially connected to enabling our lives. One of our participants observed that: "digital literacy encompasses a set of practices and strategies that enable us (student, academics, professional staff) to adapt to changing technologies that are ubiquitous and essential for studying, working and living in a digital world (Participant A)." Some of the representative definitions provided by our participants are mapped against the JISC model in the table below.

Table 3: Definitions of digital literacy provided by the participants

JISC (2014) the six elements of digital literacy	Our participants' responses/definitions
i) ICT proficiency	• 'Knowledge, skills and behaviours necessary to effectively use digital devices and technologies to achieve desired goals.' • 'To look up/process/present information.' • 'To use digital tools to effectively and efficiently produce quality work that is fit for purpose.'
ii) Information data, media literacies	• 'Make an internet search to find trustworthy information.' • 'To find, use and disseminate information.' • 'To work in the digital environment and communicate with images as seamlessly as with words.'
iii) Digital creation, innovation and scholarship	• 'Use technology to change the way you do your tasks and change the way you think.' • 'To effectively and confidently navigate through a world that relies on technology.'
iv) Digital learning and self-development	• 'Building experience and confidence in technology as part of career pathway.' • 'To use technology to support learning and work activities and for life needs.' • 'Ability to seek and apply digital technologies to complete academic work.'
v) Communication, collaboration and participation	• 'Knowledge of digital tools, platforms, equipment and software that enable to perform work effectively and to communicate knowledge transfer with colleagues, industry and students.' • 'Knowing how to best use technology to communicate/provide information to your audience.'

	• 'Facility with the use of digital technologies for communication.'
vi) Digital identity and wellbeing	• 'To interpret and create meaning digitally or in digital environments.' • 'Understandings of the impact of technologies – how technology supports/distracts in an individual's personal and professional life, and the potential empowerment/disenfranchisement, economic or otherwise, impact on the global community.'

Attitudes towards digital literacy, teachers, students and the University

The survey also asked participants about their attitudes towards digital literacy in the context of learning and teaching at university, and in relation to their/students' capabilities and the university's responsibilities.
Our participants largely believed that i) the use of digital technologies is critical to teaching, learning and assessment (90% for agree + strongly agree) and also ii) they thought the University had the responsibility to equip students (90%) and academics (96.7%).

However, when they were asked about the level of understanding around digital literacy to confidently teach and assess it, a level of uncertainty crept in (24.14% neutral) and 10.34% of the participants disagreed. Interestingly, when they were asked about their knowledge and skills compared to their students, there was a small but recognizable portion of uncertainty (72% combined in Q5 and Q6) and disagreement (31% combined). Finally, participants generally didn't seem to think they received enough support from the University to develop digital literacy skills (28% disagree + 36% neutral) and only 36% agreed.

	STRONGLY DISAGREE	DISAGREE	SOMEWHAT NEUTRAL	AGREE	STRONGLY AGREE	TOTAL
I feel that using digital technologies is critical to teaching, learning and assessment.	3.33% 1	0.00% 0	6.67% 2	43.33% 13	46.67% 14	30
The University has a responsibility to equip students with digital literacy/skills.	0.00% 0	0.00% 0	10.00% 3	40.00% 12	50.00% 15	30
The University has a responsibility to equip academics with digital literacy/skills.	0.00% 0	3.33% 1	0.00% 0	26.67% 8	70.00% 21	30
I understand digital literacy enough to be able to confidently teach and assess this outcome for my students.	0.00% 0	10.34% 3	24.14% 7	55.17% 16	10.34% 3	29
My knowledge of digital literacy is more advanced than my students'.	0.00% 0	13.79% 4	31.03% 9	51.72% 15	3.45% 1	29
My digital literacy skills are more advanced than my students'.	0.00% 0	17.24% 5	41.38% 12	34.48% 10	6.90% 2	29
I receive enough support from the University to develop my digital literacy/skills.	7.14% 2	21.43% 6	35.71% 10	25.00% 7	10.71% 3	28

Figure 1: Attitudes towards digital literacy skills and knowledge

Ways of finding out new digital technologies

When the participants were asked about how they found out about new technologies, they responded with a wide range of sources (Figure 2). Work colleagues were unsurprisingly the most popular source (86.67%), followed by online/digital sources (63.33%), professional networks (63.33%) and friends/family (60%). Others, for example, included: conferences, communities of practice, faculty learning and teaching team and volunteering in primary schools.

ANSWER CHOICES	RESPONSES	
Friends/family	60.00%	18
Work colleagues	86.67%	26
Online/digital source	63.33%	19
Recommended by students	23.33%	7
TV	10.00%	3
Radio	13.33%	4
Newspaper	13.33%	4
Library	20.00%	6
Professional networks	63.33%	19
Other (please specify)	20.00%	6
Total Respondents: 30		

Figure 2: Sources for finding out new digital technologies

Support and resources needed - potential enablers

The participants were also asked about what resources or support they thought they needed to teach and assess digital literacy effectively. The responses to this question had a variety of ideas, which are then categorized into the following four themes – a) pedagogical support, b) technology support, c) time and smoother process and d) team expert support:

Pedagogical support

- 'Ways to express digital literacy skills in Unit Learning Outcomes.'
- 'Skills taxonomy for academics (not students) linked to Bloom. A resource of what digital literacy looks like when taught and assessed.'
- 'Support/resources that integrate this [i.e. digital literacy] into the context in which it is being used for each unit.'
- 'I would like to be more aware of the digital literacy levels that employers/industry are requiring and to ensure that students are being taught at this level.'

Technology support

- 'Technical support is greatly appreciated.'
- 'Access to dedicated IT help for staff.'

Time and smoother processes

- 'Time, WAM allowance, Relaxing constipated processes.'

Team/expert support

- 'The Pods [i.e. faculty learning and teaching units] could have a key role in supporting academics in developing their own digital literacy skills and in embedding the teaching of digital literacy skills in their courses.'
- 'A team with skills and expertise to assist with learning design. A team that contributes expertise to student online study/research skills & online academic resources (Library). A team that contributes expertise to student comprehension and writing skills (Language Learning Advisors).'
- 'Access to dedicated coaching as I learn to use the technology effectively and with confidence.'

Conclusion and future implications

This preliminary investigation into university educators' conceptions of digital literacy has revealed some of the complexity that underlies the challenge to teach and assess digital literacy in the context of higher education. The participants in this study revealed a broad range of conceptualisations around digital literacy when analysed using the JISC framework. However, none of the participants perceived digital literacy in a manner that covered all dimensions of the JISC framework in their single definition. The activity of teaching digital literacy as a learning outcome is therefore challenged by the need to be 'assembled' across the multiple activity systems of the university. While educators, academic developers and librarians all contribute to a conceptualisation of digital literacy consistent with their more localised activity system, this really calls for new ways of working with these activity systems to develop a shared and more coherent understanding of digital literacy as a learning outcome. The Change Laboratory model which we applied in the second part of this research project provides a basis for achieving that outcome and will be reported in a separate paper.

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Designing a video playing interface for second language learners

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With an unprecedent use of videos in education, several video playing interfaces have been proposed to enhance video learning. However, little research to date has explored how video playing interfaces should be designed for the need of language learners. In this pilot study, we explored how language learners utilize and interact with different types of macro- and micro-scaffolding features while they watch academic lectures and government advertisements. We elicited the learners' thought processes and tracked their interactions with the scaffolding features in several prototypes of video playing interface. The analyses revealed some important findings concerning scaffolding in video learning, most notably being the video type and the difficulty of its content seem to effect how language learners use micro-and macro-scaffolding. Based on the findings, we propose a new video playing interface.

Introduction

Over the past decade, videos have been increasingly used in education due to advances in video broadcasting technology and a remarkable affordability of video production software. Recent pedagogical innovations in education, e.g., MOOCs, blended learning, and flipped classroom, make use of videos to deliver learning contents that can be accesses anytime and anywhere. Unlike traditional forms, videos provide learning contents more dynamically in both auditory and visual channels, which shown to be an effective way to enhance learning compared to static and less dynamic learning contents (Berney & Bétrancourt, 2016). Nevertheless, if designed poorly instructional materials in videos can place extraneous load on learners' limited cognitive resources (Mayer, 2001). To alleviate the negative effects, several studies have, among others options, explored segmenting videos into smaller chucks, adding pauses, or using scaffolding activities (e.g, Merkt, Ballmann, Felfeli, & Schwan, 2018).

Making the case for language learners

Despite a large increase in video material, little has been developed with language learners in mind. Understanding video content for language learners can be very challenging. For one, the transient nature of video makes it difficult for language learners to process multimodal information. As English is the often the primary language of global resources, e.g., MOOCs, learners need to have a strong command of the language to study effectively; less proficient students may be unable to follow course and thus lose motivation. One way to support language learners is to design a video playing interface that caters for their needs. In this study, we explore the use of macro-scaffolding features (headings and table of content) and micro-scaffolding features in several prototypes of video playing interfaces. To our knowledge, exploring how language learners utilize and interact with these video features has not been investigated before.

Related studies

Perhaps one key characteristics computer-based learning environments (CBLEs) is that it requires self-regulated learning skills (Devolder, van Braak, & Tondeur, 2012). Self-regulated learning is a multidimensional construct but in its basic form it refers to learners' taking an active role of their learning (Mega, Ronconi, & De Beni, 2014).Obviously, learners require supports or scaffolding in self-regulated learning environments more than in traditional environment (Dabbagh & Kitsantas, 2005). In CBLEs, Sharma and Hannafin (2007) described scaffolding as "... the provision of technology-mediated support to learners as they engage in a specific learning task" (p. 29). There is a significant body of research on scaffolding with printed texts. However, little research to date has investigated how scaffolding can be implemented in video-based learning. As video technologies are advancing rapidly, there are many possible ways to support or scaffold learners in video learning environments (Merkt & Schwan, 2014).

Micro-scaffolding

Videotexts pose additional difficulties for language learners that print and audio texts do not present; most notably, the processing of transient delivery of multimodal information. To eliminate the effects, some researchers suggest that learners should be given a control over the flow of the information by, for example, allowing them to play, stop, rewind or replay the video text (e.g., Hasler, Kersten, & Sweller, 2007). When given such control, learners seem to achieve better learning outcomes (Schwan & Riempp, 2004). Basic micro-level features (e.g., start, stop, and replay) are available that may help learners better control the processing of information (Merkt, Weigand, Heier, & Schwan, 2011).

Macro-scaffolding

The role of headings and table of contents (TOC) have been studied extensively with printed textbooks, and act as textual signalling devices (Schneider, Beege, Nebel, & Rey, 2018) that communicate different types of information to the readers, e.g., demarcation, organization, labelling, and identifying the topic (Lorch, Lemarié, & Grant, 2011). While headings and TOC have been shown to benefits readers, little is known if the same benefits can be achieved with video learning. Recently, Cojean and Jamet (2017) documented the benefits of both macro-scaffolding (TOC) and micro-scaffolding (markers in the timeline) on information-seeking activity. Merkt and Schwan (2014) examined the effects of three video playing interfaces (non interactive, common, and enhanced video player) with the enhanced video has more options of micro-and macro features. In summary, previous studies have proposed designs of macro- and micro-scaffolding to enhance video navigation, information seeking, and self-regulated learning. How though, given their unique constraints, do language learners utilize the scaffoldings embedded in differing videotexts?

Methodology

In this study, we report the results of an initial cycle of Design-Based Research (DBR) project that seeks to develop a video playing interface for language learners. DBR is "a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually-sensitive design principles and theories" (Wang & Hannafin, 2005, p. 6-7). DBR has been used in education to align advances in research with educational practice (for review read Anderson & Shattuck, 2012). DBR is particularly well suited for developing new technology-enhanced learning interventions (Wang & Hannafin, 2005) including those in Computer-Assisted Language Learning (CALL).

While it has acclaimed a good standing in many research fields and communities, a number of critiques was levelled against the use of DBR. Most notably, Barab and Squire (2004) argued that "if a researcher is intimately involved in the conceptualization, design, development, implementation, and re-searching of a pedagogical approach, then ensuring that researchers can make credible and trustworthy assertions is a challenge" (p. 10). Anderson and Shattuck (2012), however, have argued no approach can claim that bias is totally absent. They further argued that the knowledge the researchers bring to the research project "adds as much as it detracts from the research validity" (p. 18). As we ourselves are language instructors and researchers, we believe that our collective knowledge and deep understanding of the context is an asset. Following a typical DBR journey, this pilot study was undertaken in four phases as illustrated in Figure 1.

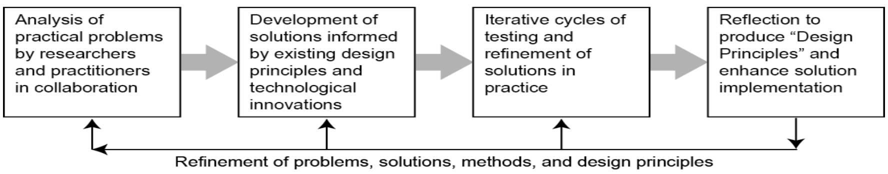

Figure 1: Reeves' Design-Based Research approach. Adapted from (Reeves, 2006, p. 59).

Selection of video materials

In a comprehensive survey study, Winslett (2014) documented a wide spectrum of video types and production styles have been utilized in the production of educational videos. While Winslett (2014) could not link a particular type of video to a certain learning outcomes, there are growing empirical evidences suggesting the varying impacts of video genre and production style on how learners interact with and learn from videos (Chen & Wu, 2015; Hong, Pi, & Yang, 2018). We hypothesized that there is relationship between learners use of scaffolding and video length, type, and content. Therefore, we selected four videos that diatonically different in genres (academic lectures vs. government advertisements), and production styles (documentary, lecture, PowerPoint slides).

Video playing interface design

We designed four initial prototypes of video playing interfaces which contain one of the following options: concise headings and TOC, detailed headings and TOC, and embedded headings. The concise and detailed TOC are used videos from both genres (see Figure 1 for an example). Embedded headings and concise TOC used with one academic lecture. We use the term "embedded headings" to refer to those headings already embedded within video by the original instructional designer as it is commonly used in a slide-based academic videos.

Figure 1: A prototype of video playing interface with a detailed TOC and control buttons

Participants

After gaining human research ethics approval, we recruited four English as a Second Language learners to participate in this study. The learners are all adult and male students from Saudi Arabia who, at the time of the study, have completed an advance English course and recently commenced their graduate studies in an Australian university.

Data collection and Analyses

A web application was purposefully developed to: (a) host the video playing interface designs and making them accessible to the participants, and (b) video record the participants as they verbalize their thoughts and track their clicks and interactions. The application was implemented using Django 2, a Python web framework, and frontend coding languages (HTML, CSS, and JavaScript). We tracked the participants' interactions using Google Analytics. Additionally, semi-structured post-hoc interviews in Arabic were conducted in which participants were asked to discuss experiences, and if they have any suggestions for improving the interface designs.

To eliminate the novelty effect, all participants took part in a warm-up task to become familiar with the platform and its features. Recordings of verbal reports and post-hoc interviews were first transcribed and then analysed and coded by one of the authors. A second coder was asked to blind code 20% of randomly selected transcripts; following that, the two coders discussed discrepancies until full agreement of the codes was achieved.

Findings and discussion

The analyses of verbal reports, interviews, and tracking data resulted in a number of findings concerning the use of micro (play, pause, rewind, and forward) and macro scaffolding (headings and TOC). These findings, and their implications, are summarized in Table 1.

Table 1: Findings and implications for design

Categories	Findings	Implications for design
Frequency of use	• Learner use concise TOC more than detailed one. • Learners use micro level features more frequently with longer videos.	• Use concise headings and TOC for video navigation.
Purpose of use	• Detailed headings and TOC do not seem to help learners develop conceptual understanding of video content. • Concise TOC may be better than detailed TOC for video navigation and understanding. • When they are embedded in the video, headings seem to be more beneficial.	• Avoid using detailed headings and TOC • Use embedded headings for better video understanding
Video type and content	• Video content and production style seem to affect learners' use of micro- and macro scaffolding. • Video content difficulty may interact with how frequently learners use video features.	• With difficult content, use both concise TOC and embedded headings

The quantitative analyses of click events showed that language learners used TOC less frequently than we anticipated, perhaps because they were not asked to do any activity with the video. If, for example, learners watch the videos to take a comprehension test at the end, they may use micro-level features more frequently. In their verbal reports, learners indicated that they start exploring different video features when they find video content either boring (easy) or confusing (difficult). Therefore, relying on quantitative data alone can lead to misinterpretations of learners' behaviours. Additionally, the data does not show any indications of learners using scaffolds to build structural knowledge of the video content. Taken together, these preliminary findings have already resulted in an improved design of our interface (Figure 2).

Figure 2: A proposed video playing interface with a visual indexer and a search bar

One change in our interface is the inclusion of an interactive visual indexer that allows learners to save timestamped frames to help them jump between different segments of the video, as a way to promote greater learner control. A second feature allows for improved search functionality. Both features will be investigated in our planned second cycle of research.

Conclusion

In this pilot study, we explored how language learners use and interact with micro and macro-scaffolding features while watching videos. The results suggested that concise headings and TOC is better than detailed ones and language learners seem to use video features differently when video content is challenging. Note should be made here that these findings are generated from small pilot study and should not be generalized to other contexts. We plan to further investigate the effects of scaffolding features with a larger sample.

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Interdisciplinary Open Science: What are the implications for educational technology research?

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Evidence-based educational practice and policy relies on educational research to be accessible and reliable. For educators, creating the next generation of critical thinkers, collaborators, and effective communicators, is a complex educational problem, requiring a delicate marriage of methods and approaches for understanding the mind, behaviour, and social context of the learner in the digital age. As such, educational technology research plays an important role for informing practice and policy. However, reaching across the boundaries of research, policy, and practice, is inherently challenging, and can invoke unintended consequences. Miscommunications, and mistakes, are inevitable in interdisciplinary and applied science, but advances in technology now make it possible to openly share and translate educational technology research for policy and practice. Our aim in this paper is to describe how the emerging set of practices and philosophies within the Open Science movement can make educational technology research more transparent and aid translating it into practice.

Keywords: Open science, educational technology research, interdisciplinarity, translation

Interdisciplinary educational technology research and the translation problem

Translating educational technology research when designing for learning in various contextualised settings is an intrinsic challenge in educational practice. The problem of designing effective instruction for learning that will enable better critical thinking, problem solving, collaboration, and communication in the digital age is as complex and *wicked* as they come (Rotherham & Willingham, 2010). A basic understanding of cognition (and metacognition) inferred from conventional laboratory-based experiments can fall short when applying the findings in the physical or virtual classroom. Likewise, general inferences about how people learn drawn from *in vivo* studies, thematic analyses of survey responses, or behavioural patterns uncovered in big data can fail to generalise when tested experimentally across materials, contexts or tasks (Lodge, Alhadad, Lewis, & Gašević, 2017). Educational researchers have argued that interdisciplinary collaboration is crucial for making real progress (McNamara, 2006; Palghat, Horvath, & Lodge, 2017) towards discovering general principles of learning across levels of granularity, and designing genuinely effective learning and instructional methods for use by learners, educators, and policy makers at the *chalkface*.

Interdisciplinarity can be viewed as a defining characteristic of educational technology research. A delicate marriage of methods and approaches to examining the mind, behaviour, and social-technological context of the learner is considered greater than the sum of its disciplinary parts. But effective communication is fundamental to the success of any scientific enterprise, particularly interdisciplinary work. The different languages across the family of academic disciplines and applied practices making up the educational technology community can obscure the methods, findings, and "*modi operandi*" of our peers (Dudai, Roediger, & Tulving, 2007), and inevitably result in miscommunication. This translation problem is exemplified by the propagation and persistence of educators' misconceptions about learning and the brain, and *neuromyths* in the classroom (e.g., learning styles, hemispheric dominance etc.; Howard-Jones, 2014; Pasquinelli, 2012). The inherent fogginess in bringing qualitatively different fields together to answer common questions about learning is also evidenced by the divided discourse around neuroscience and education as uncomfortable bedfellows (Ansari & Coch, 2006; Bruer, 1997).

More cooperation and collaboration between scientists, practitioners, and policy makers is a commonly proposed antidote to the (side) effects of interdisciplinary and applied research. There are also lessons to be borrowed from medicine, where seemingly simple interventions for saving lives, such as pre-surgery checklists, have initially failed on implementation without "user buy-in" or engagement with local hospitals (Anthes, 2015). It is impossible to effectively assess and appreciate the contributions of our interdisciplinary peers, and to effectively synthesise and translate our collective findings for use by educators and instructional designers, without sharing crucial elements of our research: materials, protocols, code, data etc. Transparency in *how* evidence is produced is a *sine qua non* for effective translation across disciplinary and implementation boundaries.

Interpretation, transparency and metascience

Research translation in educational technology is not helped by the opaque nature of research practices, which are themselves moulded by the interpretations of individual researchers. Humans are notoriously expert at seeing patterns in noisy, even random, data. Our chronic apophenia is illustrated by our tendency to expect a fair coin toss to come up tails if it follows a series of heads (i.e., gamblers fallacy; Bar-Hillel & Wagenaar, 1991), or to favour a basketball shooters' chances of scoring a free throw if they've been successful in previous shots during a game (i.e., the hot hand illusion; Gilovich, Vallone, & Tversky, 1985). We find illusory faces in pure noise images (i.e., pareidolia; Liu et al., 2014), and we hear illusory backward messages in rock music when told to listen for specific phrases (i.e., expectancy effects, confirmation bias; Vokey & Read, 1985). Such *regularities*, *heuristics*, or *biases* in judgements and decisions are shaped by our experiences; we rely on them automatically and with little awareness, and crucially depend on them to help make sense of the vast amount of information and complexity in our environment (Nisbett & Wilson, 1977). Scientists are trained to tell the difference between genuine systematic variations, and randomness that *looks* like systematic variation. Across disciplines, we deploy a range of methods to safeguard against our tendency to over-interpret random data (e.g., randomised controlled trials, blinding, reliability measures, meta-analysis, peer review). But, as acknowledged in a landmark report responding to the alarmingly high number of preventable medical errors in the US healthcare system (Kohn, Corrigan & Donaldson, 2001), "to err is human," and even the most rigorous methods, frameworks, coding schemes, and statistical models are inescapably in the hands of human researchers.

Metascience — or the science *of* science — has emerged in response to these issues. Metascience is concerned with issues of reproducibility and rigour and, much like interdisciplinary and implementation science, it is firmly embedded in the new zeitgeist sweeping across disciplines. In their manifesto for reproducible science published in *Nature Human Behaviour*, Munafò et al. (2017) argued that the combined effects of *apophenia*, *confirmation bias*, and *hindsight* (also known as the *knew-it-all-along* effect, where we tend to be influenced by the knowledge of an outcome; Fischhoff & Beyth, 1975), can easily lead to unconscious self-deception when performing research of all kinds, and ultimately to false conclusions, biased research syntheses, and faulty applications. Demonstrations of difficulties in reproducing research findings can be found in psychology (Open Science Collaboration, 2015), neuroscience (Poldrack et al., 2017), biomedical science (Ioannidis, 2005), economics (Camerer et al., 2016), and education (Makel & Plucker, 2014). A sobering proportion of researchers in other disciplines have reported failures to reproduce the results of other scientists (Baker, 2016). Makel and Plucker (2014) analysed the entire history of research articles published in the top 100 education journals, finding just 63 direct replications (with a 71.4% success rate) and 153 conceptual replications (with a 66% success rate).

Insufficient power (i.e., using small sample sizes to find small true effects; Button et al., 2013), selective reporting and publication bias (i.e., preferentially reporting and publishing positive or surprising results; Simonsohn et al., 2014), data dredging (i.e., confirmation bias; Head et al., 2015), hypothesizing after the results are known (i.e., hindsight; Kerr, 1998), and unavailability of a priori research plans, materials, protocols, code, and data, or *poor transparency*, are among the reasons put forward for the high prevalence of irreproducible findings. Methods with greater flexibility or *degrees-of-freedom* in how they can be used (e.g., exploratory multivariate analyses, use of preexisting datasets, document analysis) may be particularly vulnerable to errors in research synthesis resulting from unconscious cognitive influences (Dawson & Dawson, 2016). These issues are also commonplace in educational research. Polanin et al. (2016) reviewed 383 meta-analyses of intervention studies in top-tier education and psychology journals, finding just 81 with sufficient information to compute an average effect size, and substantially inflated effects in the published literature. This publication bias is indicative of the interpretative nature of science, its cumulative negative effects on meta-analytical synthesis, and the need for greater transparency in how research across education, including in educational technology, is carried out.

The emergence of Open Science

In response to the findings from metascience, the Open Science movement emerged, transforming scientific practice in an ever-increasing number of fields (Nosek et al., 2018). While openness is a key principle of scientific practice as an enabler of practical and societal change, "Open Science" is an emergent set of research practice methods and recommendations to improve the quality and integrity of research through more transparent, and robust practices. The current conceptualisation of "Open" in Open Science is that openness exists in a continuum – associated practices can be more or less transparent, or accessible. Broadly, the set of recommended evidence-based practices of Open Science are based in common ideological goals of more transparent, shareable, honest conduct of and communication of research, and include access to, dissemination of, review of, and reuse of publications, data, materials, and methodology. These goals are underpinned by the desire to improve the quality of science in general, and can be implemented by, and affect the various members of the educational technology research and practice community – researchers, institutions, journals, funding agencies, practitioners, industry.

The Open Science academic community has thus far been working on developing recommendations to resolve normative issues in research methods and publishing cultures such as publication bias (Simonsohn et al., 2014), replicability (Open Science Collaboration, 2015), and questionable research practices (Banks et al., 2016). Open Science is not just a collection of research practices but is also a mindset – with the practice comes a democratised way of doing science, and critically in the present stage of the movement, an openness to examine and improve one's own research practices. This, therefore, constitutes a cultural and transformative change, and brings about important shifts in systemic ways of thinking, doing, and knowing. Such implementations are accomplished not only through changes in practices, but also of culture at the different levels of research endeavours – and as such, can be revolutionary. This major systemic culture change is affecting other fields such as Psychology and Ecology more significantly, though is starting to make its way into Education. The current landscape of Open Science in Education includes some evidence of emergent discourse and changing practice. This includes two special issues in journals that have put out a call for research papers on the subject, with one invited review paper (see van der Zee & Reich, 2018), and an explicit attempt at seeking reproducibility (Beardsley, Hernández-Leo, & Ramirez-Melendez, 2018), notwithstanding the adoption of some Open Science practices by educational researchers on the ground (e.g., pre-registered research plan, MacQuarrie et al., 2018; pre-print, Selwyn, 2017). *The British Journal of Educational Psychology* has also recently (13 July 2018) announced that they are now accepting registered reports. For us researchers and practitioners in educational technology, this presents as an opportunity for us to lead (and participate in) this transformative change in the broader interdisciplinary Open Science discourse.

Open Science and educational technology research

The adoption of Open Science practices promises to be useful in helping to disseminate and translate educational technology research for use in practice. The problem of translation in educational technology research, and the issues associated with opaque research practices, can partially be solved by openly sharing more elements of our research process in easily accessible online repositories. Transparency and openness are cornerstone features of science, crucial for advancing knowledge. We are hindered in our ability to evaluate, reproduce, and extend on the research findings of our peers (and ourselves) if the necessary detail about how they were produced is missing or not freely available. *Open* science is about making these details—research methods, materials, data, code, workflows, pre-specified or a priori research and analysis plans—publicly available to other scientists and end-users. Figure 1 illustrates eight prototypical elements of the research process that can be made open and accessible to others. Historically, many of these elements (those shaded grey) have not been open, with few options to pre-register research plans or archive vital content and data.

Advances in technology have helped buoy several promising open science initiatives, such as the Transparency and Openness Promotion (TOP; Nosek et al., 2015) guidelines, which encourage journals to incentivise open research practices (e.g., by publishing pre-registered reports, awarding badges to authors for posting methods, materials, and data in trusted online repositories; see Kidwell et al., 2016 for early signs of success). Several free and easy to use online platforms, including the Open Science Framework (http://osf.io/), have been created to support individuals in making their research-related content openly available. These platforms are purposefully designed as tools for increasing transparency: they are built to facilitate pre-registration of all kinds of research and analysis plans (confirmatory or exploratory), and are capable of storing vast swathes of data.

There is, of course, nuance to how research is conducted across fields, and depending on the method of inquiry, and applies to research conducted in the educational sector or industry. Not all research projects contain all eight elements outlined in Figure 1. There are some cases where it is not possible to make all elements publicly available. Sharing *raw data files*, for instance, may be particularly tricky in areas of educational technology research where studies involve working with children or at-risk populations and data cannot be anonymised. The issue of consent and strategies to ensure data is not identifiable post-anonymisation becomes a key part of the a-priori research plan. Sharing other elements, such as *tools and materials* (e.g., survey items, concept inventories, examples, stimuli etc.), *measures of learning* (e.g., test items, behavioural data), or *code* (for statistical analyses, presentation of materials), may present challenges for projects where there are legal and/or financial barriers (e.g., research using costly equipment, lab and classroom-based studies using copyrighted materials etc.). Seeking normative methods of transparent practice is nontrivial – there are many nuanced challenges for applied research that will need collective efforts at resolving. Research evidence is not value free, and subject to processes of judgment and interpretation, as is the process of translating and using research evidence to inform practice. Greater transparency should, in theory, serve to aid these processes of judgement and inference in both contexts, and it will serve the community – both researchers and practitioners – to collectively consider *how* transparency can support this. There are gradations to transparency and openness, however, and working within the constraints at hand, even modest individual efforts to make more elements of our research process transparent and available—towards becoming *open educational technology researchers*—could aid translation across disciplinary boundaries, and ultimately benefit our cumulative efforts to better understand how people learn, and how best to teach. These efforts should be complementary to, rather than instead of existing efforts to aid translation. For instance, proactive journal efforts to do so, such as inclusion of “Practitioner notes” for research papers (e.g., *British Journal of Educational Technology*, *Journal of Learning Analytics*), or vice versa (“Researcher notes” for practitioner papers; see *Journal of Learning Analytics*) are commendable practices towards bridging translation across disciplines and roles.

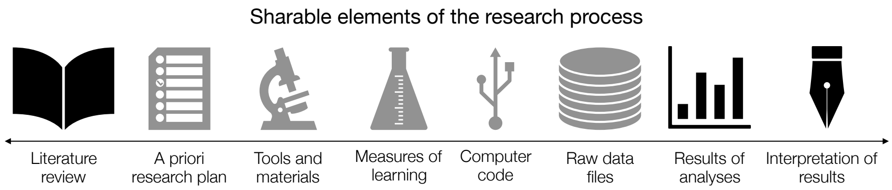

Figure 1: Prototypical elements of research that may be shared openly online (shapes shaded solid black indicate commonly available elements; shapes shaded light grey indicate those that are rarely shared).

In many ways, we have already become more open in our practices. Whether we like it or not, social media platforms are changing the nature of scientific communication and practice. This mode of communication of research is the field adapting to new means of sharing. Educational technology researchers often translate their research in order to affect practice and policy, and social media platforms connects us directly to practitioners and the society at large. Researchers are increasingly using Twitter to communicate research (Côté & Darling, 2018), and educators are increasingly using Twitter as their means of professional learning (McPherson et al, 2015). Thus, these platforms also provide a means to connect and build a community of practitioners and researchers. This increases the potential of collaboration and co-creation, and allows a stronger connection to the source of societal issues they may be working to address. As McKenney (2018, p.6) states:

> The past two decades have witnessed a blurring of traditional distinctions between science and society. This is happening through increased societal participation in the mechanisms that guide research … Furthermore, society’s voice is being heard through the increase in researcher engagement with practice.

This blurring of the traditional borders of research and practice in today’s society means that critical reflection in scientific practice could now also include dialogue with practitioners and other researchers in the community in more open, transparent ways. Translation is therefore, an important aspect of educational technology research at every level. How educational technology researchers share and converse about their research influences how practitioners and the public engage with, and understand it (Adams et al., 2017), as a reflection of the field.

Conclusion

Educational technology research and practice are deeply intertwined. Learning and teaching in the digital age is a complex and changing problem. Designing effective instructional methods for developing learners’ critical thinking skills, as one example, has proven to be quite the challenge (Van Gelder, 2005). More interdisciplinary and translational research has been called for to help develop innovative and effective teaching and learning interventions, and implement them in practice. These efforts can be hindered, however, by unconscious cognitive influences, and a lack of transparency in how research is conducted. Improving transparency can help researchers communicate more accurately and efficiently with one another, better synthesize and evaluate educational science, and better translate those findings for use by learners, educators, and policy makers. Our hope is that this paper will serve as a catalyst for sparking further discussion towards this goal.

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New shores: Preliminary observations from a proof-of-concept project to define and design a student-centred approach to study mode selection

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Contemporary higher education providers require students to choose between on-campus, online, or hybrid 'blended' study modes. Education providers predetermine which study mode/s are available for each course. Even in 'blended' offerings, education providers pre-determine the mix of on-campus and online study activities all students must complete. This paper focusses on the multi-faceted challenges of defining, designing and trialling a new student-centric 'StudyFlex' mode of study at La Trobe University and the genesis and rationale behind that initiative. StudyFlex does away with predetermined bright line distinctions between online, blended and on-campus offerings and empowers students, within the context of a single course or subject offering, to self-select and adjust their preferred study mode pathway throughout their studies. Specifically, in this paper, the focus is on the curriculum design and development challenges of ensuring equivalent learning quality experiences for all students, whilst at the same time accommodating a multitude of bespoke student-selected study mode pathways within a single course or subject offering. As a primer for further research, the authors also flag the additional polycentric regulatory and administrative challenges posed by innovations such as the StudyFlex trial and the attempts to reach new student-centric shores which such initiatives represent.

Keywords: Student-centred; Digital learning; Innovation; Flexible study mode; Higher education

Familiar shores: Contemporary university modes of study

For contemporary university students, the higher education environment offers an array of study modes, including onshore or offshore/international, online or on-campus, or blends of various modalities. While this may seem commonplace, such a situation was only predicted at the end of the twentieth century (Blight, Davis & Olsen, 2000). In addition, education providers are increasingly offering students a choice of study mode for their selected course of study. To accommodate student choice and learning preferences, many institutes employ 'blended learning' as a mode of study, often oversimplified to signify a mix of both online and on-campus subject learning (Colasante & Hall-van den Elsen, 2017).

Despite these contemporary advances, a number of fundamental truths remain. Prime among these is the reality that education providers continue to determine which study mode options will be made available to students. Further, even when education providers offer a choice of study mode, students are typically required to select their preferred study mode at the same time they make their course or subject selections. Once committed to a particular study mode, students can face significant administrative challenges in changing their study mode preferences. Even in the context of an expansion of 'blended' study mode offerings, the education provider still typically predetermines the combination of on-campus and online study activities all students must complete.

The nomenclature of 'blended learning' is arguably more useful as a staff-facing identifier or change agent than for providing students with clear meaning. Indeed, there have been calls to abandon this terminology for over a decade given its inconsistent use and its lack of student focus (Oliver & Trigwell, 2005). Most pertinently, criticisms extend to an acknowledgement that terms such as 'blended' do not adequately reflect the normalcy of the mix of technology in other aspects of everyday life. Modern life is not simply compartmentalised into neatly pre-determined silos of online and face-to-face activities. Shifts in activity and preferences are increasingly seamless, spontaneous and expected. In education, technology that supports digitally enabled learning is eroding distinctions between traditional on-campus and distance education, while simultaneously university students' daily lives are interwoven with technology which influences their learning expectations (Kirkwood, 2014).

While Oliver and Trigwell (2005) found fault in relation to the term blended learning, they also proffered that benefits of blended learning could be found when offering students variation in aspects of their learning experiences. Using the variation theory of learning, they explain that "for learning to occur, variation must be experienced by the learner", such as variations in media but also variation in ways for students to think about or approach their study (p.22-23).

Nevertheless, educational terminology and practices tend to continue to push against this changing tide, perhaps informed by the reality of the need for education providers and practitioners to work within their means, even if this requires them to "constrain themselves with models of teaching and learning that are no longer sufficient or appropriate" (Kirkwood, 2014, p.217). Few hold visions to reimagine benefits for students in adopting new approaches (*ibid.*), or when opting for new approaches, many simply react to what others are doing (Watkins & Kaufman, 2007). In terms of the latter phenomenon, Watkins and Kaufman envision successful outcomes for institutions who undertake proactive change focused on adaptability, including creation of a future they and their community of students desire, as opposed to reacting to what others do (2007, p.371).

It is clear that new, student-centric thinking is required in this space, such as that flagged by Krause:

> "We prefer 'no-lines'; online, face-to-face, our students are not really seeing the line in between… Students say online doesn't give us on-campus opportunities. It is not 'either/or', it's 'AND'." – Professor Kerri-Lee Krause, Deputy Vice-Chancellor (Academic) La Trobe University, All Staff Briefing, Semester 1, Bundoora, 5-June-2018

Following, the 'no-line' direction signalled by Krause, this paper focusses on La Trobe University's trial of a student-centred blended study approach nominally referred to in the trial as 'StudyFlex'. In this currently underway proof of concept project, the curriculum design team was tasked with redeveloping several existing subjects to offer students a way to better meet their needs of flexibility in moving between on-campus and online study modes; to enable students to create their own personalised in-subject study pathways within the context of a single subject instance. This task has posed significant curriculum design and development challenges, which will be the subject of much of the balance of this paper. However, it is not without broadly relatable precedent. Most pertinently work carried out at Southern Cross University known as the 'Converged Learning' project. This work surfaced as a starting point for the StudyFlex trial project team and, accordingly, warrants elaboration from the outset.

Mapping the journey to new shores: The SCU 'Converged Learning' project

As detailed by Taylor and Newton (2013), another Australian university attempted to create "one single mode" by collapsing "divisions between external and internal enrolments" (p.55). Southern Cross University piloted a 'converged delivery' model involving 39 subjects across eight academic schools and over 3,000 students (although, at the time of writing, we have found no available evidence that the initiative was sustained beyond this large pilot project).

Feedback on the model as gathered from students involved in the SCU pilot identified the need for attention to:

- online subject navigation, including subject concept maps and guides on the alternative forms of learning;
- technological orientation, including basic detail and offering practice sessions using specific technology;
- teacher-to-student support; responsive, available, contactable, supportive; and
- student-to-student connectivity; clear mechanisms for how to contact other students.

The major barrier to the SCU project (Taylor & Newton, 2013) involved the Australian Government policy of funding three discrete modes only, internal, external, and multimode, and thus not permitting a 'converged' mode. An overall institutional barrier was that clarification was missing on what "converged delivery/blended learning/flexible learning means for students and staff" (Taylor & Newton, 2013, p.57).

These barriers provided the La Trobe team with some excellent starting points for the StudyFlex trial. First, it was recognised that creating StudyFlex as a new formal and distinct 'mode' alongside internal, external and multimode delivery was likely to cause confusion and administrative difficulty. Hence, StudyFlex has been envisaged from the outset as a distinctively student-centred reimagining of multimodal or 'blended' delivery. Second, in order to avert the internal barriers encountered by SCU insofar as ensuring a clear understanding of what StudyFlex might mean for students and staff, the trial was undertaken with the preliminary task of settling on a clear definition of StudyFlex and developing a series of clearly defined parameters or principles underpinning any StudyFlex offering. The following part of the paper outlines the approach taken to these preliminary tasks.

Essential equipment for the journey: Defining StudyFlex and its key principles

Defining StudyFlex

The StudyFlex team in seeking to define and develop StudyFlex principles were initially guided by the student-centric strategic aspirations of their university. These aspirations are relevantly and simply encapsulated in comments such as the following:

> "I want students to feel that they are at the centre of everything we do" - Professor John Dewar, Vice-Chancellor La Trobe University, Media & Communication | La Trobe News 28 May 2018

Hence, in the broadest sense, for StudyFlex to empower students to self-direct their study mode preferences any definition and principles must ensure a pedagogical design which tests the limits of the capacity of the University to shift the choice of study mode offering to the student rather than the institution. This intent is driven not only by the University's own agenda, but by similar governmental announcements such as the following by the Department of Education and Training:

> "It was broadly accepted that a healthy institutional culture that embraces diversity and flexibility and puts the student first is a key factor in whether a student feels like they are supported and a valued member of the institutional community" (Dept. of Education and Training, 2017, p.21).

From this broadest of starting points, the StudyFlex trial team settled upon a simple working definition of StudyFlex for use during the proof of concept stage, with expectations of a university agreed definition to be finessed post proof of concept and before any larger formal pilot.

> In a StudyFlex offering, all students are enrolled in a single subject or course offering. Once enrolled, students will be able to choose from week to week or topic to topic how they wish to study. They can choose completely online, or exchange some online activities with a degree of on-campus activity that suits them. Students can modify their choices on short notice.

Figure 1 below helps to simply illustrate the concept. Overall, the student experience is supported by a quality online subject design 'spine', utilising the subject LMS (learning management system). The design will provide core detail. This includes clear navigation and technical guidance, including plain English general and subject-specific technology guides and contact options for further assistance. It also provides full assessment detail, topic introductions, learning resources, additional materials, and interaction opportunities. Online social experiences include creating a sense of community and belonging in the subject, commencing with icebreaker activities, through to social constructivist learning opportunities via purposeful team learning activities.

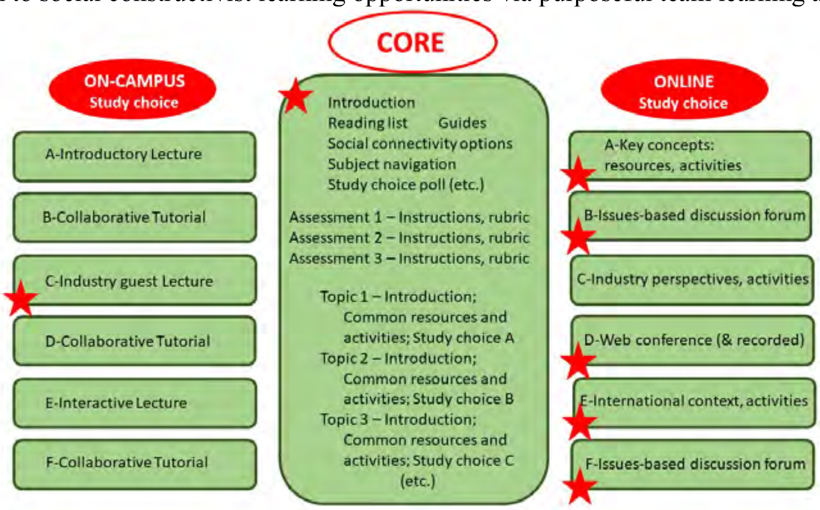

Figure 1: Simple presentation of the concept, where the fictional 'Red Star' student navigates her journey through the subject, in this case selecting more online learning experiences than on-campus.

Beyond the core online design, student choice points will provide well-signalled dichotomous pathways. Each pathway can be accessed by all students, with each student choosing their preferred pathway. On-campus options will include timetabling information and details of any preparation and post-attendance activities and/or requirements. Each online option will comprise a complete topic package of resources and learning activities.

Core StudyFlex Principles

The core StudyFlex principles can be reduced to two fundamental concerns – (1) guaranteeing learning equivalence for all students; and (2) maximising student choice to accommodate the broadest possible range of student learning mode preferences.

Equivalence for all students
At its core, as alluded to in the working definition above, a StudyFlex subject comprises (1) a core online component that all students complete and use as their overall guidance across the semester, and (2) clear choice-points of components where students can create a personalised pathway by choosing either an on-campus or online option of an equivalent standard. Specifically, at each choice-point across a 12-week semester subject, all corresponding learning and assessment activities must be of equivalent standard including intended learning and effort required to successfully complete.

The success of any StudyFlex offering hinges on ensuring learning equivalence for all students. As MacKeogh and Fox (2009) have observed, while the rise of technological infrastructure enables multiple modes of delivery, including "flexible modular frameworks [and] innovative pedagogical approaches", the most crucial requirement of such approaches is a "…commitment to equivalence of access for students on and off-campus" (p.149). This is a particular challenge for StudyFlex given the potentially large number of possible combinations and permutations of student-driven study mode choices which lie at the heart of the StudyFlex philosophy.

For definitional purposes, this paper refers to the term 'equivalence' as offering higher education student experiences that are equivalent in learning value via curriculum opportunities, despite access mode and as tailored to best suit specific access modes. That is, comparable learning opportunities are provided to students in distance and 'home' provisions when designing or reviewing courses, where-by one group of students is not disadvantaged compared to another as a result of the resources they do/do not have access to (Smith, 2010).

Maximum student choice and suitability
A StudyFlex offering must be capable of accommodating the study mode preferences of the broadest possible range of students. Hence StudyFlex offerings must include both online and on-campus learning experiences, where the students may complete the subject online, on-campus, or a personalised pathway of their choice including both elements. Consequently, StudyFlex offerings should not include compulsory on-campus attendance requirements and must include some on-campus activities for those willing and able to participate in those activities.

However, there are two further important dimensions to ensure the fullest possible commitment to this principle. First, synchronous activities should be avoided or kept to a minimum with an equivalent asynchronous option to ensure that students unable to attend (either on campus or online) at a particular time are not disadvantaged or precluded from study. Second, StudyFlex principles where adopted should be applied to entire courses (degrees). Whilst students may benefit from StudyFlex options being included in some of their subjects, there is little benefit for large numbers of students if these options are not available across their entire course.

To illustrate the point - many students choose to study via online or virtual study spaces to transcend geographical and timing constraints (Gibbings, Lidstone & Bruce, 2015). Many look for study solutions to fit with other life commitments and/or to meet preferences for flexible, networked learning over traditional lecture-styled classes (Oblinger, 2006). Obviously, such students would benefit little from a course which only accommodates their needs in some of their subjects, while requiring on-campus attendance for non-StudyFlex subjects required to complete their chosen course of study.

The journey so far: Conclusion and next steps

The StudyFlex trial potentially offers students a form of student-centric approach to selecting and personalising their study mode preferences. Much planning is yet required following the proof of concept of the StudyFlex mode, and prior to conducting a formal, wider university pilot for subject and course redesigns in this mode. There are still curriculum design and development issues to be resolved as highlighted in the proof of concept exercise to ensure this potential can be translated into reality. To aid refinement of the overall concept, a study has been designed in preparation for gathering student and teacher perspectives in the immediate post teaching and learning periods of each of the trial StudyFlex subjects.

The challenges are not confined to curriculum design and development. The issues raised in the SCU Converged Delivery project surrounding potential regulatory implications and ensuring clarity of vision and understanding of concepts such as StudyFlex are difficult to resolve and need to be fully addressed. Equally, there are substantial challenges in ensuring existing university systems can "provide all students with opportunities to make informed decisions about their enrolment and study options" (Taylor & Newton, 2013, p.58). Such challenges are ripe for closer study and consideration beyond the scope of this paper.

Nevertheless, the StudyFlex proposal is somewhat rare in being able to generate potential benefits for students, but equally for staff who can be freed from the challenges of delivering multiple offerings of the same course or subject to a fragmented student cohort, in order to accommodate different study preferences. Certainly, even at this preliminary stage of the StudyFlex trial there is much to merit continuing on this journey to the largely hitherto unexplored shores of student-centric multimodal course and subject delivery.

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Engaging millennials with online content delivery through a discourse community understanding of learning

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Short videos are now a standard feature of online content delivery and a wealth of literature has emerged regarding best practice in designing for student engagement. In this concise paper we argue that lessons from research on engaging with 'millennial' students in general can also be applied constructively to video design. In particular this generation of students has been shown to desire a personal connection with their teachers, they expect educators to be 'passionate' or 'enthusiastic' about the topic, and they demand a line-of-sight connection between the immediate learning activity and the end-goal. Furthermore, we argue that an understanding of transition to university studies which conceives of disciplines as discourse communities provides an integrative understanding of student engagement that further informs the design of effective video vignettes. We describe a set of videos, in which teaching academics describe their research to students in a core first-year Bachelor of Science subject, which have been produced according to the principles derived from the above research and approach, with the aim of attaining a high level of student engagement. These videos have recently been trialled and are soon to be evaluated.

Keywords: video, online learning, engagement, millennial, discourse community

Introduction

Short videos are a standard feature of online content delivery in the higher education context. Research continues to determine the parameters under which student engagement with such videos is optimized, with length and interactivity among the factors shown to be significant. In parallel, other studies have been carried out in recent years to determine how best to engage the most recent generation of school leavers, sometimes known as the 'millennials', in university education. This paper argues that a discourse community approach to understanding the transition to higher education also provides insight into how to create video content that is potentially more engaging to students, in particular the millennial generation.

By discourse community approach is meant an understanding of learning in the higher education context as a process of joining an academic discourse community. According to this approach, disciplinary knowledge is understood as being 'constituted in the flow of meaning produced between knowledgeable people when they communicate together' (Northedge, 2003, p. 17). In a broad sense, an academic discipline can be conceived of as a community, of which the subject taken by undergraduate students is a particular instantiation in time and space. Furthermore, '[e]ach subject has its own discourse' and 'transition to the new culture is reconceptualised as one of gaining familiarity, and ultimately mastery, of these discourses and literacies' (Lawrence, 2005, pp. 246-247). Finally, this approach considers social and affective dimensions of learning, by accepting that it involves becoming acquainted with 'social practices' of the community, and acquiring a 'sense of identity' with it (Hutchings, 2006, p. 248).

Thus, the totality of the content, the use of subject specific-concepts and their interrelationships, the writing and assessment genres, referencing conventions, but also the accepted practices for interrelating with staff, peers, and university authorities are thought of as a discourse space, and learning in the subject as a process of joining and gaining acceptance as novice members of the discourse community. This conceptualization foregrounds the social dimension of the learning process, which extends beyond interaction with peers and staff members to encompass the socially constructed nature of knowledge, recognizing that the rules governing what is 'right' or 'wrong', logical or illogical, appropriate or inappropriate in the discourse is governed by socially agreed rules and conventions. In particular the discourse community approach makes clear that the process of learning is also related to an evolving identification with the target community.

The discourse community approach provides a context for integrating otherwise ad hoc findings on improving student engagement. In the current context we are particularly interested in engaging millennial students, and the design of engaging videos in online content delivery.

Background

At a Victorian university, a new first-year science subject, which is core for all Bachelor of Science students regardless of major, was developed to introduce students to scientific concepts and literacies through a study of 'big ideas in science'. The subject is intended to be cross-disciplinary, covering topics ranging from the big bang to the DNA double helix. Key aims were to develop an understanding of the scientific process, and improve scientific writing skills. Subsidiary aims of the subject were to raise awareness among students of the scientific research being carried out at the university, to motivate them in their study of science, and to assist undecided students in their choice of major.

To this end, a series of short videos was created featuring research academics at the university, who also teach into the Bachelor of Science, in which they each identify a 'big idea in science' under which their research area can be categorized, and then go on to describe their research, and its scientific or social significance. The videos were usually filmed with the featured academic in the laboratory or in the field, and often also contained segments in which research students contributed to the explanation, or demonstrated laboratory processes. The videos also frequently made use of 3D animations to support the scientific narrative provided by the academic in question. The videos featured research academics and their graduate students from as many as possible of the majors and minors offered within the Bachelor of Science, which range from pure mathematics and statistics via nanophysics, chemistry and biomedicine to botany, zoology and neuroscience. These videos were first embedded in the subject's LMS in the first semester of 2018; ethics approval has been received for a process of evaluation, which is about to commence.

Student engagement

In addition to the discourse community conceptualization, the design of these videos was informed by two fields of research. The first is the state of the art of what constitutes engaging video production; the second is the research on engaging with the most recent, or 'millennial' generation of school-leaving students.

From the literature on video design, three important characteristics emerged. The first is that videos need to be short. A large study of the video viewing habits of MOOC students, for example, demonstrated that engagement fell away if videos were longer than about 6 minutes (Guo, Kim & Rubin, 2014). This criterion was taken as a guideline for the production of our videos. The second is the need for videos to be interactive, that is, to be presented in a format with pause, rewind, fast-forward and speed selection functions, so that students can control the pace of information flow, replay sections they find difficult to follow, etc. (Merkt et al., 2011). Thirdly, studies show that videos need to have a personal touch. Talking heads have been shown to be more engaging than voice-over-images; and presenters addressing the viewer directly, for example speaking straight into the camera from their office desk, are more engaging than those addressing a lecture theatre full of students, perhaps from behind a podium, when the viewer of the video is relegated to the role of a passive onlooker (Guo, Kim & Rubin, 2014). This research demonstrates that not all videos are equal, and that there are clear steps than can be taken to make viewers feel more engaged.

The second body of research informing our video design concerned engagement with millennial students at a general level (not merely through the medium of video). Firstly, studies repeatedly find that among the factors identified by students as contributing to improving their engagement with learning is that the teacher possesses a characteristic that is typically described as being 'passionate' or 'enthusiastic' about the topic, or being 'inspiring' (Revell & Wainwright, 2009; Bowen et al., 2011; Roehling et al., 2010). Secondly, studies have also found that millennial students expect to be given a 'line-of-sight' connection between the immediate task at hand and the end-goal, including a clear pathway to success through their degree and beyond (Hershatter & Epstein, 2010; Benfer & Shanahan, 2013). A third element identified by the literature as contributing to engagement with the millennial generation is the expectation of a personal connection with the teacher (Bowen et al., 2011). Students expect teachers to take a personal interest in their progress and welfare.

Many of the features identified from these two fields of research make sense within a discourse community understanding of discipline learning. The construction of the student as a discipline novice negotiating entry into a discourse community is in harmony with millennial students' stated desire for personal attention from discourse initiates such as the teacher. Videos that address students directly in informal language can therefore be expected to more engaging. The need for a line-of-sight connection with the end-goal of community acceptance is also a logical characteristic of the learning process. The search for 'enthusiastic' role models is also consistent with the social understanding of the transition to higher education embodied in the discourse community approach.

The videos

The creation of the videos was guided by the features associated with improved engagement that have been outlined above. Videos were kept short, with the initial intention to keep them under 6 minutes. In the end only 4 of 17 were longer than 6 minutes, and only one over 7 minutes (7:11). Subjects were filmed relatively close-up and asked to speak directly to the camera and off-the-cuff. They were filmed in their natural surroundings (in their lab, in the field, or sometimes in their offices), rather than in a studio. Research students were frequently included in the videos, providing an accessible model of a more integrated member of the discourse community, which commencing students could identify with, or even aspire to. Diversity was an important consideration when selecting subjects, with 10 male and 7 staff members, and a further 2 male and 7 female research students with speaking roles, and 2 male and 2 female students depicted at work in labs but not speaking. Amongst the students there was a good cross section of ethnic backgrounds; unfortunately, of the 17 staff members there was only 1 non-Caucasian, reflecting a reality that was beyond our control. Student speakers were also on the whole less willing to speak off-the-cuff, meaning (with two noticeable exceptions) that their delivery was somewhat stilted. Significantly, in terms of role-modelling, in addition to examples of male supervisors with male and female graduate students, there was also a female supervisor with both a female and a male research student. Because a significant aim of the videos was to nurture identification with the discourse community, in particular encouraging novices to imagine themselves as ‘full’ members of the community, diversity is clearly an important consideration.

We also consciously included line-of-sight elements firstly in the form, as already mentioned, of graduate students representing a future possibility for novices, but secondly by ensuring that each video ended with the speaker identifying the major or minor or, in some cases, individual subjects that the student could take if he or she found the research topic interesting. In one of the videos the speaker finished by pointing out that if students chose a certain elective in third year, they would be working with graduate students and post-doctoral fellows in the very lab in which she was speaking.

We also attempted to address the student expectation of ‘passionate’, ‘enthusiastic’ or ‘inspiring’ teachers. While scientists are not necessarily naturally flamboyant speakers, it was hoped that the authenticity of staff members speaking about their research, a subject they are undeniably passionate about, would to at least some extent meet this expectation. To support this aim we also added a number of elements to the video production itself. Firstly, as much as was possible on a limited scale, additional video, or ‘B-roll’ illustrating the speakers’ narrative was included; in many of the videos short 3D animations were created to illustrate scientific points; and finally, a snappy soundtrack ‘sting’ reminiscent of a TV science magazine was used to break-up sections or cover transitions. We note that animations have also been linked to improved student engagement (Lin & Atkinson, 2011). To the extent that ‘passion’, ‘enthusiasm’ and ‘inspiration’ are reasonable expectations on the part of students, we felt that we addressed them to the fullest extent practical.

A few of the videos also included fast-motion ‘guided tours’ of parts of the campus students may be unfamiliar with. For example, one of the videos was filmed at a joint research facility on the outskirts of the campus that many students would be unaware of: the story began with a 30-second fast motion trek from a clearly identifiable point at the centre of the campus to the doors of the research facility, to familiarize students with the location and in particular the proximity of the labs. Familiarisation with the special dimension of the discipline community was therefore also an aspect of some videos.

Finally, all the staff members featured were research academics who also teach into the Bachelor of Science. The videos therefore also served to ‘introduce’ students to their future teaching staff. Staff have already reported being recognized by students as a result of featuring in the videos. While this element of community-building should not be overstated, it nevertheless serves to demonstrate the social element of engagement to which video can be applied.

Conclusion

Taking a discourse community approach to designing video content for online subject delivery provides us with strategies for improving student engagement with videos and subject content in general at a more holistic level than technical aspects of video design itself, on which most research to date has focussed. We have produced videos which attempt to meet student expectations of ‘passionate’ or ‘enthusiastic’ teachers by presenting research academics speaking on topics they are passionate about, their own research. Music, 3D animations and illustrative footage have been added to make them more appealing. The videos aim to simulate a personal connection with lecturers through framing the speakers as directly addressing the viewer, in an informal register of speech. Furthermore, they provide line-of-sight information to students in the form of advice on what major to take 'if you are interested in this kind of research', and role models of graduate students presented in a laboratory or research context, as discourse community initiates with whom undergraduate students are able to identify. While the resulting video productions look promising, further research will enable us to measure the extent to which we have truly been able to engage with millennial students through the medium of video.

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Towards understanding of student engagement in blended learning: A conceptualization of learning without borders

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In this paper we report on our research exploring undergraduate distance students' experiences of engagement in a context that is blended with on-campus peers and incorporates work-based learning. Drawing on interviews of educators, a survey and focus groups with students we seek to build a picture of what engagement in learning means in the current Aotearoa New Zealand context and unravel some of the contradictions and complexities in what constitutes effective learning and teaching. This paper provides an overview of the study including a review of the way engagement has been conceptualised in online and blended learning contexts over the past decade. Findings suggest that for students, flexibility is paramount and that digital tools did support this along with helping in understanding, independence of learning and enjoyment. Students also foregrounded other less visible learning strategies and the importance of peer support outside of the classroom. There was also a link between students sense of wellbeing, inclusion and/or belonging (related to their feelings and emotions) and digital tools.

Keywords: student engagement, distance learning, contextual conceptualization

Introduction

Not another paper on student engagement! The topic of student engagement has been reported on for decades and there is a multitude of literature adopting different perspectives and views conceptualizing and defining this topic. The terminology has become commonplace in every day discussion about learning and teaching and people talk about student engagement as if we all understand the same thing by it. With so much research on student engagement and what it means, why is this such a difficult concept to understand? Over the past 5 years at ASCILITE alone there have been 24 papers with engagement in the title. In grappling with understanding the concept of student engagement in our context of distance students in a College of Education, Health and Human Development in Aotearoa New Zealand we reviewed over 66 articles defining or conceptualising student engagement (particularly with a focus on online, distance or blended learning) over the past 10 years. Four of these themselves were systematic literature reviews on the concept (Henrie, Halverson, & Graham, 2015; Nortvig, 2018; Schindler, 2017; Trowler, 2010) and all this did was demonstrate to us that engagement can mean many different things to different people. In their new book *Student Engagement in the Digital University*, Gourlay and Oliver (2018) in re-theorising the concept, move away from the idea of a definition or framework and instead view student digital engagement as a set of socio-material practices. However, whilst student voices are critical and individual experiences are clearly varied, we are still grappling with what are the mediating variables that influence each student's engagement with digital learning.

Background and context

Our college at the University of Canterbury (UC) has a long history of distance learning stretching back some 20 years when it first made its Bachelor of Teaching and Learning degree available to students studying at distance. Initially conceptualised as flexible learning this approach was delivered in mixed mode involving on-site intensives and resource-based learning complement with an early innovative LMS. The Christchurch earthquakes of 2010/2011 however catapulted the program into adoption of additional new modes of e-learning and quickly developed innovative digital solutions. The program and its educators have received many acknowledgments for their excellent practice and have been recognised through teaching awards, such as awards from our national association for open flexible and distance learning (Astall et al., 2016; Ayebi-Arthur et al., 2016; Hunt et al., 2011). However as both UC and educational technology continue to evolve (Davis, 2018) it is timely to focus on how we can better support distance students in their learning.

The term engagement has many definitions (Louwrens and Hartnett, 2016; Henrie, Halverson and Graham, 2015). Research on student engagement in the tertiary sector confirmed its influence on both student satisfaction and learning and identified reciprocal and complex interactions between emotions, engagement, and learning (Kahu, et al, 2014). In a higher education context some institutions have been “legislating” engagement through requirement for lecture and tutorial attendance believing that students’ physical presence is an important precursor for learning. Innovations such as lecture recording are often met with distrust as a result of concerns that having the option to “watch” a lecture online will result in low attendance by students. In the online / distance context institutions wish to find ways of monitoring student activities that is similar to attendance, which can result in the allocation a mark for contributions to forums and requiring students attend synchronous sessions or undertake particular activities as coursework. Lots of solutions are being developed and “learning analytics” is seen as a powerful way of identifying at risk students (Vyberg, Hatakka, Bälter, & Mavroudi, 2018). But how can one make sense of such information when there is confusion about what is meant by engagement?

In order to develop the foundation of our study we undertook a literature review of how the concept of engagement had been described over the past decade. Using the search terms distance learning, online learning, blended learning, engagement, concept, definition and framework we identified 66 articles and grouped them according to themes. Four dominant views emerged

1. Social dimension: The key element is social interaction. Definitions were based on a constructionist and Community of Inquiry approach, active learning, student identity/belonging. Engagement understood as a result of social interactions. [20 articles]
2. Individual dimension: The key element is the student’s behavior. Definition based on the individual’s involvement with activities and conditions likely to generate high quality learning. [15 articles]
3. Flow – effective teaching practices: The key element is student satisfaction. Definition based on the individual's feeling of enjoyment. and the extent to which they become immersed in their learning. The idea is that individuals engage in activities that meet certain or specific conditions that motivate them to continue to study and enjoy learning. It is argued that the triggering of interest establishes engagement. [11 articles]
4. Multidimensional approach: Definition based on the idea that engagement does not comprise a single dimension but different and interconnected ones (e.g. behavioral, cognitive, emotional, etc.) [12 articles]

Our view, which is in line with the Aotearoa New Zealand Ministry of Education (TKI, 2018) is a multifaceted concept that goes beyond learning and teaching and pedagogy because it intersects with the individual student’s confidence, motivation, culture, and life experiences in their diverse interconnected ecosystems (physical and digital) (Davis, 2018). From an organisational perspective, student engagement in ODL encompasses both the conditions which create an enabling (or disabling) environment for learning along with the pedagogical strategies that are used in course design. The socio-emotional aspect is critically important in our context.

Research Design

The research began at the start of 2018 in response to the College Learning and Teaching Committee request to research the learning experience of undergraduate students studying at a distance. The first stage of research explored the current context. The research team interviewed five tertiary educators including e-learning champions, members of the institutional e-learning support team and program convenors to get a broad understanding of what different stakeholders understood by “distance education”, obtain an overview of pedagogical approaches currently adopted in our distance courses in the College, and explore their conceptions of student engagement. This helped us position our research focus and assisted in guiding the design of a survey for students. All distance students (n=386) across all years in undergraduate teacher education programs (our one year graduate diploma and four degree for primary and early childhood teachers) were surveyed near the midpoint of their academic year. These programmes are fairly typical for initial teacher education (Davis 2010), except that the students study in a hybrid mode so that the online learning spaces in the LMS and sometimes video conference are the same for both distance and on-campus students, a development that is discussed later in our paper. The survey and focus groups explored the distance students’ overall experience of distance education as well as their self-efficacy/confidence in using digital tools for learning (n =84; 21.7% of the total). Our survey drew on existing instruments such as the Community of Inquiry framework (Akyol, Garrison and Ozden 2009), the Online Learning Environment Survey (Clayton, 2007) and the Student Digital Experience Tracker (JISC 2018). This was followed by 7 focus groups (n=46; 54.8% of survey participants) to gather more data about students’ expectations and preparedness for studying at a distance, the aspect(s) of the program were the most valuable in supporting their learning, and their challenges.

Findings

We begin with reflecting on who our students are and why they choose to study at a distance. When asked why they decided to pursue their current qualification by distance the majority of students surveyed (40%) responded that it was to give them flexibility, and another third indicated it was their only option (see Table 1). If location had not been a factor, 54% would still have preferred to be a distance rather than on-campus. This reminds us that for half of our students, distance learning best supports their circumstances and the flexibility they wish for study. Through the focus groups we found that flexibility, family, and work commitments, as well as individual learning style preferences, were closely related to this choice. Participants explained that they look for a programme which fits well with their time constraints due to their multiple commitments as well as their personal predispositions or orientations to learning (e.g. preference for taking tests or engaging in activities online from home) as one student indicated "*I like to pause the lectures throughout. I find this beneficial as I can better seek clarification by recapping or doing further research*" (Survey)

Table 1: Why students chose to study by distance

I decided to study by distance because it would give me flexibility in my schedule.	40 %
I decided to study by distance because this was my only option (e.g. live outside Christchurch).	33 %
I decided to study by distance because I felt that on-campus study was not for me.	9 %
Other:	17 %

In terms of whether distance enabled enough flexibility in their schedules the majority indicated it did (45% were definite and 48% said somewhat), whilst the remaining 7% indicated somewhat not or definitely not. Some contradiction that emerged in the focus groups indicated that, whilst they students valued the flexibility their distance programs provided, certain factors implemented as part of their programmes (often with the intention to enhance flexibility) had the opposite effect. The coding of qualitative data about program effectiveness identified that "tool friendliness" and "course organisation" were mentioned in all focus groups (45 and 33 times respectively). This was a more dominant theme than workload, student guidelines, staff-student relationships and course structure (which had either 22 or 23 mentions each). In relation to this, students indicated that the lack of consistency in the design of courses in our institutional LMS and the variable way in which recordings are used led them to spend extra time and effort finding what they needed rather than focusing on learning. One student encapsulated this well as "*time is so precious for all of us, to waste so long trying to figure out how each different course is set-up, whereas there's a couple of courses for example, our xx course which I find really well set-out, and I can just go on it, and boom – boom – boom –I know what I have to do.*" (FG 2). They also mentioned being overwhelmed by the workload and the multiple tasks (watching recordings, collaborating online and attending real-time sessions on top of readings and online activities).

Students were asked to indicate their general attitudes towards the use of digital tools in the course including the LMS and a range of video conferencing. The statements with which most students agreed related to flexibility, understanding, independence of learning and enjoyment, see Table 2. Although the majority agreed with all aspects, the two aspects that fewer than 70% of students agreed with were the role of digital tools in connecting them with lecturers or other learners. Participants demonstrated a positive attitude towards technology, its use and effectiveness during the focus groups; however, some students indicated that some digital tools appeared to be used for ineffective purposes at times. They also commented on the wide variation that they experienced in teacher educators' digital practices.

Table 2. Students' positive attitudes towards digital tools

When digital tools are used in my courses	Strongly agree/ Somewhat agree	Neither agree nor disagree	Strongly disagree/ somewhat disagree
I can fit learning into my life more easily.	82%	12%	4%
I understand things better.	79%	15%	5%
I am more independent in my learning.	78%	12%	9%
I enjoy learning more.	71%	20%	7%
I feel more connected with my lecturers.	62%	18%	19%
I feel more connected with other learners.	53%	24%	21%

Students confirmed that they had reasonable access to online learning with 83% indicating they almost always or often are able to access the course materials and could go through this without support. Likewise, students were positive about their ability to control their learning (77% indicated they almost always or often had control) and 62% found the internet stimulating for their learning. In addition, during the focus groups students also indicated that they engaged in meaningful learning activities outside of the formal learning environment such as study groups (either with other students in close proximity or through social media), spending time annotating hard copy readings, and talking to others about what they learn.

Whilst engagement is most often viewed in terms of positive experiences (eg connection, independence, understanding, enjoyment), lack of engagement is seen in terms of negative experiences (eg overwhelming, frustrating, isolating, distraction). These negative experiences have been reported as challenges for learning online (Kebritchi, Lipschuetz, Santiague 2017). As shown in Table 3 less than a third of students strongly or somewhat agreed that digital tools resulted in these “negative” disengaged activities. This demonstrates a link between feelings and engagement, at least for some students. These different perspectives demonstrate the importance of understanding individual student’s needs and there appeared to be a link between the sense of wellbeing, inclusion and/or belonging (related to students’ feelings and emotions) and digital tools. Students’ support networks were explored further during the focus groups, where the importance of peer support to provide experience, knowledge, emotional, social and practical help was evident in all the focus groups (mentioned 20 times); it was mentioned more than family networks (9 mentions) or other colleagues (12 mentions). Participants highlighted the importance of "interactions" and their need to establish "real" connections with their lecturers and peers. Peer support appeared to be critical in helping students cope.

Table 3: Students’ negative attitudes towards digital tools

When digital tools are used in my courses	Strongly agree/ Somewhat agree	Neither agree nor disagree	Strongly disagree/ somewhat disagree
I find it harder to motivate myself.	19%	22%	57%
I feel overwhelmed.	32%	13%	52%
I feel frustrated or annoyed.	26%	22%	50%
I find it harder to manage all the information.	39%	15%	45%
I feel more isolated.	36%	20%	45%
I am more easily distracted.	31%	23%	44%

Discussion and Conclusion

We plan to deeply reflect on how to act upon our findings. At this preliminary stage we have yet to develop a complete picture of the findings and still need to analyse data with participating teacher educators and other staff; a process that will inevitably result in a broadening of our sources of evidence as we seek to make recommendations about how to optimally design our blended learning spaces. It might be useful to note that a project approximately a decade ago, informed the change to the blend we have today with the unusual configuration of one LMS course site for multiple course offerings. We had recognised that distance students could feel like second class citizens and made a conscious decision to create remove those boundaries in the virtual learning space and share the distant students’ course materials with on campus students and stream campus lectures and workshops with for distance students so that students in both modes could benefit and participate in various ways. Thus, considerable co-creation and sharing had resulted from that college-wide decision and related support from champions and leaders as well as students. This blurring of boundaries mirrors the conference theme “Open oceans: Learning without borders”. We have strived for an “ocean” where our distance students “swim alongside” our on-campus students so as to increase opportunities for engagement (Dabner, Davis & Zaka 2012).

Students’ desire for consistency across courses does present a challenge as differences in pedagogy that come with different disciplines, cross disciplinary area’s and teaching philosophies, make it inappropriate to prescribe a common LMS course template. In addition, reducing the diversity of our teaching approaches could result in a reduction of student and staff engagement, if it became less stimulating and limits opportunities to model a diversity of good practice that can be transferred into schools (Davis, 2010). However, it does appear that an explanation of how the course is structured at the start might assist students to navigate the differences in the pedagogical design of courses more easily, while also assisting transfer into their future practices as teachers. Our findings also indicate that with the widespread uptake of social media, students’ agency has increased thus adding previously unconsidered informal channels to their learning interactions; something that was only dreamed of in 2008 (Dabner & Davis 2009). We already recognise that the social aspects are invisibly mixed with private and informal learning. The visible perspective of engagement should not "wash away" the informal and social aspects so that they are missed. This reminds us that, while engagement with digital tools continues to increase in prominence for staff and students, they are only the more visible of channels through which students engage in their learning. Therefore, as educators, we need to be cognizant of this and seek ways to acknowledge the variety of tools and channels including the invisible non-digital components that are likely remain particularly important for the learning of students who engage from a distance.

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Striving for authentic social constructivism in online learning; Examples from postgraduate Law & Humanities

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Constructivist and social constructivist processes have long been promoted to foster deep learning opportunities for students as active contributors to their learning. A separate but related focus reminds tertiary educators to promote authentic learning in the age of virtual experiences. However, such learning experiences are not always easy to design in online settings. This paper brings these learning concepts together through sharing examples of authentic social constructivist learning designs in the online space, with subjects from the disciplines of Law and Humanities and taught into an interdisciplinary Master of Cybersecurity degree. The learning design examples of the respective subjects are presented and discussed in an authentic social constructivist context.

Keywords: Online learning; social constructivist; authentic learning; practitioner perspectives.

Introduction

Constructivism positions students as active learners who interpret and interact with their worlds in an iterative and non-linear building process using structures, activities and language for meaning-making to occur (Fosnot & Perry, 2005). Online constructivist learning can be characterised as "discussion-oriented, authentic, project-based, inquiry-focused, and collaborative" within "environments that support critical reflection and experiential processes" (Huang, 2002, p.35). Constructivist theory can help inform online learning, although there have been calls for more research focused on aligning elements of online learning environments with constructivism (Swan, 2005), and in determining what constructivism brings to the practice of teaching (Fosnot & Perry, 2005).

Building on constructivism, social constructivism is a learning process where knowledge is constructed via community social interactions (Palincsar, 1998; Swan, 2005). Palincsar (1998) affirmed the inseparability of social and individual learning processes within knowledge co-construction, and that learning is dependent on sociocultural contexts. Methods of teaching that support social constructivist experiences ensure students engage collaboratively with realistic problems, such as case-based or problem-based learning or other collaborative tasks to promote deeper, transferable learning opportunities (Hanson & Sinclair, 2008; Swan, 2005). Realistic problems should be culturally and contextually specific (Palincsar, 1998).

This paper shares learning design details from two subjects, one in Law and the other in Humanities. Both subjects are taught into the same Master of Cybersecurity degree in an Australian university, and both use authentic social experiences to facilitate student learning. Design features of the subjects are presented and discussed in regards to characteristics of authentic social constructivist online learning (adapted from Hanson & Sinclair, 2008 and Herrington et al, 2014). These examples are shared via practitioner perspectives to facilitate further discussion and potential enhancements to social constructivist learning in the online space.

Social constructivist learning with real-world contexts in the online space

It is long understood that social interactions utilising the tool of language form essential elements to knowledge construction in a wide range of learning environments, including various educational sectors both pre and during the digital age (e.g. Dewey, 1938; Hanson & Sinclair, 2008; Lefoe, 1998; Palincsar, 1998; Swan, 2005; Vygotsky, 1962; Woo & Reeves, 2007). Swan (2005) positions online social constructivism as dependent on a community-centered design. That is, to strengthen online learning the setting needs to support, value and encourage student participation, with community expectations of seeking understanding via collaboration and negotiation of meaning, and where "multiple perspectives are respected and incorporated into collective meaning making… [with learning] situated in authentic "real-world" problem solving" (Swan, 2005, p.9).

While social constructivism is generally viewed as a learning theory and not a teaching methodology (Fosnot & Perry, 2005), Hanson and Sinclair (2008) use a social constructivist teaching methods perspective to review the characteristics for engaging students in collaborative problem solving. The left-hand column of Table 1 gives an adaptation of their contextualised list. Herrington and colleagues, meanwhile, frame authentic learning in the age of technology via nine characteristics based on an authentic learning perspective (e.g. Herrington, Reeves & Oliver, 2010; 2014). In this approach, learning designs offering authentic contexts reflective of the use of knowledge in real life can enhance authenticity via integration of collaborative group tasks, for example, public articulation of ideas and enabling social then individual thinking (Herrington et al, 2010). Authentic learning characteristics, as updated by Herrington et al (2014), can be aligned to the problem-solving social constructivist characteristics relayed by Hanson and Sinclair (2008). Given constructivism's advocacy of real-word examples and authentic learning experiences (Huang, 2002), and that authentic learning and assessment, which is tied with real-world performance rather than dormant knowledge, "is solidly based on constructivism… [that] recognises the learner as the chief architect of knowledge building" (McLoughlin & Luca, 2000, p.517), we bring these ideas together in an authentic social constructivist approach as shown in Table 1.

Table 1: Social constructivist characteristics in the context of authentic, collaborative problem solving

<table>
<tr><th>Social constructivist problem-solving characteristics (Hanson & Sinclair, 2008)</th><th>Authentic learning characteristics (Herrington et al, 2014)</th><th>Extrapolated characteristic for authentic social constructivist learning online</th></tr>
<tr><td>All learning and assessment activities start with and iteratively return to realistic problems</td><td>Authentic contexts: complex, purposeful; motivates exploration; reflects application in real-life</td><td rowspan="2">[1] Online provision of:
- realistic problems applicable to real-life contexts</td></tr>
<tr><td rowspan="2">Engage with collaborative problem-solving activities, under the close supervision and coaching of an educator</td><td>Authentic activities: ill-defined problem requiring subtasks; integrated with assessment</td></tr>
<tr><td>Coaching and scaffolding: some deliberate facilitation and scaffolding supports</td><td rowspan="2">[2] Online facilitator modelling, coaching and scaffolding</td></tr>
<tr><td rowspan="3">Lecturers act as model inquirers by scaffolding the process of collaborative problem solving; gradually fade to a coaching role where they facilitate critical reflection on group interaction</td><td>Experts and modelling: access to expert performance/modelling/ thinking</td></tr>
<tr><td>Coaching/scaffolding (as above)</td><td rowspan="2">[3] Online guidance for reflection on learning & group interaction</td></tr>
<tr><td>Reflection: meaningful reflection on learning</td></tr>
<tr><td>Small groups collaboratively solving the problem</td><td rowspan="3">Collaborative construction of knowledge: pairs/groups collaboratively solve real-world problems and construct knowledge through the process</td><td>[4] Collaborative online learning/assessment tasks</td></tr>
<tr><td>Teamwork: some task distribution among members; all members accountable to group</td><td rowspan="2">[5] Resources and guidance for:
- learning participation in the task/s
- technological participation in the task/s</td></tr>
<tr><td>Group self-management or self-direction to decide learning needs to better understand the problem</td></tr>
<tr><td rowspan="2">Dialogue and the negotiation of shared understanding (as central to the process)</td><td>Articulation: express understanding and/or gaps in understanding; present reasoning</td><td rowspan="2">[6] Resources and guidance for:
- participation in online discussion and negotiation
- multiple perspectives</td></tr>
<tr><td>Exposure to multiple perspectives</td></tr>
<tr><td>Activity purpose beyond problem solving to learn and construct knowledge; can generalise beyond specific problems</td><td>Authentic assessment: demonstrate effective application of and performance with new knowledge</td><td>[7] New knowledge applied in:
- different or evolving contexts in online space
- eventual workplace roles</td></tr>
</table>

Online learning examples of postgraduate authentic social constructivist

In this section, two postgraduate examples are offered, while simultaneously discussing their design in relation to the social constructivism and authentic learning literature aligned to Table 1. The examples are *Surveillance and privacy in the digital age* (Law) and *Issues management in strategic communication* (Humanities). Both subjects are taught online into the same interdisciplinary Master of Cybersecurity degree as intensive six-week online subjects, as well as in various on-campus or hybrid modes in other postgraduate degrees.

There are some noted commonalities in online design across the two subjects. First, both assessment designs offer demonstration and application of new knowledge in an authentic context relevant to the students' anticipated future workplace. This includes an assessment piece achieved collectively with others. This is consistent with the work of Boud and Falchikov (2006) on viewing assessment in terms of participation in practice beyond graduation and into socially constructed learning in particular contexts (e.g. work), and, where possible, involving cooperation with others. Second, both subjects include socialisation and communication opportunities throughout. They begin with a collaborative online icebreaker activity to reduce barriers between students, introduce them to some initial subject concepts, and encourage practice with subject relevant technology. Further, each subject has general information/communication such as a welcome-to-subject video, general class discussion forums, and responsive/proactive facilitator use of announcements.

Law example: Authentic social constructivist learning in SPD

The subject *Surveillance and privacy in the digital age* (SPD) introduces students to the *Privacy Act 1988* (Cth) and offers the opportunity to explore key legal and policy issues in various dimensions of privacy, including growing concerns about mass surveillance. Case studies drawn from Australia and overseas invite students to engage with a range of relevant perspectives, views and interests. The subject also exposes students to ethical dilemmas in privacy and surveillance and enhances their capacity to develop strategies to address such issues.

Key learning design detail
The four assessments for SPD include subject-wide issues-based discussions and a three-part problem-based scenario. The scenario increases in complexity as it follows a local start-up from their experimental trial through to engagement on large scale commercial and government contracts, then overseas expansion. Each phase introduces new narrative elements which alter the facts so that different aspects of the Australian law, and eventually the overseas law, become relevant. In addition to the law, students must consider the views and concerns different stakeholder groups are likely to have both locally and overseas. The assessments overall:

- Issues-based discussion (class forum for each topic)
- Problem-based scenario (evolving across three parts):
    - Part A – Australian business context (individual written response)
    - Part B – Stakeholder considerations (group role-play and report generation)
    - Part C – International comparison (individual written response)

Social constructivism becomes prominent for the collective activities in the group-based tasks, that is, the class discussion and Part B of the problem-based scenario. The latter involves a preparation step of a group web conference, which is largely administrative for group members to select their role-play roles, but also allows student familiarity with the technology. This is followed by a video conference role-played meeting which is recorded, and finally collaborative work in generating a report.

Learning design alignment to authentic social constructivist online learning
The design aligns to a range of characteristics for authentic social constructivist online learning, as extrapolated from marrying the work of Hanson and Sinclair (2008) to that of Herrington et al (2014) (see Table 1; as italicised and numbered in text). First, the issues-based discussion provides for a *collaborative online learning/ assessment* [4] subject-wide activity. There are six modules (topics) and in each the facilitator poses a complex topic-related question for class discussion, encouraging *application of new knowledge in different contexts* [7]. *Facilitator coaching* [2] and *online guidance for learning and technological participation* [3] occurred via offering the first issues-based discussion as an un-marked practice opportunity to answer a complex question and receive formative feedback. Additionally, end of subject assessment submission simply requires students to submit a document listing the two topics whose discussions they want to be graded on. Students are encouraged to *reflect on their learning and group interaction* [3] in making their choice. The Marking Rubric includes a section for "contributes effectively to the discussions by sharing and responding to peers in a thoughtful and collegiate way" worth 10%, proving further encouragement to *collaborate in online learning/assessment* [4].

Realistic problems applicable to real-life contexts [1] are provided primarily via the problem-based scenario. It involves a modern-day scenario of an Australian start-up company XYZ. The company needs advice tackling complex issues related to privacy and surveillance, which are further complicated upon consideration of expansions in their services. There are questions of how this might affect others in the broader community, and then how expansion into overseas markets may change the rules in which they operate. Providing legally appropriate advice to the company requires *application of new knowledge in evolving contexts* and as relevant to potential *eventual workplace roles* [7]. SPD *facilitator scaffolding* [2] occurs by staging the scenario in three messy but manageable stages, via parts A, B and C, and by providing feedback after each part is completed.

The role-play component or Part B of the problem-based scenario is a primary social constructivist learning opportunity for the SPD students, as a *collaborative online learning and assessment task* [4] provoking *multiple perspectives* [6]. Completing this task involves multiple steps and two forms of evidence. The first is a meeting conducted online and recorded (the 'role play'). The second is a written report from the group. *Facilitator coaching and scaffolding* [2] and *online guidance for learning and technological participation* [5] occurred via early group engagement in organising a web meeting to delegate roles for both the role-play (in which each member represents the interests of a particular stakeholder) and group management processes based on options provided by the facilitator, and to practice using the technology and recording the meeting. Students meet via online technology before the stress of looming assessment dates and are supported with technological guides. Difficulties in using the technology aim to be sorted before the groups' more critical role-play web meeting.

To encourage productive meetings and collaborative drafting of meeting reports, *online resources and guidance* are provided for *participation in online discussion and negotiation* [6]. Student groups are asked to prepare prior to their meeting by deciding on a shared document format (e.g. Google doc or Office 365 with instructions provided), and by preparing draft positions. They are guided to aim for consensus, but if not reached, to document the points of difference for the role-played stakeholder groups. The final document is based on the group's discussion, agreed to by all group members, and includes the URL for the recorded role-play.

Humanities example: Authentic social constructivist learning in IMSC

In an increasingly complex, interconnected and globalised world, the subject *Issues Management in Strategic Communication* (IMSC) offers students skills and knowledge prized by organisations cognisant of public sentiment, reputation protection and the preservation of public trust. Students examine issues management across government, not-for-profits, businesses, including techniques and strategies for understanding the potential for issues to emerge from both expected and unexpected events. They learn formal strategies and techniques to provide effective planning for and responses to these issues aiming to maintain reputations and public confidence. Case studies illustrate the historical foundations of this field and the ongoing challenges which each cultural situation provides. In the Master of Cybersecurity, case studies, learning activities and assessment tasks are presented in the context of cybersecurity and the online environment, with specific attention given to issues and crisis management as applied to cyberterrorism, data breaches and hacking.

Key learning design detail
The assessment tasks designed for IMSC scaffold the formal strategies and techniques of the real-world process, from issue and crisis identification (including differentiation and yet to emerge issues), through to constructing comprehensive plans to deal with the issue/crisis via strategic communication. The three assessment tasks are:

- Video presentation – identify and analyse a real issue or crisis (post video to forum and discuss with class)
- Issues management plan – write plan for organisation facing an issue identified in environmental scanning
- Crisis management plan and crisis communication plan – write corresponding plans for a crisis evolved from the issue in the prior issues management plan.

Social constructivism becomes prominent for the community-styled activities in the student-generated video presentation discussions, and for case study crisis analysis activities in Module 2 of IMSC (equivalent to weeks 3-4 of a regular semester). Module 2 challenges the students to work together as if already in the field of strategic communications to analysis an issue or crisis that has occurred. They form groups to examine a specific case and work through the crisis to build collective critical analyses as wiki resources.

Learning design alignment to authentic social constructivist online learning
The case study crisis analysis activities in Module 2 of IMSC provide *realistic problems applicable to real-life contexts* [1] in the form of three recent and publicly known cases of real-world crisis situations that have a cybersecurity component. As a *collaborative online learning task* [4], student groups each critically analyse one case study, and practice articulating the factors that comprise the specific crisis. *Online facilitator coaching* [2] is offered mid-module via a web-conference session, for students to discuss with the facilitator (and each other) their progress in both learning and group relations, thus providing additional *online guidance for learning participation in the task* [5] and *reflection on learning and group interaction* [3]. *Online resources and guidance for technological participation in the activities* [5] is provided via instructions and further support resources related to how to access and contribute to the group wiki tool and the web conference session.

Additional *online guidance for reflection on learning and group interaction* [3] is provided in the closing stages of Module 2, when students are encouraged to read the wikis of other groups to widen the learning experience and view the *new knowledge applied in the different contexts* [7] of the various cases. At this stage students can also view the wrap-up video for their case (with the other cases also available to view), as presented in the view of a strategic communication expert in the university. This allows further *online modelling* [2] and, along with the *multiple perspectives* [6] in the various resources in the case packages, further perspectives provide exposure to other points of view enabling further *online guidance for reflection on learning* [3]. This is an important inclusion as conflated analysis and interpretations reveal the non-binary and social contextualisation of criticism. This is in contrast with many cybersecurity information technology contexts where 'solutions' would be considered binary outcomes. Overall, the case study crisis analysis activities require *application of new knowledge in different contexts in the online space* [7], that is, different to contexts in their assessment tasks.

Conclusion and next steps

This paper introduces the concept of authentic social constructivist learning and defines its seven key characteristics. The paper shares, via the learning designs of two online subjects, how practitioners applied these in the contexts of Law and Humanities. Various ways to engage were embedded across the subjects, yet not all students availed themselves of the opportunities afforded in these designs. Without direct student data, it is impossible to know the full range of reasons for this. Evaluation of student engagement with and perceptions of the range of social constructivist learning activities is currently in planning. Further work could examine operationalisation and scalability of the approach, including how to build wider acceptance of academic and learning designer colleagues for this approach. The table offered in this paper provides an informative, logical tool, which could be adopted and adapted by others in further authentic social constructivist online contexts.

The subject facilitators are alert to keeping their respective subjects authentic and current. The SPD coordinator updates scenario elements in response to active involvement with the sector. The IMSC coordinator recently posted a new case to the class highlighting the then running crisis of the Facebook/Cambridge Analytica data breach, finding that the posting of an 'active' case-study and the ongoing real problems flowing from the issue provided an authentic and immediate social context with a genuine and flowing impact. Having an issue currently being debated in the 'public domain' analysed in a private learning context, with the tools outlined in the subject, highlighted the social immediacy and the ongoing value and application of skills taught. The authors are also exploring the use of crisis simulation software for use in IMSC assessment. The software runs a simulated crisis in real-time where participant students are required to 'solve' the crisis via online collaboration. The simulation requires a multi-layered and coordinated response set against a time-impact evaluation.

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Integrating mixed reality spatial learning analytics into secure electronic exams

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This paper presents an approach to using mixed reality (MR) technologies in supervised summative electronic exams. The student learning experience is increasingly replete with a rich range of digital tools, but we rarely see these same e-tools deployed for higher stakes supervised assessment, despite the increasing maturity of technologies that afford authentic learning experiences. MR, including augmented and virtual reality, enables educators to provide rich, immersive learner centred experiences that have unique affordances for collecting a range of learning analytics on student performance. This is especially so in disciplines such as health, engineering, and physical education requiring a spatial dimension. Yet, in many institutions, paper-based exams still dominate, in some measure due to concerns over security, integrity and scalability. This is despite a key concern for educators and institutions in producing employment ready 21st century graduates being the authenticity of assessments used for high stakes judgements. We therefore present a proposal for how MR pedagogies can be deployed for use in supervised examination contexts in a manner that is secure, reliable, and scalable.

Keywords: Mixed reality, learning analytics, electronic exams, spatial pedagogy

Introduction

In many higher education institutions paper-based exams still dominate higher stakes supervised assessment. Researchers such Hillier & Fluck (2013) cite concerns over security, integrity, and scalability with respect to using digital technology in exam halls. However, there is an increasing need to bring these out-dated means of assessment into line with the digitally rich work and education practices of today. In disciplines that require the examination of spatial skills such in heath, engineering, architecture and physical education, paper based higher states assessment restricts examiners to assess spatial understanding of students (Roca-González, Martin-Gutierrez, GarcÍa-Dominguez & del Carmen Mato Carrodeguas, 2017). This is concerning because research suggests that manipulating physical objects is valuable to create a feedback loop for learning (Paas & Sweller, 2014) in spatial disciplines.

Mixed reality (MR) technologies - comprising augmented reality (AR), virtual reality (VR) and 3D printing - allow for spatial skills assessment (Birt, Moore & Cowling, 2017), but the uptake in education has been hindered by cost, expertise and capability. This is changing with the recent wave of low-cost immersive 3D MR hardware and powerful interactive 3D visualisation software platforms such as Unity3D. However, while the latest MR technology has been deployed for formative learning with respect to spatial capabilities, these technologies have yet to be deployed in electronic exams (e-exams).

A barrier to deploying MR technology for e-exams is that spatial data gathering using MR technology (primarily mobile devices) relies on having access to an internet connection and networked data storage. Conversely for e-exams to be reliable and secure the reliance on an internet connection presents a point of potential system failure while the use of hard-to-control mobile devices presents risks to assessment integrity. Therefore, a question in deploying MR for e-exams is “How can an e-exam effectively be administered whilst still allowing the use of MR technologies for spatial visualisation and data gathering?”. This paper addresses this question through a MR learning solution for spatial analytics and assessment, which can be merged into an existing e-exam system. Providing a spatial visualisation experience for students, addressing security and authenticity required for an examination.

Background

It is increasingly recognised that there is value in the use of e-exams, both to address the digital preference of students as well as the cost and logistics of conducting exams. Recent research has shown an increase in student's preferences for using a keyboard over a pen and paper for exams (Hillier & Grant, 2018). In light of increasing student numbers and constrained funding to higher education the potential for cost saving due to eliminating paper and increases in marking efficiencies may be seen as attractive. The adoption of computers for exams also offers the opportunity for a greatly expanded pedagogical landscape in the exam room (Hillier & Fluck 2013), such that academics will be able to design a wider range of assessment tasks that draw upon a range of multimedia technologies and sophisticated software tools. Students will be able to utilise new tools in responding to the problems set by the examiner. This enhances the university's ability to accredit graduates as being able to solve problems and operate in modern workplaces (Adams, Cummins, Davis & Yuhnke, 2016).

In disciplines such as health and engineering visualisation is increasingly being used in teaching classrooms as key means of improving learning, skills and outcomes, particularly as more disciplines in higher education support the development of practical skills (Höffler, 2010). To enhance students' conceptualisation, manipulation, application, retention of knowledge and practical skills, MR visualisations in the classroom specific learning design characteristics are recommended (Mayer, 2014; Moreno & Mayer, 2007). In part, these visualisations must prime the learner's perception, engage their motivations, draw on prior knowledge, avoid working memory overload through specific learning objectives, provide multiple presentation modalities, move learners from shallow to deeper learning and allow learners to apply and build mental models (Hwang & Hu, 2013; Mayer, 2014).

The fundamental assumption(s) of MR visualisation and their use in the classroom are: that no single technology offers a silver bullet for students to grasp specific concepts (Moreno & Mayer, 2007); multiple representations must take advantage of the differences between the representations (Ainsworth, 2014); and students learn through a variety of approaches (Mayer, 2014). This reflects the general proponents of blended learning approaches that long appreciated and advocated for multiple modes of presentation, delivery and content (Bernard, Borokhovski, Schmid, Tamim & Abrami, 2014). Many disciplines, especially those with STEAM (Sciences, Technology, Engineering, Arts and Mathematics) subject matter(s), are suitable for 3D MR presentations if they benefit from the observation that multiple 3D modes of engagement can be reinforcing and synergistic within the pedagogy (Birt & Cowling, 2017).

To assist with this innovation, technologies such as 3D printing, AR, VR and mobile bring your own devices (BYOD) are becoming available for use commercially and thus able to be incorporated into the classroom. MR, a continuum of these innovative technologies, provides a framework to position real and virtual worlds (Milgram & Kishino, 1994), resulting in the development of new paradigms, tools, techniques, and instrumentation that allow visualisations at different and multiple scales and the design and implementation of comparative MR pedagogy across multiple disciplines (Magana, 2014). The 2016 NMC Higher Education Horizon Report (Johnson, Adams Becker, Cummins, Estrada, Freeman & Hall, 2016) and Technology Outlook for Australian Tertiary Education Report (Adams et al., 2016) specifically highlight these technologies as key educational technologies and drivers for learner engagement.

Finally, tying these concepts together are learning analytics. Learning analytics is a growing field, especially in education, where it is perceived that learning analytics can help to understand student behaviour. As education becomes more digital, more data on this behaviour can be collected, analysed and mined to understand how successful the student learning process is (Siemens & Baker, 2012). Despite this, however, researchers such as Beer, Tickner & Jones (2014), note that this process requires a clear understanding of the context of the data being collected and how it might effectively be used.

Ferguson et al. (2016) identified that the use of learning analytics to improve and innovative learning and teaching is still in its infancy, and requires significant action to drive work in education and training, including work at the institutional level, as well as work at the practice level to ensure learning analytics are developed that make good use of pedagogy. Currently, data is often collected to inform learning analytics predominantly through a learning management system (LMS), identifying characteristics of students that make them higher risk for failure, leading to the use of learning analytics for "early warning" type systems (e.g. Macfadyen & Dawson, 2010).

Moreover, despite this recognition that the use of learning analytics is still in the early stages and the collection and analysis of data is often a problem, work has been completed on the use of learning analytics in virtual learning environments (VLEs), particularly through virtual worlds such as second life. For instance, work from Agudo-Peregrina (2014) looks at the use of student participation in VLEs to predict student success and performance in their coursework, with the main finding of the work being that whilst there is some correlation in online courses, no significant correlation exists for students studying face-to-face. Similarly, using MR outside of the VLE space, Aljohani & Davis, (2012) looked at the use of learning analytics in a mobile environment, and in particular in a pervasive learning environment, coining the terms mobile learning analytics (MLA) and pervasive learning analytics (PLA) respectively to describe this approach, and noted how these could be used to help with understanding of the teacher of the learners' pattern of interaction between themselves and their context. In particular, their system SCROLL made use of historical contextual information about the students geolocated position to help students recall what they wrote at this location effectively.

However, the use of other features of AR or VR systems, such as the spatial positioning of digital objects or student interaction with these objects, seems to be non-existent in the literature, as does the implementation of them in a locked down electronic exam system. Our proposal, therefore, is to use the affordances of a MR system, in particular one that involves the manipulation of digital objects, to record learning analytics for student interactions that involve the spatial positioning of digital objects within the MR environment, as well as student interaction with these objects. This data will need to be captured in a secure exam environment, but can then be replayed for the academic to give a feel for how students proceeding with their learning that can be judged by an expert. We call this type of analytics spatial learning analytics and the resulting data MR spatial memories.

Building a mixed reality spatial memory system

The case study for this paper will be a MR system integrating spatial learning analytics for facilitating the learning of anatomy by health science and medicine students through a visualisation of the human heart. An example of the relative traditional and MR pedagogies is shown in Figure 1.

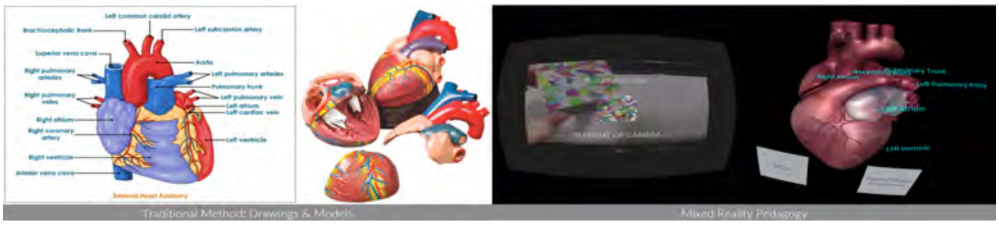

Figure 1. Pedagogies for teaching anatomy with a heart diagram/model

The Heart MR system, first proposed in Birt & Cowling (2016), allows students to visualize a heart model using a MR system built into their BYOD smart mobile device, together with a commercially available Google Cardboard. Once running the application, students can present a coloured cube to the system that will be translated into an interactive model of the heart. As they rotate, yaw and pitch the cube, the heart will move and annotations will appear for the student explaining the different parts of the heart. This is achieved through AR using VUFORIA and Unity3D. Simultaneously, learning analytics are collected on the student's interaction with the app. To understand what learning analytics information could be collected, and how insights could be derived from this information by learners, a model presented by Davenport Harris & Morison (2010) was adapted for this work. This includes recording data for reporting, alerting, extrapolating, modelling, recommending and simulating the model. In this case the data required is the X,Y,Z and rotational information recorded 24 times per second and recorded answers to anatomical recall questions. Data from the learning analytics system can then be stored or transferred to a LMS and used by key stakeholders to interpret student learning outcomes and responses. Using this approach, a MR system can be used to collect data on student performance in spatial analysis and to provide coaching to students on the process. During term, this can be done formatively, and students can be coached through the process. However, at the end of term, if students are required to complete an exam, the question still remains of how this spatial data can be translated and used for summative purposes considered the security and controls expected of a supervised summative exam. This is where integration with existing electronic exam systems becomes important.

Integrating mixed reality with electronic exams

Existing e-exam systems implement a secure environment in several ways, either using institution supplied equipment or student owned equipment (BYOD). Hillier and Fluck (2013) have argued that BYOD is likely the only viable approach to large scale deployment of e-exams. In terms of securing BYOD one of two approaches are used - to install lock-down software within the student's resident operating system on the device or to start the device using an alternative operating system from a network or secondary storage device. The former can be quite invasive and raises risks of interfering with the ongoing operation of the device while the latter avoids any interference with data on the student's internal drive. It is common that only approved applications and documents can be opened, and network access may be removed or limited to 'whitelisted' resources, frequently via the use of a 'secure' browser. Lockdown techniques are available for computers running MacOS, Windows or Linux, but is almost always implemented using desktop and laptop class computers, but not mobile devices.

This presents a barrier for the use of MR pedagogy because MR technology commonly makes use of mobile devices such as Android phones and increasingly leverages stereoscopic headsets to create a greater sense of immersion. Therefore, the challenge is to enable Heart MR to fit into a typical secure e-exam environment using desktop/laptop centric operating systems. One approach is to use emulation software (such as Genymotion www.genymotion.com) or an Android Virtual Box to allow the Android system to run within a desktop OS. This in turn would allow Heart MR to work within or in conjunction with existing secure electronic exam solutions. An example Android app running in GenyMotion on Linux (Ubuntu) is shown in Figure 2. The cube shown in this image is being generated dynamically through visualisation triggered by markings on a physical object (cube) presented to a webcam attached to a laptop computer. Specifically, spatial and rotational information regarding the cube is captured at 24 times per second and animated, producing the digital visualisation.

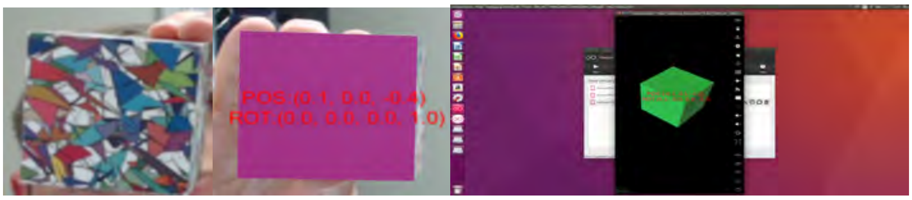

Figure 2. Mixed Reality Pedagogy Running in a Secure Environment through Genymotion

However, limitations currently mean that the use of stereoscopic headsets as required in the original Heart MR application (see Figure 1) would not be viable. Instead, a webcam will need to be used to capture data with the visualisation to be displayed on a regular computer screen. The use of the emulator will allow the same version of the app to be presented to students during the term and for use in exams. This means better continuity between formative and summative assessment can be achieved where the unique affordances of MR pedagogy can be integrated into a secure exam environment for the benefit of students and subsequent assessment by staff. As a first step for exam use, the app can be customized to remove information elements (such as annotations) that students can then be asked to replace as part of their examination learning analytics data can be collected from students as they manipulate the app, providing an extra layer of assessment information that can be used by markers. More advanced designs can take advantage of the unique spatial affordances of MR to allow new insights. However, a question remains as to whether the lack of a stereoscopic headset in the exam will allow students to experience the simulation with the same impact as was conducted formatively, given that the immersive nature of MR has been shown to have a positive impact on learning.

Conclusion

The affordances of MR allow for sophisticated use and analysis of spatial attributes and this is becoming more important in a number of discipline areas to assess in more authentic ways. Education is looking to adopt technologies such as MR, however portions of the education system such as exams appear to be slow to catch up with this trend. This paper presents a method to enable the use of MR to collect analytics and incorporate these into a secure exam environment. The future work of this project will look to conduct live trials of the proposed method.

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Designing online delivery through educational design research

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This paper reports on an early-stage educational design research project to develop scalable online delivery at a higher education institution with relatively low maturity with digital learning. This involves not only an intervention aimed at transforming the curriculum and teaching practices, but also considers the broader set of institutional services that support students and faculty. The paper introduces the substantive problem in context, reviews existing design principles in the literature on high-quality online delivery and provides an overview of the emerging intervention design. This 'whole-of-institution' scope is fairly novel for educational design research, and the paper closes with a reflective analysis of using educational design research for this type of project.

Keywords: Educational design research; Design-based research; Online learning

Introduction

Two key trends in higher education are the ongoing growth in student demand for online and blended modes of delivery (Norton & Cakitaki, 2016), and digital transformation of institutions and pedagogies (e.g. Adams Becker *et al*., 2017). Institutions that are not engaged with these trends are at risk of being left behind, however the transition from traditional on-campus teaching to contemporary technology-enabled practices is often challenging (Salmon, 2005). This paper describes an early-stage educational design research project to develop scalable online delivery at an Australian non-university higher education provider that currently has a very small online student cohort and relatively low maturity with digital learning. The project is intended to build digital capabilities within the institution and launch a high-quality online mode of delivery for a postgraduate course. This paper aligns with Killen, Beetham and Knight's (2017) definition of digital capability as "extent to which culture, policies and infrastructure of an organization enable and support digital practices".

Contributions are made in two areas. First, a set of design principles from the literature are identified to guide the design and implementation of high-quality online delivery. These design principles are drawn from several papers and reports that provide guidelines, principles or recommendations for designing online delivery (Bailey *et al*., 2018; Collis & Moonen, 2002; Singh & Hardaker, 2014; Stone, 2017). Second, educational design research has mainly been used in smaller-scale interventions (Anderson & Schattuck, 2012) and this project is an opportunity to examine the approach as a technique for projects that involve a whole-of-institution intervention. As an early-stage project, this paper focusses on the analysis/exploration stage of educational design research (McKenney & Reeves, 2012) with some design/construction and reflection also discussed.

Educational design research

Educational design research (EDR) is "a genre of research in which the iterative development of solutions (e.g. educational products, processes, programs or policies) to practical and complex educational problems, provides the setting for scientific inquiry, and yields new knowledge that can inform the work of others" (McKenny & Reeves, 2014, p.132). It was popularised in the early 2000's (e.g. Design-Based Research Collective, 2003; Barab & Squire, 2004), and since then has seen use in a broad range of contexts and disciplines. It is part of a family of design-oriented approaches, including design-based research (Design-Based Research Collective, 2003). Educational design research has mostly been used in relatively small contexts, with fewer studies into interventions that impact a whole institution or the sector (Anderson & Schattuck, 2012).

A generic framework has been proposed by McKenny & Reeves (2012), with three stages towards a maturing intervention and increased theoretical understanding: Analysis/Exploration, Design/Construction, and Evaluation/Reflection. Anderson & Schattuck (2012) propose that quality educational design research is characterized by: being situated in a real educational context; focusing on the design and testing of a significant intervention through a collaborative partnership between researchers and practitioners; using mixed methods; and involving multiple iterations with an evolution of design principles.

In this project, the educational design research approach is adopted to increase likelihood of success by drawing on existing knowledge on high-quality online delivery and incorporating a strong evaluation/improvement cycle. It also facilitates dissemination of outcomes and design principles.

Below, the description of the project is divided into the core elements of educational design research suggested by Barab (2014). The *naturalistic context* and *problem* are combined to provide a contextualized discussion of the problem; *theory* is based on existing design principles identified in the literature (Reeves, 2006); followed by a description of the intervention *design*.

Substantive problem: Launch high quality and scalable online delivery

While the uptake of online learning is increasing, institutions often start embracing digital learning through substitution rather than making use of the more transformational opportunities of technology (Salmon, 2005). In contrast, this project aims to transition a non-university higher education provider with low levels of digital maturity to more contemporary and digitally-enabled approaches of teaching and learning. The institution has around 1000 students across two campuses, with undergraduate and postgraduate courses in project management, business, and information technology. There is a small cohort of students studying online, with no further intakes planned until online delivery is overhauled. Teaching practices are fairly traditional, with class time split between a lecture and a more active tutorial. Students can get lecture slides via the learning management system LMS, and also submit assignments via Turnitin. A strategic decision has been made to overhaul and relaunch the online delivery, both for growth in student numbers as well as to build digital capability within the institution to prepare for the future of education. The online delivery will delivered fully online and will be designed so that a reasonable increase in number of students and courses can be handled without greatly changing technologies or workflows.

The problem, then, is to develop and launch scalable and high-quality online delivery in an institution with mostly on-campus delivery and services, and relatively low digital maturity. Table 1 describes the context with reference to Collis & Moonen's (2002) four components of flexible learning.

Table 1: Institution context – current state and future vision

	Current state in institution	Vision and plans for institution
Institution	• International students on-campus, small cohort of online students. • New senior leadership team. • Some student services have online access arranged as-needed.	• Online delivery to be considered as 'core business' within the institution. • Regular online student intakes, scaling up with accreditation cycle. • Renewed emphasis on quality.
Implementation	• Period of curriculum renewal through the reaccreditation cycle. • Some experimentation led by lecturers.	• Rolling out online delivery is a major initiative for the institution.
Pedagogy	• Relatively traditional model with most interaction occurring through lectures and tutorials. Slides provided online.	• New curriculum model based on transformational learning (Slavich & Zimbardo, 2012).
Technology	• Core technologies: learning management system, text matching. • Slides and assignments submissions through LMS. Forums and online quizzes used in some classes.	• Scalable suite of learning and teaching technologies that meet needs of students and the desired pedagogy.

Theory: Design principles for designing online delivery

A substantial body of knowledge exists on what has (and hasn't) been effective for online learning. To guide the intervention, a set of design principles for developing online delivery has been identified by reviewing key papers and reports that provide guidelines, principles or recommendations for designing online delivery (Bailey *et al.*, 2018; Collis & Moonen, 2002; Singh & Hardaker, 2014; Stone, 2017). These papers were selected based on their provision of a set of evidence-based design principles about components of online learning, that with appropriate granularity to help shape the project intervention design.

These papers were mapped against Collis & Moonen's (2002) four components of flexible learning: institution, implementation, pedagogy, and technology. Two papers focused mostly on specific components of flexible learning, while the other two were broader in scope. Through this process, the emphasis on the need for high levels of embedded student support was noted in Stone (2017). To reflect the embedded nature of student support, the pedagogy component has been re-defined to include not just the instructor but also the broader network of student support that is provided to a current student, such as personalised early intervention. In addition, the institutional curriculum model based on Transformational Teaching (Slavich & Zimbardo, 2012) provides more detailed guidance on teaching methods.

Table 2: Design principles for developing high-quality online delivery

	Synthesised design principles
Institution	• Identify specific goals with a simplified approach to measuring progress or outcomes (Collis & Moonen, 2002) • Know who the students are (Stone, 2017) • Use different delivery configurations for different student groups (strategic portfolio) – institutional focus on prioritizing students' needs (Bailey *et al*., 2018) • Develop, implement and regularly review institution-wide quality standards for delivery of online education (Stone, 2017) • Take a long-term view for resourcing and infrastructure, using vendors for innovation where necessary (Bailey *et al*., 2018; Collis & Moonen, 2002)
Imple-mentation	• Engage faculty as partners and leaders, from strategy development to new methods of teaching and learning (Collis & Moonen, 2002; Singh & Hardekar, 2014) • Equip faculty for success, with just-in-time support, flexible frameworks, and capabilities and expertise to design for quality (Bailey *et al*., 2018; Collis & Moonen, 2002; Singh & Hardekar, 2014) • Align strategic initiatives with the "cultural configuration" of the institution to encourage diffusion of innovations (Singh & Hardekar, 2014) • Clear vision and communication of strategy, alongside an evolving road map (Collis & Moonen, 2002; Singh & Hardekar, 2014) • Don't try to change too much at the same time (Collis & Moonen, 2002) • Leaders should role model use of eLearning systems (Singh & Hardekar, 2014)
Pedagogy	• Intervene early around student expectations, skills and engagement (Stone, 2017) • Value and support 'teacher-presence' (Collis & Moonen, 2002; Stone, 2017) • Design for online, focussing on an inclusive, engaging and flexible learning environment (Bailey *et al*., 2018; Collis & Moonen, 2002; Stone, 2017) • Collaborate for holistic, integrated and embedded student support (Stone, 2017) • Use learning analytics to target and personalise student interventions, and contact and communicate throughout the student journey (Bailey *et al*., 2018; Stone, 2017)
Technology	• Adopt core and complementary technologies, and focus on adoption (Collis & Moonen, 2002) • Offer flexibility and choice, but don't overload (Collis & Moonen, 2002)

Design: Project description (a prototyping approach)

Developing and launching online delivery within an institution is a significant undertaking that requires work across the whole institution. At the core of the project design is a series of iterations, which help break up the work into more manageable pieces as well as align the project with an education design research approach. These iterations operate at two levels. The online units can be evaluated in each study period and improvements identified (a more granular level of analysis). As well, the institution is in a period of curriculum renewal and so there are opportunities to run three phases of iterations that have a broader scope and unit of analysis. This allows more transformational changes to be implemented and evaluated through the broad project phases, while also allowing smaller changes to be made and evaluated in each unit within a project phase. These design iterations are planned across three partly concurrent phases.

Phase 1: minor improvements to current delivery. Collaboration is being undertaken with the lecturers in each upcoming online unit to iteratively improve delivery and incorporate elements of the new curriculum model. Initiatives that have been taken already include improving teacher presence through welcome videos, swapping to a more reliable virtual classroom system, supporting a lecturer to do an improvement they are interested in (i.e. using an online rubric for marking), and strengthening the data collection and evaluation cycle.

Phase 2: Live prototype of new approach. The online delivery will be overhauled using the currently accredited course and relaunched at a small scale. This involves a whole-of-institution approach to implement effective and integrated service provision to the online students as well as start to embed the notion of online delivery as core business to the institution. The design principles will be used to guide the project development, although it is expected that some will only be partially achieved at this stage. Project development work includes:

- Institution: new student market, cohort model for admissions, online provision of support services to teachers (e.g. professional development; educational design support; induction; technical support) and students (e.g. orientation, out of hours technical support); new quality frameworks;
- Implementation: aligning changes and planning with the reaccreditation course advisory committee, building capability and new support services for teachers (e.g. professional development; educational design support);
- Pedagogy: aligning curriculum, assessment and teaching with the new curriculum model, with guidance from the design principles; developing an embedded approach to academic support and pastoral care; and
- Technology: expanding the suite of core and complementary learning technologies.

Phase 3: Scalable online delivery. Once reaccredited, the postgraduate course will be launched via online delivery (as well as an on-campus/blended mode) in a scalable manner that could be replicated for other courses. The model for online delivery will be informed by the outcomes and evaluation of the live prototype in the previous phase. Preparations for this are being done through standard academic processes, starting with the new curriculum model and the Course Advisory Committee for the course reaccreditation. Aligning this phase with the course renewal provides an opportunity to embed the design principles into the course design.

Additionally, work is being done to develop the general digital capability of the institution, including management modelling use of new technologies and encouraging academic staff to incorporate these technologies into their work practice. For example, the institution has multiple campuses so the virtual classrooms tool is being promoted as a way for academics to engage in cross-campus collaboration.

Reflections on designing online delivery through educational design research

While it is too early in this project to evaluate and analyse outcomes, there are some observations that can be made on the use of educational design research on an intervention that targets whole-of-institution changes.

1. The educational design research approach of iterative development appears to align well with large scale changes of this nature. As argued by Coughlin, Suri and Canales (2007), prototypes can assist organisational change by giving staff permission to explore new behaviours and potentially 'fail' in small, low-impact ways, while also providing something tangible that people can perceive and play with.
2. The institutional context has heavily shaped the design of the project iterations, particularly the course reaccreditation timeframe. In turn, the project has raised issues for consideration within the course advisory committee. It is expected that the institution's business environment or plans may change during the project which would require reconfiguration of the iterations.
3. The intervention within this project operates at two levels, outcomes and process. There is a direct intervention into the design of the existing units (Phase 1) that has an immediate focus on student outcomes. However, in Phases 2 & 3 the object of the intervention is to design a process (i.e. planning a whole-of-institution project). This adds complexity to the educational design research process, as the design principles are at a high-level with less guidance on granular decisions such as teaching techniques to adopt.
4. Evaluation and reflection can be directed at both outcome and process, while also considering the interplay between these aspects. Good quality educational design research requires linking processes of enactment to outcomes (Design-Based Research Collective, 2003) in a rigourous way (which Barab (2014, p.157) describes as "principled accounts that provide logical chains of reasoning and prove useful to others"). Doing this well across multiple levels of intervention is likely to be challenging, and possibly only a subset of the design principles will be able to the meaningfully evaluated and extended.
5. Comparing the design principles against the institutional situation highlighted one substantial gap in the technology component. Additional learning technologies are needed to enable scalable and high-quality online delivery, and this poses the question of how to architect the suite of learning technologies to enable the sophisticated approaches specified in the design principles. The literature on aligning technology affordances with pedagogical approaches is generally too granular for enterprise systems selection decisions. Drawing on IT portfolio approaches (e.g. Maizlish & Handler, 2006) to align the suite of systems to business strategy and requirements may provide a more useful set of techniques.

Next steps

The project will follow the phases described above: (1) introduce new techniques to the existing online delivery, and review the LMS and online tutorial system; (2) initiate a whole-of-institution project to prepare for the new online delivery, with four work streams: educational design and delivery, integrated student support services, administration for student and term lifecycles, and marketing; and (3) embed online delivery as core to the postgraduate program as it goes through the reaccreditation design process.

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Procedural and conceptual confusion in a discovery-based digital learning environment

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Confusion has been found beneficial to learning in specific conditions. However, the roles of procedural and conceptual confusion in such conditions are still unknown. This paper presents a preliminary study investigating the relationship between procedural and conceptual confusion and their impact on learning processes and outcomes in a non-challenging online task. Participants completed an online predict-observe-explain task on star lifecycles, which included a star simulation. One group watched a video tutorial on how to use the simulation prior to the task (n=22), while the control group did not (n=22). The tutorial group reported higher confidence and lower challenge in using the simulation compared to the control group. The tutorial group also reported higher confidence towards the concept being learnt than the control group, although no differences were found on concept challenge. However, these differences on conceptual and procedural confidence and challenge did not impact time spent on the simulation, use of self-regulatory skills or learning outcomes. Implications for future studies are discussed.

Keywords: confusion, confidence, challenge, self-regulated learning, online learning

Introduction

Confusion has been found to be both beneficial and detrimental to learning. Students tend to benefit from confusion when they are well-supported through the confusion period, resulting in deep learning (D'Mello, Lehman, Pekrun & Graesser, 2014). However, there is still much to understand about confusion and the most appropriate support to be provided once confusion starts to be detrimental to learning (Arguel, Lockyer, Lipp, Lodge, & Kennedy, 2017; Lehman, D'Mello & Graesser, 2012). This study aims to better understand the relationship between the provision of procedural instructions and two types of confusion – procedural and conceptual – in a digital learning environment.

Confusion is an emotion about cognitive processes, particularly about the feeling of not knowing (Hess, 2003). It is usually experienced in challenging situations, when students are not confident about their learning (Lodge & Kennedy, 2015). Once confused, students need support to have a deep learning experience. This support may come from students' themselves, through the use of self-regulated learning skills, or from the environment. Self-regulated learners plan and monitor their learning, making changes to their study approach if they perceive unsatisfactory progress (Pintrich, 2000). When confused for a sufficient amount of time, students are expected to reflect and control their learning. However, students may lack self-regulated learning skills or may not be motivated to activate them. In these cases, the likely outcome of confusion is boredom or frustration, and external support could be useful in assisting students to overcome their confusion.

Digital learning environments have the potential to provide personalised feedback to assist students in overcoming unproductive confusion. This is a two-step process: first digital learning environments need to identify moments of student confusion when assistance is required, and then the environment needs to provide appropriate support to promote effective learning and engagement (Baker, Rodrigo, D'Mello & Graesser, 2010). Even though research has made significant progress over the last decade on the detection of confusion (Arguel et al., 2017), much still needs to be understood about different types of confusion.

Previous research has found that students may be confused about procedural and conceptual knowledge while completing a non-challenging task in a digital learning environment (Kennedy & Lodge, 2016). Procedural knowledge is "the ability to execute action sequences to solve problems", and conceptual knowledge is "one's mental representation of the principles that govern a domain" (Rittle-Johnson, Fyfe & Loehr, 2016, p.577). Therefore, procedural confusion is related to the feeling of not knowing how to execute a sequence of actions to solve a problem, while conceptual confusion is related to the feeling of not knowing about the principles being studied.

Procedural and conceptual knowledge are thought to share an interactive relationship. For example, in the area of mathematics learning, while procedural and conceptual knowledge have been found to influence each other (Rittle-Johnson, Schneider & Star, 2015), it is also possible for students to experience low procedural knowledge (unsure how to solve a problem) and high conceptual knowledge (understand what the concepts are) – or vice versa. In digital learning environments procedural knowledge might be additionally compromised by the usability of a particular educational technology and its interface (Ardito et al., 2004). For example, a student can have limited knowledge about how to use an interface to create a star in an astronomy simulation, but he or she may have more than adequate knowledge about the concept being learnt (e.g., the physics properties of a star).

In a previous study, participants' reported feeling confused about both procedural knowledge on the use of a simulation and conceptual knowledge on the concept being learnt while completing an online predict-observe-explain task in a discovery-based digital learning environment (Kennedy & Lodge, 2016). The task consisted of using a simulation to create stars and observe their lifespan across time (procedural knowledge) to investigate the relationship between their mass and lifecycle (conceptual knowledge). The current study investigated this further but considered the relationship between procedural and conceptual confusion and the impact this has on learning processes and outcomes. The use of a non-challenging task that all participants easily learn allowed us to isolate the effect of procedural confusion, without needing to account for task difficulty or individual differences in cognitive abilities. More specifically, the study examined whether providing procedural instructions on the use of the simulation (i) reduces procedural confusion, (ii) impacts conceptual confusion, and (iii) impacts learning processes and outcome in a non-challenging task.

Method

Participants and context

Participants were 44 students from a metropolitan university in Australia. There were 32 female and 12 male participants, and they were mostly from second- and third-year undergraduate courses (8 from 1st year, 19 from 2nd year, 12 from 3rd year, and five from other). Ethics committee approval was obtained from the University and all participants provided informed consent. Participants were invited to a computer laboratory to complete an online task – *Stellar Lifecycles* – about the relationship between lifecycle of stars and their mass. Stellar Lifecycles was created in the *SmartSparrow* platform with a predict-observe-explain learning design (White & Gunstone, 1992). This online task is part of the online course *Habitable Worlds* at Arizona State University (Horodyskyj, Mead, Belinson, Buxner, Semken & Anbar, 2018).

Measures

1) Procedural and conceptual confusion

In the current study, confusion was measured in the "Observe" phase of *Stellar Lifecycles*, which is where participants' have reported feeling confused previously (Kennedy & Lodge, 2016). Confusion is a construct that is difficult to measure directly through self-report data (see Arguel et al., 2016) and previous studies have used measures of confidence and challenge as proxies for confusion; as confidence correlates negatively with confusion, while challenge correlates positively with confusion (see Lodge & Kennedy, 2015). Therefore, the current study measured confidence and challenge as indicators of confusion.

Procedural confusion was measured by asking participants "How confident are you on operating the Stellar Lifecycles simulation?" and "How challenging is operating the Stellar Lifecycles simulation?" while conceptual confusion was measured by asking participants "How confident are you that you are understanding the concepts covered in this activity?" and "How challenging are the concepts covered in this activity?". A scale from 1 (*not at all*) to 10 (*very*) was used for all items.

2) Learning processes

Learning processes were measured as time spent using the simulation and use of self-regulated learning skills. Time spent using the simulation was recorded by *SmartSparrow* in seconds. Self-regulated learning skills were measured using two items: one on the use of monitoring strategies ("While completing this activity, I asked myself questions to make sure I understood the material") and one on the use of regulating strategies ("While completing this activity, I tried to change my approach to the activity depending on the feedback received").

Items were adapted from previous research (Pintrich, Smith, Garcia & McKeachie, 1991) and used a scale from 1 (*not at all true of me*) to 10 (*very true of me*).

3) Learning outcomes

There were two measures of learning outcomes. The first measure was a comparison between participants' initial hypothesis selected at the "Prediction" phase and the hypothesis selected at the "Explain" phase. Participants were categorized as "learnt", "already knew", "unsuccessful", or "unlearnt". *Learnt* meant that participants selected an incorrect option at the "Prediction" phase, and the correct option at the "Explain" phase. *Already knew* meant that participants selected the correct option for both "Prediction" and "Explain" phases. *Unsuccessful* meant participants selected the incorrect option for both "Prediction" and "Explain" phases. *Unlearnt* meant that participants selected a correct option at the "Prediction" phase, and the incorrect option on the "Explain" phase. The second measure of learning was a knowledge transfer task, where participants solved a problem that required using information learnt during the Stellar Lifecycle. Participants' answers on the transfer task were compared with their answer on the "Explain" screen and were categorized using the same four categories: "learnt", "already knew", "unsuccessful", or "unlearnt". Participants were asked to provide an open-ended explanation whenever selecting a hypothesis. Two participants from the tutorial group, who selected the correct hypothesis in the "Prediction" phase but mentioned that they were guessing in the open-ended question, were considered as selecting an incorrect hypothesis in the "Prediction" phase. No participants mentioned guessing the hypothesis selected in the "Explain" phase or in the transfer task.

Procedure

Figure 1 shows a visual representation of the procedure. On the "Predict" screen participants were asked to select a hypothesis predicting the relationship between star mass and lifecycle. There were four incorrect options and one correct option. After this screen, participants in the tutorial group were directed to the "Tutorial" screen, where they could watch a video with procedural instructions on how to use the star simulation. After watching the tutorial, they were directed to the "Observe" screen. The control group were directed from the "Predict" screen straight to the "Observe" screen. On the "Observe" screen participants used a simulation to create stars with different masses, observe how long their lifecycle lasted, and report mass and lifespan of three stars. After 60 seconds on this screen a pop-up with the first survey automatically appeared, asking students to complete items on procedural and conceptual confidence and challenge. Automated feedback was provided to participants on the "Observe" screen if they tried to move to the next screen without completing the instructions. After the "Observe" screen participants were invited to complete a second survey, with items measuring their use of self-regulated learning strategies. On the "Explain" screen, participants could see which hypothesis they had selected initially, and were asked to select a hypothesis again. They had the same options as on the "Predict" screen. In the final screen participants were invited to complete a "Transfer Task". The transfer task consisted of a problem-based question where participants had to apply the concepts related to the relationship between star mass and lifecycle learnt during the previous task.

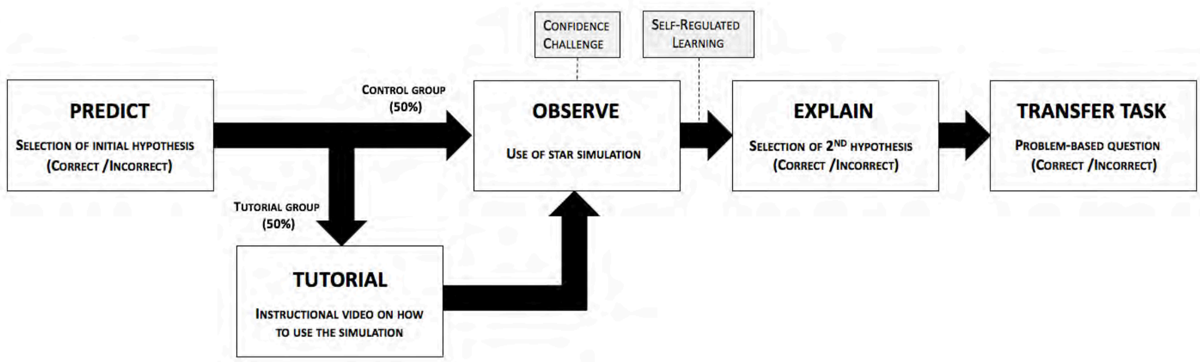

Figure 1: Procedure in the current study.

Results

1) Procedural confusion

A one-way between groups multivariate analysis of variance (MANOVA) was conducted to investigate group differences in procedural confusion. Dependent variables were confidence and challenge towards using the simulation. No violations of normality, linearity, univariate and multivariate outliers were noted. There was a significant difference between control and tutorial group on the combined simulation challenge and confidence variables, F (2, 41) = 11.05, $p < .001$; Wilks' Lambda = .65; partial eta squared = .35. An inspection of the mean scores indicated that the control group reported lower confidence and higher challenge on simulation use than the tutorial group. These results are presented in Table 1.

Table 1: *Group Differences on Simulation Confidence and Challenge*

Variable	Control Group	Tutorial Group	Tests of Between-Subjects Effects
Procedural Confidence	2.97 (2.84)	7.05 (2.85)	F (1, 42) = 22.60, $p < .001$, partial eta squared = .35
Procedural Challenge	6.59 (3.01)	4.26 (3.20)	F (1, 42) = 6.01, $p = .018$, partial eta squared = .13

2) *Conceptual confusion*

A MANOVA was conducted to investigate group differences in conceptual confusion. Dependent variables were confidence and challenge towards the concept being learnt. No violations of normality, linearity, univariate and multivariate outliers were noted. There was no difference between control and tutorial groups on the combined concept challenge and confidence variables, F (2, 41) = 2.45, $p = .099$; Wilks' Lambda = .89; partial eta squared = .11. However, when considered separately, tests of between-subjects effects found a significant group difference on concept confidence. Mean scores indicated the control group reported lower confidence on the concept being learnt than the tutorial group. These results are presented in Table 2.

Table 2: *Group Differences on Concept Confidence and Challenge*

Variable	Control Group	Tutorial Group	Tests of Between-Subjects Effects
Concept Confidence	3.66 (2.61)	5.52 (3.00)	F (1, 42) = 4.84, $p = .033$, partial eta squared = .10
Concept Challenge	5.99 (2.61)	5.42 (2.33)	F (1, 42) = 0.58, $p = .450$, partial eta squared = .01

3) *Learning processes*

A MANOVA was conducted to investigate the differences between groups on learning processes. The dependent variables were: monitoring SRL, regulating SRL, and time spent on simulation. No violations of normality and linearity were noted. Time spent on simulation had five outliers, which were not considered in this analysis (three from the control group and two from the tutorial group). There was no statistical difference between control and tutorial groups on the combined variables, F (3, 35) = 0.55, $p = .649$; Wilks' Lambda = .96; partial eta squared = .05. Results are presented in Table 3.

Table 3: *Group Differences on Self-Regulated Learning and Time Spent on Simulation*

Variable	Control Group	Tutorial Group	Tests of Between-Subjects Effects
Monitoring SRL	6.68 (2.89)	6.53 (2.86)	F (1, 37) = 0.03, $p = .864$, partial eta squared = .001
Regulating SRL	6.86 (2.78)	5.98 (2.75)	F (1, 37) = 0.99, $p = .327$, partial eta squared = .03
Time spent on simulation (seconds)	243.47 (84.86)	219.35 (95.18)	F (1, 37) = 0.70, $p = .410$, partial eta squared = .02

Note. SRL = Self-Regulated Learning.

4) *Learning outcomes*

Chi-square tests indicated that there were no significant group differences on the two measures of learning outcomes: selection of a new hypothesis in the "Explain" screen (X2 (1, n=44) = 4.25, p=.120) and transfer task (X2 (1, n=44) = 5.13, p=.077). Most participants selected the correct answer in the "Explain" screen (43 out of 44) and in the transfer task (40 out of 44).

Discussion and Conclusion

In this study, we investigated the relationship between the provision of instructions and two types of confusion – procedural and conceptual – for a non-challenging task in a discovery-based digital learning environment. The relationship between procedural and conceptual confusion was examined, as well as whether providing procedural instructions impacted on learning processes and outcomes. The results of the study indicated that providing procedural instructions impacted on procedural confusion, with the tutorial group reporting lower challenge and higher confidence towards using the simulation than the control group. Providing procedural instruction, however, did not impact on conceptual confusion. When considering concept and confidence separately, the tutorial group reported higher concept confidence than the control group. In addition, providing procedural instructions did not impact on students' learning processes (time spent using the simulation and monitoring and regulating their learning), or on their learning outcomes.

Participants who watched the instructional video reported higher conceptual confidence than participants who did not watch the video, but that did not impact their learning processes and outcomes. That is, understanding how the content was being presented made them feel confident about what they were learning, but did not make a difference on how they were learning and whether they learnt the content or not. Previous research has reported similar findings, with instructional interventions impacting students' confidence but not their learning outcomes. For example, Carpenter, Mickes, Rahman and Fernandez (2016) found that students who watched videos with higher fluency (strong, deliberate) had more confidence but not better learning outcomes than students who watched disfluent (hesitant, disengaged) videos. This could be partially explained by participants not perceiving the Stellar Lifecycles task as very challenging (i.e., most participants selected the correct hypothesis on the "Explain" phase and on the transfer task). In this case, findings from the current study suggest that there may not be a need to include procedural instruction in low challenge tasks; as providing them did not impact learning processes and outcomes. Future studies investigating the impact of procedural instruction on procedural and conceptual confusion should aim to use a more challenging task – both in procedural and conceptual knowledge.

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Technology for the scalability of co-creation with students

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Student-staff co-creation is a growing topic in higher education research. Framed as a mechanism for universities to better modify and meets the needs and expectations of students, student co-creation has a wealth of potential benefits. However, with the expansion of research, many scholars have stumbled upon a similar limitation, the scalability of co-creation. This issue is due to co-creation currently occurring in face-to-face (f2f) interactions (e.g. pedagogical consultants). However, co-creation can also arise in online spaces, enabled by technology, that could allow for greater scalability. In this paper, three strategies supported with technology to enhance the scalability of co-creation will be discussed including, crowdsourcing, customisation and prosumer behaviour with relevant industry examples for each as well as suggestions for practice in higher education. The limitations, benefits, and new directions for research will further be discussed. It is the aim of the paper to provoke ideas on how co-creation can be made more accessible to all students.

Keywords: co-creation, technology, higher education

What is co-creation?

There exist various ways to define co-creation, however, in its most simplified sense, co-creation is an interaction between two or more unique stakeholders (i.e. staff, industry, students, local communities) to jointly integrate their respective resources to provide greater benefits to all stakeholders. As co-creation is originally a concept from business literature, most literature to date delineates stakeholder groups between the 'organisation' and the 'user', however, in the higher education context, stakeholder groups could just as easily be the 'university' and the 'student' (Dollinger, Lodge, & Coates, 2018). Co-creation is often accredited to C.K. Prahalad through his iterative work on the subject that began as a core competency model, otherwise known as a framework that encouraged organisations to understand their strengths and resources across organisational boundaries (Hamel & Prahalad, 1990). Arising from the core competency model it was demonstrated that a commonly ignored core competence and potentially transformative resource within organisations was users' perspectives and knowledge (Hamel & Prahalad, 1990). Thus, identifying non-traditional capabilities including user-contributed resources would later pave the way for developing and theorising the process of co-creation and how to include users in production and delivery (Prahalad & Ramaswamy, 2000).

Co-creation is increasingly prevalent in higher education research. Regarding co-creation with technology-supported functions, three examples stand out in the current literature as they highlight an apparent attempt to couple co-creation with technology. The first is from the Spanish higher education context where a research project allowed students and staff to co-create a Moodle environment for marketing subjects (Navarro-Garcia, Peris-Ortiz & Rueda-Armengot, 2015). Transparency was a fundamental principle in the project, and all participants were encouraged to share ideas about what the platform should be and what resources it should hold (e.g. databases, blogs, tasks, wiki). The evaluated benefits of such were that both students and staff were more satisfied with the results and students also expressed other key benefits such as experience in teamwork (Navarro-Garcia, Peris-Ortiz & Rueda-Armengot, 2015). Another example, also from Spain, comes from Gros and Lopez (2016) who utilised students and staff for the co-creation of technology-enabled resources for a subject. The process included four stages, exploration, envisioning, operationalising and assessment/reflection where participants brainstormed and gave suggestions on digital resources that could be used by teachers. Students in this activity expressed greater self-management of their learning and greater levels of communication. The final example is from Australia, where Browne et al. (2017) co-created learning resources for a massive open online course (MOOC) with students. They again note benefits such as student engagement and teamwork but also mention that the process may be improved through clear guidelines and a scaffolding process.

While co-creation often seeks to include as many stakeholders as possible, the above examples were not accessible to the entire population of students and staff within the institutions. Instead, the cases involved a few select students led by a staff member. Thus, while case studies of co-creation continue to grow in higher education, there exist few examples which showcase how co-creation could be scalable to all students or include staff members not familiar with co-creation literature. However, drawing on technology-enabled strategies and industry examples, some methods could promote scalable options for co-creation in higher education as this article will discuss. However, before mechanisms are discussed, it is important first to introduce the distinctive theories and concepts that underpin co-creation.

Theories and concepts underpinning co-creation

Numerous theories underpin the concept of co-creation including stakeholder theory, organisational citizenship behaviour, diffusion of innovation and service-dominant logic. Of these, it is service-dominant logic that most aptly differentiates co-creation from its counterparts (i.e. students-as-partners, student voice, student engagement). Service-dominant logic is a theory supported by Vargo and Lusch (2008, Lusch & Vargo, 2006) stating all products are services (e.g. goods dominant logic is outdated as all goods also have corresponding service functions) and all services are co-created as the value of the service is a joint process between what the organisation offers and the user consumes. Vargo and Lusch (2008) use the example of a car, which does not have value unless a user places value on it. Moreover, depending on the user, the value is likely to differ. For one user, the value may be it helps them get to work, for another, it may be that the car represents success and wealth. Therefore, service-dominant logic argues that value is created not only during production (as was traditionally assumed) but also post-production, when the users apply and/or modify value. This concept is known as value-in-use (ViU) and is one of the key components of co-creation (Ranjan & Read, 2016). As Ranjan and Read (2016) write there are two distinct components of co-creation, value-in-use, and co-production, or the jointly created value during the production process. While often only one of these components is referred to as 'co-creation' for the co-creation process to be fully developed both components should be present (though not necessarily equal).

Depending on the intervention and the context, the benefits of co-creation vary. In organisational literature, co-creation approaches have been linked to greater revenues, profits and referrals (Payne, Storbacka & Frow, 2008). In higher education meanwhile, Bovill, Cook-Sather and Felten (2011) have found numerous benefits such as students and academic staff gaining a deeper understanding of learning as well as enhanced engagement, motivation and enthusiasm. However, other scholars have noted that benefits from co-creation are not always equal and often result in a compromise between the user and the organisation (Edvardsson, Tronvoll & Gruber, 2011). Select research has also warned that with the same potential to gain a greater understanding of the user perspective, co-creation may also result in co-destruction if user perspectives and/or resources are improperly applied or ignored (Ple & Chumpitaz Caceres, 2010).

Three mechanisms for the scalability of co-creation

As previously mentioned co-creation in many contexts, including higher education, is stifled by a lack of scalability. With scale comes both benefits and drawbacks to co-creation. For example, scale may hinder the richness of user data and opinions, as well as relationship-building interactions. However, scale also allows for those who wish to co-create with other stakeholders to hear more voices and more diversity. This enables the co-creation to include more people and avoid only meeting the needs of the few who participated. The three mechanisms for the scalability of co-creation discussed here will include crowdsourcing, customisation and prosumer behaviour. Examples, benefits and limitations of each of these mechanisms will be discussed.

Crowdsourcing

Crowdsourcing is one mechanism to engage a larger audience in co-creation. Using online technology, crowdsourcing is a distributed problem-solving and production model that encourages users to actively participate (Brabham, 2008). Crowdsourcing often supports user-generated ideas and suggestions and can be applied through various means and along various points of the value chain. In higher education, universities could ask potential students to crowdsource ideas for orientation activities, or they could ask students to crowdsource ideas for a new building on campus. Using either a mobile application and/or a website portal, crowdsourcing is a relatively easy way to collect data on students' opinions and perspectives. Crowdsourcing further touches upon both concepts of co-creation, co-production and ViU. As students crowdsource they contribute resources and innovate the service, but they also can derive more value from the service or activity if it is tailored to their specific needs and preferences.

However, important to note are some of the drawbacks to the crowdsourcing model. First, as some scholars have pointed out, crowdsourcing is actually more co-creation between users and technology, as organisations do not input their own resources (except for choosing the topic to crowdsource) (Anderson, 2011). Anderson (2011) uses the example of a stagnant online course, where students can integrate their resources (i.e. time, energy) to learn from the online content, in some ways co-creating the learning experience and yet never involving a university staff member. Another pitfall of crowdsourcing is that often crowdsourcing models separate user-generated ideas from professional designers, researcher, and industry experts. Therefore, these multiple stakeholder populations do not work together, but almost, rather against one another, which can limit innovation.

Customisation

Customisation is another mechanism that can be supported with technology towards greater scale of co-creation. While co-creation and co-production both advocate for collaboration with stakeholders from the beginning or initial design of the process, customisation is a final stage modification and is often quite superficial. An example would be students choosing the layout of their student ID card. Customisation often occurs in this way, late in the value chain, because it is not cheap (Ogawa & Piller, 2006). It can even take years to develop a technology or business model that allows organisations to customise services on a large scale. Further, as it is late in the value chain, customisation does not allow for user flexibility in innovation, as users are unable to give suggestions or ideas that may reshape the design or principles of a service (Wind & Rangaswamy, 2001).

Yet there do exist ways that customisation could be further explored in relation to co-creation, especially to enhance ViU. One such area to date has been customisable dashboards or learning analytics software. For example, the Student Relationship Engagement System (SRES) allows teachers to choose what data they would like to collect and then personalise emails they send to specific groups of students (Arthars et al., forthcoming). Teachers and students, in this scenario, therefore both could benefit from increased value, as teachers can align the software to their own individual perspective on teaching design and students can receive emails that were curated for them. Industry educational platforms such as Lynda are further exploring customisation, as they allow segments of professional development videos to be curated and then distributed, allowing for the curator to, in a way, design their own subject.

Prosumer behaviour

Prosumer behaviour, sometimes known as ‘prosumption’ is a third mechanism that can support the scalability of co-creation. Prosumer behaviour is when users produce content or other related value in the service (Toffler, 1980). Famous examples include platforms such as Facebook and Twitter where organisations have created the platform, but the content is written by users (Ritzer, 2013). Prosumer behaviour therefore has limitations, as users cannot modify or edit the structure or platform. Prosumer behaviour, however, can lead to brand communities, or groups of consumers who strongly identify enough with a brand that they willingly donate resources. For example, in Linux, an open source model, many hobbyists donate a code to the platform as that process actually offers them intrinsic rewards (Brabham, 2008).

An example of co-creation in higher education prosumer behaviour could include students creating a website or social media content for universities. Another example comes from Khosravi, Cooper and Kitto (2017) in a peer recommender system where students write questions for the subject and have the ability to rate the question. Similar to a recommender software like Netflix, this allows popular, well-rated questions to be seen more commonly, and less useful questions less so. Thus, students and staff co-create the learning resource and content and participate in what is known as ‘prosumer behaviour’. However, prosumer behaviour and crowdsourcing models need the organisation to distribute control and power in ways the organisation may not have done before. For the co-creation in both of these processes to be authentic, students, and all stakeholders should have equal ability to contribute ideas and even see those ideas come into practice. Therefore, it is important to caution that co-creation is not for organisations that are unable or unwillingly to give up full control.

Future directions of research

Can co-creation be scalable? To this, the answer is both yes and no. Co-creation through technology-enabled mechanisms such as customisation, crowdsourcing and prosumer behaviour can extend into greater numbers of stakeholders, include more people, and thus be more scalable. However, what research is yet to uncover is if these more scalable options also reap fewer benefits within the co-creation process. Benefits of co-creation, for example, often are the relationships between students and staff (Dollinger, Lodge & Coates, 2018) which are unlikely to be replicable in a large online format. Future research should continue to investigate this area and explore the costs and benefits of co-creation scalability. Further, research should seek to explore the value of co-creation beyond service innovation to understand how the approach could enhance educational effectiveness.

For universities that are interested in providing more co-creation opportunities to students and other stakeholders, three mechanisms outlined here, crowdsourcing, customisation and prosumer behaviour are all relatively easy to implement and good first steps to allowing for co-creation. This is important as it is likely that for co-creation to be implemented on a more in-depth level likely requires participants to have some previous experience with it. However, it is with caution that mechanisms such as customisation, crowdsourcing and prosumer behaviour are suggested as strategies for co-creation as these online supported mechanisms could easily offer less transparency and authenticity than f2f co-creation.

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Preparing to Succeed: an online orientation resource designed for postgraduate study success

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Students who study wholly online have different expectations and face different challenges than students studying on-campus. Similarly, the experience, capabilities and expectations of postgraduate students differ from those of undergraduate students, especially school-leavers. Both online and postgraduate cohorts exhibit high attrition rates, often linked to time constraints, poor preparation and dissatisfaction with learning experiences not tailored to their needs. Yet little attention has been paid to how orientation and transition support might be customised to better accommodate these cohorts. In this paper, we provide a rationale and case study for developing an online narrative-led orientation resource tailored to address issues of affiliation, connection and belonging, specific to postgraduate students.

Keywords: postgraduate orientation, online learning, digital learning design, social learning

Introduction

Increasing numbers of students are enrolling in postgraduate and online courses (Brunton et al., 2016; Norton & Cakitaki, 2016), but these cohorts also have higher attrition rates than traditional, undergraduate, on-campus cohorts (Department of Education and Training, 2017; Moore & Greenland, 2017). It is vital that universities provide effective support for these students to help them complete and succeed in their studies. Early support for students, throughout the period of transition to study, is particularly important for student success (Brunton et al., 2016).

Postgraduate students, and those studying wholly online, have unique circumstances and study support needs. For example, postgraduate students are more likely than undergraduate students to study part-time and balance their studies with part-time or full-time employment and family commitments (Lang, 2002; Norton & Cakitaki, 2016). Academic expectations of postgraduate students in terms of independent study, critical analysis and academic writing are often higher (O'Donnell, Tobbell, Lawthom, & Zammit, 2009) and some postgraduate students struggle to understand and meet these expectations (Bunney, 2017; Heussi, 2012). Postgraduate students are also more likely to study online (Norton & Cakitaki, 2016). Online students often report feeling isolated and disconnected from the university and their peers (Brunton et al., 2016). Indeed these feelings of isolation, alongside poor preparation for study, and dissatisfaction with course content and other university services not customised to the online environment, are often cited by students as reasons for withdrawing from their studies (Brunton et al., 2016).

Student support services, orientation and transition activities are rarely designed with online or postgraduate students in mind, despite acknowledgement that online content needs to be specifically designed for the digital learning environment and the specific needs of online student cohorts (Heussi, 2012; Moore & Greenland, 2017; Stone, 2017). Online learning environments and the role of teaching staff in digital learning delivery may be very different from what students have previously experienced and it is vital that students are adequately prepared for these aspects of online study (Blaschke, 2012). Students need to be able to not only access their learning materials, but also interact with them effectively and have realistic expectations about the flexibility of online study (Brunton et al., 2016; Northcote, Gosselin, Reynaud, Kilgour, & Anderson, 2015). Thomas (2013) argues that universities can better build students' sense of belonging by providing opportunities for meaningful interactions with peers and staff, especially early in their studies. Students also feel a greater sense of belonging when their learning experience is relevant to their interests and goals (Thomas, 2013).

For these reasons, we sought to develop an orientation resource specifically designed for postgraduate online students that not only addressed these factors, but also supported Deakin's broader strategic vision in terms of student engagement, outcomes and approach to best-practice digital learning design.

Our approach

Deakin addressed a gap in orientation and transition support by developing a new, coherent, digitally-enabled and narrative-based approach to postgraduate orientation for commencing online (Cloud Campus) students. By leveraging key functionalities of the FutureLearn online learning platform, the resulting *Preparing to Succeed* orientation resource was envisaged as means of bringing to life the University's strategic vision of a 'brilliant education' supported by incorporating leading-edge technologies, communications and student support. FutureLearn mirrors this objective by focusing on three key pedagogical principles: 1) learning through story, 2) learning through conversation, and 3) celebrating progress.

Learning through story

While an abundance of information, including learning materials and support resources, are available to postgraduate students online via the Deakin current student and library websites, these had not previously been curated within any single, unifying framework designed specifically for this cohort. By employing a narrative-led introduction to postgraduate life and study preparation at Deakin, an opportunity was identified to address this lack of customisation for commencing online postgraduate students in a memorable and meaningful way. The linear sequencing of interconnected activities and steps (which function much like chapters and sections in a book) combined with the ability to utilise media-rich digital storytelling techniques such as videos and inline hyperlinks, are key features of the FutureLearn platform. These features enabled the possibility of constructing a polyphonic narrative incorporating not only the voices of senior university executives, academics and professional staff, but also foregrounding the experiences of past and present postgraduate students including mature-age students and those undertaking postgraduate study through wholly online programs. By applying conventional storytelling techniques such as a three-part structure (i.e. a beginning, middle and end), the threads of individual stories and perspectives could be woven into a single coherent narrative with logical nodes for embedding useful links and other resources.

Learning through conversation

A key pillar of Deakin's learning philosophy is 'getting involved'. This idea of active participation within the context of socially enabled learning communities is linked to increased student engagement, improved learning outcomes, and stronger connections with other participants (Zhao & Kuh, 2004). The FutureLearn platform supports this by encouraging learners to comment on topics, discuss issues, ask and answer questions and receive feedback on their ideas in a peer-supported learning environment. Coupled with mechanisms for facilitating a strong educator presence, such as videos, posts and contextualised quiz/test feedback responses (e.g., Stone, 2017), it also affords learners multiple opportunities to interact with Deakin academic and professional staff at each and every step. This social and networked learning model encourages students to learn with and from others by sharing insights, experiences and resources (Goodyear, 2005).

Celebrating progress

Key barriers to postgraduate course completion include lack of time and confidence (Brunton et al., 2016). By packaging essential postgraduate orientation information into a single online resource with an estimated completion time of one to two hours (dependant on time spent in conversation, engaging with learning activities or exploring further learning links), commencing online students would be better positioned to allocate and manage their time with a clear end-goal. We anticipated that setting clear parameters for time and effort would encourage more students to complete the course, leading to a sense of achievement and improved confidence. FutureLearn also supports smaller-scale celebration by encouraging learners to use the 'mark as complete' button at the end of each step. This function provides an incremental sense of achievement and confidence by providing students with a cumulative percentage of steps completed on a visual progress bar (e.g., de Raadt & Dekeyser, 2009).

Program design and development

Preparing to Succeed was developed by a cross-functional and interdisciplinary team of academics and professional staff, including learning designers, student support advisors and dedicated Cloud Campus team members. It was structured around three key questions commonly asked by commencing online postgraduate students that also informed a set of clear learning outcomes for the course:

1. How can I be a successful online student?

2. What does Deakin's online learning environment look like and how does it work?
3. Where can I access support services and resources when I need them?

In turn, the learning design was scaffolded around five FutureLearn activities (or themes) comprised of two to four steps (or topics) each, throughout which three simple but important messages were threaded:

1. We want you to succeed.
2. You are not alone.
3. A wide range of services are available to support you.

To connect these ideas, *Preparing to Succeed* employs a simple narrative to trace the postgraduate student journey from getting started and learning with Deakin to planning for success and achieving results. Within this narrative arc, students are introduced to key topics such as goals, time-management, study skills, learning outcomes, online learning environments, tools and platforms, and related student academic, social and wellbeing support services. Its media-rich format includes videos, images, graphics, resource links and other downloadable resources (such as week and trimester planners). To address student demand for peer-to-peer learning and contribute to a stronger sense of peer and institutional affiliation, a concerted effort was made to incorporate a wide spectrum of voices ranging from senior University figures and student support staff to past and present postgraduate students, including coursework and research students completing their degrees with varying components of online study requirements. Drawing on the principles of constructive alignment (Biggs, 1996), each step also includes a 'your task' learning activity designed to encourage students to explore specific resources and share their findings with the group and reflect on their own learning, professional or life experiences to address specific questions. To improve the quality of social interactions, students were encouraged to make use of Brookfield and Preskill's (2005) 'conversational moves', which includes liking or replying to other students' comments, joining threads and posting comments that link, compare or contrast key themes and ideas. Throughout the course, students are supported in conversation by a team of dedicated educators and mentors drawn from the Cloud Campus and academic and peer support teams. One of the highlights of the course is its conclusion, where students are invited to complete an online self-assessment that, via a short questionnaire, delivers a customised report, including recommendations for further orientation activities that can be accessed via *UniStart* – the University's mainstream orientation resource.

Student engagement with Preparing to Succeed

Student participation

In the first trimester it was offered, and with limited communications of promotion, 20 percent of 1,955 commencing online postgraduate students accessed *Preparing to Succeed*. In the following trimester, access to this resource was extended to all commencing postgraduate students regardless of their mode of study. This decision was in recognition of the fact that even students enrolled in on-campus study access many of their learning materials online (Norton & Cakitaki, 2016). The sharing of this resource with all commencing postgraduate students exemplifies the need to ensure that whenever students are accessing an online resource, all supporting resources should be optimised for equity of access within an online environment (e.g. Stone, 2017). In response, the resource content was modified to incorporate information about additional ways in which on-campus students could access support services. However, the emphasis on online study and access was maintained. Across the following four trimesters, 17 percent of all commencing postgraduate students accessed the resource, equalling a total of 1564 students.

Interaction with educators and peers

Since its introduction, 21 percent of the students who accessed the resource posted at least one comment in the discussion forums. These students posted an average of five comments each. The proportion of students commenting has been relatively consistent across the trimester-based course 'runs', ranging between 19 and 24 percent.

Within the discussion forums, students engaged with the educators to reflect on how the resource content related to their circumstances and asked questions about additional resources or areas of interest. Students engaged with their peers by introducing themselves to others studying the same or similar courses, or those with similar experiences and circumstances. They also shared their own study tips and resources with, and expressed support for, other students. When connecting with other students, several students also suggested avenues for connecting outside of the resource, such as joining existing course-based online communities, creating Facebook groups and connecting via email.

Student feedback

Although we have not yet completed a formal evaluation of the resource, students were asked to provide feedback within the resource. Specifically, they were asked which aspects they found most useful, what we could improve and whether there was anything more they wanted to know. This feedback from students participating in *Preparing to Succeed* suggests that students found the resource useful and enjoyed the opportunity to share ideas and advice with other commencing students. In particular, they commented that they appreciated and were reassured by the amount and variety of support available to them throughout their studies, and the sense of community they felt after engaging with other students and staff within the resource.

Students also indicated that they valued the way the course was structured to allow them to briefly review key content and access more information about topics of particular interest. They also reported that the 'your task' in each step provided a clear and timely prompt to reflect on their own learning, knowledge and experiences and in turn inform their future practice, which contributed to a more meaningful orientation experience. This relevance and ability to tailor the learning experience is particularly important for adult learners, who are time-poor and often bring a wealth of relevant experience to their studies (Blaschke, 2012; Sims, 2008).

Several students commented that they had previously only 'lurked' in online discussion forums, but were using *Preparing to Succeed* as an opportunity to practice posting so they could more actively participate in their unit discussion forums. 'Lurking' (which describes the practice of reading other participants' comments but not actively posting) is a common and valid method of participation in online discussion forums (Malinen, 2015; Soroka & Rafaeli, 2006). However, actively posting in forums increases opportunities for students to connect more meaningfully not only with each other, but also with teaching staff and learning materials (Balaji & Chakrabarti, 2010; Dawson, 2006).

Conclusion

The unique circumstances and needs of online postgraduate students and the higher attrition rates exhibited by this cohort prompted the development of a dedicated online, narrative-driven orientation resource with a focus on social connection. Preliminary feedback indicates that students valued the customisation of the orientation resources to their cohort and the opportunity to further personalise their experience according to their own needs. They also reported feeling more connected to the university and their peers, and more confident about succeeding in their studies.

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Advancing cultures of innovation: the change laboratory as an intervention to facilitate agency and collaborative sustainable development among teachers in higher education

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To cope with the rapidly changing Higher Education climate, teachers need the agency to act proactively to initiate and steer changes to meet their needs. The results of this study indicate that transformative agency emerges when teachers are given the opportunity to analyse, envision and redesign their practice collaboratively with the help of mediating conceptual tools. This has implications for academic development, suggesting that activities providing a 'third space' for discussion and criticism of current practices is needed to support the development of agency thus creating a culture of innovative practice.

Keywords: Agency; Academic Development; Cultural-Historical Activity Theory; Cultures of innovation

Introduction

Higher education (HE) institutions have expanded and diversified at an unprecedented rate over the last two decades in response to a number of powerful external factors (Henkel, 2016). Educational change and development is an integral part of HE teachers' professional lives (Vähäsantanen, 2015) necessitating the development and adaptation of teaching and learning practices in HE (Kirkwood & Price, 2006). It has been suggested that teacher agency is a key capability in the negotiation of the increasingly complex HE environment and development of innovative educational practices (Mathieson, 2011).

A potential problem with current academic development initiatives is that they are frequently instigated by management as a solution to a perceived problem or in response to performance targets (Murray, 2012). This approach risks resulting in approaches that do not promote the agency and engagement of participants in collaborative development activities (Voogt et al., 2015). In order to envision and implement sustainable academic development, teachers need to play an agentic role, developing the ability to question, analyse and shape their own practice (Haapasaari, Engeström, & Kerosuo, 2016; Sannino, Engeström, & Lemos, 2016). Understanding how agency emerges and how it can be supported is essential for sustainable academic development (Sannino, 2015).

This study describes a formative academic development activity aimed at facilitating sustainable agency among teachers. The intervention was in the form of a Change Laboratory (CL) (Engeström, Virkkunen, Helle, Pihlaja, & Poikela, 1996; Virkkunen & Newnham, 2013); a method for supporting participants in redesigning their work practices. The CL method was chosen as it has the potential to promote collaborative transformative agency among participants, in this case members of a teaching-team, through a cyclical process of analysing and solving contradictions in practice (Engeström, 2001; Engeström & Sannino, 2010). In contrast to design experiments, the specific problem to be examined in formative interventions comes from the participants themselves rather than external parties such as management or academic developers (Engeström, 2011; Engeström, Sannino, & Virkkunen, 2014). The focus of the study is on the development and sustainability of agency by the teachers (Haapasaari et al., 2016) where the outcomes of the CL intervention were evaluated after two years (Haapasaari & Kerosuo, 2015).

Background

Prior to the intervention, the participants, who were teachers working on an online interdisciplinary programme, faced several challenges. The organisation of the programme spanned three departments across two faculties. Responsibility for quality assessment and improvement faltered due to its distributed nature. The lack of coherency across the programme was reflected in an impoverished vision for the quality of students' learning experiences and lack of development in educational practices and implementation of new technologies. A CL intervention was therefore adopted to support the development of collective agency among teachers on the programme and to resolve observed challenges.

The notion of teacher agency has long been a focus of international research, exploring teachers' active efforts to make choices to create a constructive learning environment for their students and themselves (Edwards, 2005; Eteläpelto, Vähäsantanen, Hökkä, & Paloniemi, 2013). In recent research into agency, different conceptualisations and characteristics have been introduced. These mainly focus on the individual and their competences rather than considering the wider context in which development takes place (Di Napoli & Clement, 2014; Mathieson, 2011). The type of agency conceptualised within CHAT differs from the dominant individualistic perspective. It goes beyond the individual to encompass collective agency, known as transformational agency. Transformational agency is closely akin to relational agency (Edwards, 2005). It emphasises the expansive transition from individual initiatives to collaborative actions to achieve change and is facilitated by interventions such as the CL (Engeström, 2011).

An issue that academic development faces is whether intended changes in practice are sustained after the intervention (Stes, Coertjens, & Van Petegem, 2010). Sustainability is often lacking as development activities are carried out in isolation of day-to-day teaching practices and fail to embrace context-specific needs or local community practices (Leibowitz, Bozalek, van Schalkwyk, & Winberg, 2014; Smith, 2012). Local contexts can act to enable or constrain agency depending on structural and sociocultural conditions (Leibowitz, van Schalkwyk, Ruiters, Farmer, & Adendorff, 2012). Hence an understanding of how contexts can support or hinder agency development is necessary when designing academic development that facilitates change.

In the present study participants of the CL are able to collectively analyse existing practice and collaboratively envision new ways of working in context. From this perspective, sustainability is understood as a collaborative, communicative and continuing process (Nocon, 2004). If sustainability is to be achieved, opportunities for participants to communicate, express their needs and suggest potential solutions are essential for the development and implementation of new practices (Haapasaari & Kerosuo, 2015).

Theoretical framework: The Change Laboratory (CL)

The Change Laboratory builds on the theoretical framework of cultural-historical activity theory (CHAT) where the context for understanding human actions is the activity system (Leont'ev, 1978). From a CHAT perspective, change and development in activity systems are driven by historically accumulating contradictions arising within and between activity systems (Engeström, 2011). These contradictions act as driving forces of change, generating tensions that can lead to innovative attempts at development if participants have the opportunity to work collaboratively. By critically analysing disturbances as a part of a Change Laboratory intervention participants are able to develop an awareness of the causes and roots of contradictions, which in turn can facilitate the development of a solution through acts of questioning, modelling and experimentation (Engeström & Sannino, 2010; Englund, 2018).

Through direct engagement with the contradictions embedded in practice, the agency of participants is expanded, enabling new forms of collective activity to emerge. Discussions typically begin with individual initiatives and then expand towards collective efforts (Haapasaari et al., 2016). Haapasaari et al. (2016), building on Engeström's (2011) work, identified six expressions of participants' emerging agency. These include: resisting, criticising, explicating, envisioning, committing to actions and taking actions. The different types of transformative agency evolve over time, moving from resistance to taking change actions and from individual initiatives to collective agency.

Context and data collection

Over a period of one semester the researcher, who was also the interventionist, carried out a CL intervention with a group of twelve teachers working on an online, interdisciplinary programme at a university in northern Sweden. During the intervention, which consisted of nine sessions of 90 minutes each, sessions were video-recorded and the recordings of activity during the intervention sessions were used as observational material in the analysis of interactions and discussions between participants. Semi-structured follow-up interviews were carried out with six of the original Change Laboratory participants after two years.

Data and analysis

Analysis of expressions of agency
The nine video-recorded sessions were transcribed and analysed by the researcher. Speaking turns containing expressions of transformative agency were analysed in detail using a category framework to determine transformative agency in conversations among participants (Haapasaari et al., 2016). These were coded according to the six expressions of participants' emerging agency proposed by Haapasaari et al (2016) and recoded by a second researcher until consensus was reached.

Analysis of follow-up interviews
The follow-up interviews were approximately 45 minutes and were audio-recorded and transcribed verbatim by the researcher. Interview questions were semi-structured and participants were asked to reflect on the CL process and describe any changes and developments in practice occurring after the intervention. The transcript data were thematically analysed (Braun & Clarke, 2006; Creswell, 2007).

Results and analysis

The emergence of expressions of agency
Agency expressions were traced over the course of the intervention to examine the manner in which it supported the development process. Figure 1 shows the evolution and frequency of types of expressions of agency.

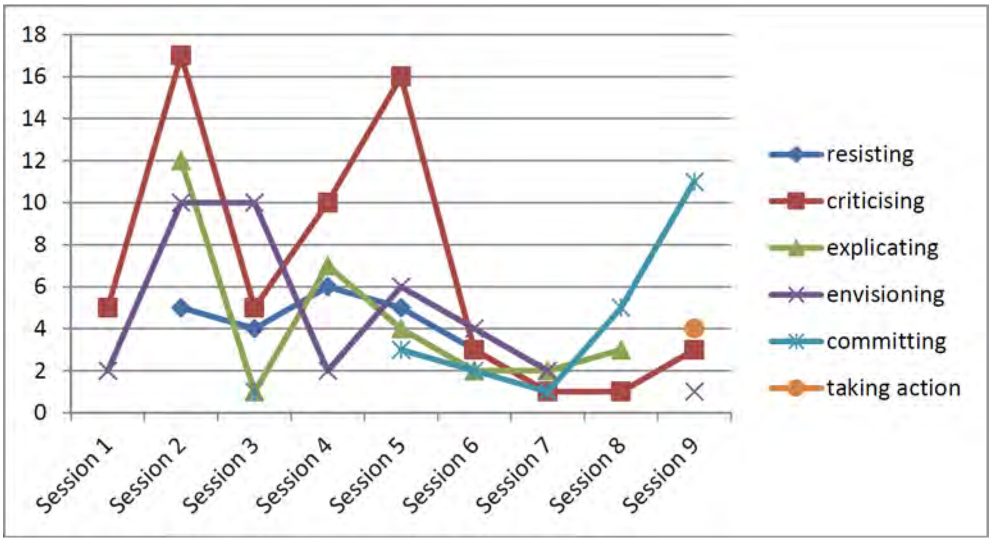

Figure 1. Evolution of types of expressions of agency over the course of the CL.

The overall picture of the evolution of agency (Figure 1) should be considered from the theoretical perspective underpinning the six types of transformative agency (Haapasaari et al., 2016). There is a development from expressions of resisting and criticising towards envisioning, committing and taking actions. Examination of the six types of expressions individually shows that resisting evolved following the model of transformative agency developed by Haapasaari et al. (2016). The highest frequency occurring in the first four sessions and disappearing in the final three sessions. As could be expected in the analysis of current practice, criticising was also at its highest in the first six sessions. It dropped significantly in session seven before rising slightly in the final session as questions concerning the division of labour arose once more. The drop-in criticisms in session three is an anomaly in this respect, caused by the participants' eagerness to begin work on a new model before analysis of the problem was complete. Explicating new possibilities and envisioning new ways of working evolved as expected although like criticising also dropped sharply in session three. Commitment to taking action followed the expected pattern, rising in frequency in the last four sessions, although expressions of taking action occurred only in the final session. In summary, the focus of the CL was on criticising and discussing problems rather than on modelling and implemented solutions.

The analysis illustrates how the participants' transformative agency evolves over time through discussion of problems and contradictions in the programme. This is a dialogic process where transformative agency is developed collaboratively and in interaction between participants.

Follow-up interviews
Analysis of the follow-up interviews after two years revealed a number of factors experienced that facilitated the development of transformative agency. All of the interviewees mentioned the opportunity to discuss and criticise practice over disciplinary borders as an important factor. Several interviewees also mentioned that being supported in the analysis of current problems and their historical origins was important. With regard to sustainability, interviewees reported continuity in the development activities of some departments but also discontinuity and breaks in the process of development for the programme overall. In the face of external pressures and constraints, work on the development of the programme halted. Contradictions between the institutional structure of the university and the autonomy of the programme acted to constrain the successful implementation of new practices developed during the intervention.

Discussion & Conclusions

This study examined the evolution of participants' collective transformative agency in a Change Laboratory intervention. By collaboratively examining and analysing problems and contradictions within their local context, participants were able to change and develop current work practices. Initially participants expressed resistance towards developing the online interdisciplinary programme and to the CL process. However, through active engagement in the process, the majority of the participants were able to move through the cycle of transformative agency. They were able to identify and analyse issues to be changed and developed, create new solutions and to some extent take concrete actions to transform practice. The institutional context, its rules and policies, were however seen to act as barriers to the implementation of new practices on the wider scale of the programme. This has implications for the sustainability of development processes in HE, necessitating the adoption of a holistic approach to academic development that takes into account both sociocultural and structural contextual factors (Englund, Olofsson, & Price, 2018).

The use of the conceptual tools of CHAT in the CL forces participants to distance themselves from everyday practice, providing the means to analyse problems and creating a mediating social space to engage in dialog and discussions (Ellis, Gower, Frederick, & Childs, 2015). This enables a collective approach to solving problems in context. Both the practice of the individual and the collective community, in this case the programme, are developed. This builds a stronger culture of development and shared responsibility among participants (Haapasaari et al., 2016). As seen in the follow-up interviews, the CL sessions provided a neutral, interdisciplinary forum for discussion of the programme as a whole.

HE teachers need agency to act proactively to initiate and steer changes in their practice in an ever-changing and developing educational landscape (Haapasaari et al., 2016). In formative interventions, the focus is on working with the participants from their perspective with a developmental purpose rather than seeking to deliver findings or policy to be implemented in their practice. The role of the interventionist or academic developer is significant, instigating and supporting a collaboratively-led development process that fosters dynamic and progressive change (Virkkunen & Newnham, 2013).

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Use of interactive video for teaching and learning

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This paper focuses on the findings of Phases I and II of an institution-wide project on the effective use of interactive video for teaching and learning in a university in New Zealand. Responding to the emerging growth of video in teaching and learning practice and scholarship, and also to the university's strategic focus on providing blended, flexible learning opportunities, this project explores the ways in which lecturers currently use videos in teaching, their challenges, and their attitudes towards making video as well as students' perceptions of learning through video. This paper discusses what we conceptualise as effective learning moments and conditions and how these can be created and maximised through the effective production and manipulation of relevant, purposeful interactive videos. The overall project combines both research and impact and develops opportunities for lecturers to enhance their competencies in creating interactive videos.

Keywords: video pedagogy, interactive video, video in teaching, engagement, teaching, learning

Video in teaching and learning

As one of the most diversified technologies, video offers numerous opportunities and possibilities for developing effective teaching and learning contexts. More recently, video has been widely integrated into many blended courses and fully online learning environments, including the main delivery mechanism in MOOCs, such as FutureLearn and Coursera. Research shows that video constitutes a critical factor in achieving learning outcomes (Boyle, 1997; Mayer, 2009) and is an effective tool for teaching and learning in various disciplines (Allen & Smith, 2012; Hsin & Cigas, 2013; Rackaway, 2012). However, simply presenting information in video format will not automatically lead to in-depth learning (Karppinen, 2005). The pedagogical design and development of videos with critical elements is crucial for video to be an effective tool in educational contexts, and tertiary teachers need to consider ways to include elements that promote active learning. This paper will showcase some aspects of a multidimensional research project on video pedagogy that we designed and developed for the University of Waikato's context to implement the university's strategic focus on providing blended, flexible learning opportunities.

This project explores the effectiveness of the use of video in teaching and learning and the ways in which interactive videos can be used and promoted as a means for active, flexible learning. Focusing on the use of video, the project was designed on the basis of a real, pressing gap identified through the lead author's consultations and work with teaching staff as eLearning designer, as well as the opportunities that were observed and identified in teaching and learning across faculties. Lecturers often report that creating purposeful, engaging video content for their teaching is time-consuming and laborious. This project investigates (a) the ways lecturers currently use videos in teaching, and students' perceptions of learning through videos; (b) how to train staff to create their own interactive videos; and (c) the effectiveness of the use of videos in teaching and learning in a fully online paper through a case study approach.

Several decades of research show the pedagogical benefits of video in education, particularly in teaching and learning. Articles written back in the 1990s discuss the ways in which video benefits student engagement, so the use of video in teaching and learning is not a new topic. However, what is new is to be found in understanding the ways in which the nature of learning has been transformed through the dramatic changes that have occurred in the world of audio-visuality and multimodality in which we live. Our students spend their lives primarily engaged with some device, interacting with multi-screens and saturated media environments. How far has this shift in the nature of learning and the ways our students engage and learn been thought out pedagogically in our teaching plans and learning designs? In essence, this project engages with this question but focuses on exploring video pedagogy for practical solutions.

Video has proven to have great potential to provide several avenues to facilitate active, blended learning. Studies have shown the ability of video to engage the learner and activate cognitive and emotional learning

(Greenberg & Zenetis, 2012), increase motivation in learning (Saeed & Zyngier, 2012), and have a positive effect on students' perceptions of learning (Bravo et al., 2011). However, little has been written on the use of interactive videos in teaching and learning. An early attempt on interactive video was through making a system called LBA (2006), similar to Panopto, which allowed students to click and pause the video anywhere they desired. The video clip explained the PPT slides and if the student did not interact, the whole recorded lecture would flow from beginning to end. In our project, we define interactive video and the way it can be made by embedding interactive learning moments (Zalipour & Gedera, 2017).

In this paper, we first describe the design of the project, comprising three phases, then define and conceptualise interactive video and the ways in which it can be created and incorporated in teaching and learning contexts. Next, we present and discuss the findings of the research. We conclude by discussing the importance of video pedagogy for facilitating active learning in tertiary education.

The project design

The project comprised three phases. In Phase I, we investigated the ways in which video is used in teaching and student learning through a pan-university online survey with staff and students. We wanted to explore both teachers' and students' perceptions and attitudes towards the use of video in facilitating learning. In Phase II, we designed and conducted a series of professional teaching development workshops to train staff in creating what we conceptualised as interactive video. In these workshops, staff were introduced to simple, easy-to-use video tools that we identified in our research project. The hands-on nature of the workshops provided opportunities for staff to experiment with making and manipulating videos for their own teaching contexts. The workshops included pedagogical discussions where we could encourage positive attitudes about the effectiveness and usefulness of using videos in teaching and learning. Through these workshops, we collected observational data on how staff responded to the idea of interactive videos for student learning and the challenges they experienced when making the videos. In Phase II, we also designed and produced a video toolkit for staff, exemplifying how interactive elements are embedded in videos.

In Phase III, we identified a case study where we could support a lecturer to develop a series of videos for a course in Semester B in 2018. As part of this phase, the lead author offered pedagogical and pragmatic support to the lecturer to review and redesign the paper and develop examples of interactive video-based content, including various forms and types of videos to facilitate active learning in a fully online course. At the end of this paper, the effectiveness of teaching and learning with videos will be evaluated through a focus group with students and one or more semi-structured interviews with the teaching staff involved. The overall research questions are:

- In what ways are lecturers at the University of Waikato currently using videos in their teaching?
- What are students' and lecturers' perceptions and attitudes towards the use of video in learning and teaching?
- How can videos be used for active, flexible learning?
- What are students' and lecturers' views on the ways the videos in the papers supported learning?
- What are the benefits and constraints of using video for promoting active, flexible learning?

Interactive video and workshops

In this project, we have focused on what we conceptualised and promoted as 'interactive video'. We define interactive video as videos that embed interactive learning moments in which deep learning can occur for students. Interactive videos create opportunities for students to actively engage and participate in the learning process in numerous ways. The manipulation of videos by lecturers creates the conditions in which students can interact with the content of the video as intended in the paper's learning outcomes and based on students' prior learning, the content of the lecture, and any other materials and elements of the paper and assessments the lecturer can think of. It is evident that making links and inter-connections enhance student learning. Interactive learning experiences can be created by manipulating and editing videos to include moments in which students are led to pause and engage with a focused learning activity.

There are many ways to create interactive learning moments in videos—through embedded questions, guided conceptual understanding, prompts for generating discussion and reflective pauses, receiving instant feedback, getting involved in creating content for the next lecture, self-centred learning, and many more. Interactive videos allow students to receive feedback, rate the usefulness of the videos utilised by the lecturer in a way similar to ‘active media audiences’ and move from being passive receivers to participating in their own learning in useful ways(Zalipour, 2016). These are moments when students have to pause and think critically, analytically or creatively about the video content and the embedded learning activity. Furthermore, using interactive videos enables lecturers to understand – through analytics or summary data – if the concepts, examples, activities, and assessments in class associated with the videos are truly effective in student learning.

In Phase II, the workshops offered professional teaching development, focusing on the design and implementation of video in teaching and learning contexts, with particular emphasis on assessments and feedback for learning and active, flexible learning approaches. The participants were invited to focus on a particular paper they were teaching in their current semester, where they used or were planning to use videos. The video tools for making and manipulating videos were introduced as the participants worked with them to embed interactive learning moments, at the same time discussing the pedagogical thinking behind their choices. The sharing and participatory atmosphere of the workshops allowed everyone to feel safe trying out different ways they could make their selected videos interactive. The workshops focused on three major ways of creating interactive video content by using screen-casting software, Websites and Learning Management Systems (LMS). For each of these, we demonstrated several tools and how they could be used in teaching and learning. The details of these tools will be discussed in another article or presentation.

For screen-casting tools, we trained staff to use Screencast-O-Matic and Loom. The participants brainstormed and discussed the ways screencast could be used in their papers. Videos can be employed in a variety of ways to enhance active, flexible learning, for example (a) to give an introduction to the course and guidelines, or walk students through instructions of an assignment; (b) as an assessment tool; (c) to record lectures (as short videos/segments), especially the invited guest speakers who cannot attend the class; (d) for demonstrations or tutorials that students may need to watch several times; (e) to record a weekly summary of the class; (e) to provide an overview of assignments or projects; (f) for demonstrations and feedback, and (g) to have students record presentations, reflective commentaries and peer feedback (Gedera & Zalipour, 2017). As part of the Moodle (LMS), H5P offers ways to create interactive learning moments. The training programme was well-received by workshop participants. Web-based tools such as Ed Puzzle and Playposit were introduced and experimented with in the workshops, which concluded by providing some quick tips on the effective use of video in teaching and learning.

In Phase II of the project, we developed an interactive video toolkit that contains succinct professional teaching development resources in the form of video. The toolkit includes a series of both interactive and non-interactive videos, helping lecturers to refresh their ideas and thinking about several key areas in learning and teaching, such as ‘reflective practice’, ‘maximising learner engagement’, ‘designing and teaching blended and fully online papers’, and ‘work-integrated learning’. Part of this initiative aims to allow teachers to see for themselves how video can create flexible learning.

The existing tertiary teaching development resources and programmes at the university are made available largely in the form of booklets, which are usually printed for those participating in the face-to-face teaching development workshops, or which can be downloaded by staff as a PDF file from the university’s website. Such workshops are offered on campus or in other places to enable staff to discuss and share examples of effective teaching and learning. We wanted the staff to engage with teaching development materials at anytime, anywhere, and at their own pace. The recent feedback from tertiary teaching staff at the university shows that they prefer concise, focused, practical teaching development resources and activities. The modules consist of focused, succinct, self-directed and interactive videos which incorporate current, innovative pedagogies. They are designed to stimulate reflection when designing and developing various aspects of teaching and learning, and are guided by voice-over, real-life scenarios, and staff interviews.

Staff and Students: perceptions and use of video in teaching and learning

For Phase 1 of the project, we had 107 staff survey responses and 642 student survey responses across various faculties at the University of Waikato. The staff questionnaire centred primarily on lecturers’ current use of video in teaching, as well as their perceptions and attitudes towards the use of interactive videos and how these could benefit student learning. The survey results showed that lecturers utilise videos for a variety of purposes related to their content and teaching subject, mainly from YouTube, Vimeo, eTV, and TED talks. These purposes include using video to supplement the lecture content, illustrate points, explain and exemplify ideas, introduce concepts and frame discussion topics. Some lecturers referred to the specific purpose of incorporating video to trigger critical thinking and discussion among students. One lecturer wrote about the benefit of videos in illustrating marketing concepts in his course "by way of viewing then critiquing television and social media advertisements". Another lecturer commented: "Sometimes, I will start with a provocative video to stimulate curiosity and discussion". There was an overall consensus that videos should be used in current learning contexts ("I use YouTube videos to break up the course material in order to appeal to students who are visual learners"), and that videos could offer alternative views and perspectives for students. "I often find YouTube videos which discuss topics from a perspective different from my own so as to reposition or reframe the in-class discussion." Others provide videos for students to watch outside classroom time, so they can engage with examples and "exemplars for oral presentations and for at home aural/listening practice".

We observed that the use of video in teaching and learning tends to be discipline-based. Videos are used in teaching some disciplines more than others. Our findings show that there is a more extensive use of video in the areas of education and science than in the humanities. Some lecturers mentioned that they make their own video lectures, lecture summaries and simple how-to or instructional videos. Overall, there were many references to the use of personal mobile phones and iPhones, Panopto, Camtasia, Office Mix and iMovie.
The analysis of staff survey responses revealed the types of difficulties lecturers face when creating videos. The overarching challenges were the lack of knowledge and skills to create videos, poor access to equipment, hardware and software, workload issues, lack of time, and lack of funding to create quality videos. A few lecturers also pointed out some specific challenges:

"Not knowing how to record effective interactive videos that hold the students' attention".

"Complexity in video production/editing; having to store videos outside LMS (e.g. G-drive) – perceived loss of control; time and labour-intensive process".

Through the staff survey responses, it was evident that lecturers do use existing videos and create their own videos, but they do not use interactive videos in their teaching in the sense defined in the present project. However, the lecturers recognised the value and benefits of interactive video in teaching and learning and described some of the affordances and benefits of interactive videos in their survey responses and during workshop discussions. They commented that through interactive videos, they are able to "stimulate students' thinking and discussion" and "encourage autonomous learning". Lecturers also acknowledged that "interactive apps/videos are among the innovating engagement tools" and "would definitely encourage students to use their cell phones, tablets in a more fruitful way". Lecturers' views also highlighted their long-standing concern and awareness of the shift in the nature of student learning: "Interactive videos enable students to engage rather than passively viewing".

It was encouraging to receive an overwhelming response number to the survey on the use of video by students across the university. In the pan-university student survey, most students affirmed that learning through videos is useful (see Figure. 1).

They have been EXTREAMLY helpful in helping me understand the concepts more. Like in Digital marketing we had youtube videos shown in the lectures about how ads work ect and having another explaination and visual example really solidified my understanding of the concepts
Yes, they have been useful. A lecturer occasionally uploading a documentary instead of a reading, for example, can be extremely engaging and gives you access to a range of different ideas and projects that are going on outside of the realm of academic articles. Documentaries especially can demonstrate the real world application of concepts you learn at uni. In other cases, my lecturers have used a short youtube clip during the lecture to illustrate a point. This is engaging and can add humour, or give you something to analyse with fresh eyes given what you've just been learning.
Yes. They are the only way around a clash
We use ads in marketing consumer behaviour classes to understand the theory more practically
Videos have been used in accounting as a pre-recorded discussion of the lecture info (as opposed to Panopto), which has been useful for missed lectures.
Yes the use of showing videos such as youtube clips or documentarys in class or in addition to content being taught is a useful way of learning and creates variety.
absolutely, perfect for when I miss something in class or want to revisit the topic or miss a class for some

Figure 1: Usefulness of videos to support student learning

Students were also asked how their lecturers used videos in their classes and the students were given the following options to choose from:

- Using videos during lectures for teaching concepts or content of the paper
- Using videos during lectures to discuss examples or case studies
- Using video to give a summary of the paper content or lectures
- Using video to give feedback on assignments or your work
- Using 'how-to videos' to show how something works; for example, to show how a particular technology or software works
- Using videos to provide instructions or guidelines about assignments or tests

Figure 2 below presents a summary of students' responses to the above question, indicating that the most common use of video has been during lectures for teaching content.

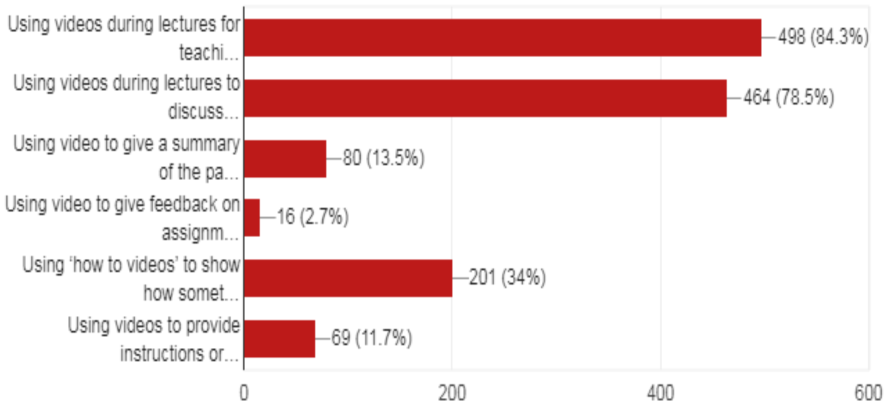

Figure 2: The ways lecturers use videos in papers (student responses)

In the main, students prefer learning through video rather than reading articles or any other forms of academically written materials. In the students' view, videos create interest in the subject and help revise content easily. They mentioned that videos "have been extremely helpful in understanding the concepts" and videos are "extremely engaging and they give you access to a range of different ideas and projects that are going on outside of the realm of academic articles". In the course of conducting the student survey, we came across personal correspondence by individual students asking us if we had considered the use of video for students who have special needs and disabilities. This is an interesting area that will add a new dimension to this research project.

Conclusion

In exploring the video and teaching and learning nexus, we aimed to understand the lecturers' and students' perceptions and attitudes towards the application of video. The findings of this research indicate that students and staff hold positive views of the use of interactive videos in teaching and learning. The workshops on creating interactive video content for teaching were extremely well received. By offering ways to create interactive videos easily and quickly for effective teaching and learning using simple tools, this study has contributed to university lecturers' positive perceptions and attitudes towards creating engaging, purposeful interactive videos. We were informed by several lecturers that they now feel more confident in manipulating and personalizing videos to create interactive learning moments. The use of video in teaching and learning engages students and provides flexible, autonomous learning options to students. The incorporation of interactive learning moments into videos gives students a sense of control and puts them in charge of their learning.

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Paper versus e-assessment: Biomedical students see advantages in moving away from traditional paper based in-semester assessments.

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Technology is becoming an integral part of the teaching and learning environment with e-assessment contributing to quality improvements in student learning experience. This research project investigated the potential effectiveness of using technology for summative assessment in an undergraduate Biomedical Science course. The results indicated that this cohort of students want choice in the location where the e-assessment is completed and choice in the device – personal or university owned. Biomedical Science students indicated that e-assessment is an effective alternative to invigilated, paper-based major in-semester assessments. Reliability of the technology and adequate feedback were also factors in the student's perception of e-assessment. Based on findings from this study, it is our view that e-assessments in this format offers a promising alternative to traditional assessment modes.

Keywords: e-assessment, validity, reliability, feedback, choice

Introduction

In the ever-changing higher educational landscape of entrepreneurialism, globalisation, internationalism and competition there is a need, and a challenge for academic staff to innovate and demonstrate evidence-based teaching practice. Over the last twenty years, technology has become an integral part of the teaching and learning environment and increasingly learning activities, including assessment, have moved into the 'online' space.

Benson (2003) strongly advocates that the 'principles of assessment' should not alter even if there is a move to the online environment. Using technology to assist with assessment practices (e-assessment) began in the late 1990's and can not only contribute to making quality improvements in student learning experience (Dermo, 2009), but also provides academic staff with valuable information on whether learning outcomes are being achieved (Benson, 2003; Alsadoon, 2017). This two-fold outcome, of evaluation and feedback, is an added bonus for both the student and teacher (Sorensen, 2013). The literature in e-assessment is quickly growing with Stodberg (2012) and Alsadoon (2017) providing a comprehensive account of the advantages and disadvantages of e-assessment that are relevant to students, teachers and the university in general. These extend to include cost, provision of feedback, flexibility and accuracy in marking to name but a few.

This paper will centre on the potential of using technology for summative in-semester assessment and investigate the perspectives of Australian undergraduate Biomedical Science students. The current Australian literature is scarce when considering this particular group of students and their perceptions of the known potential of e-assessment. This study aimed to:

- explore undergraduate student's perspectives on undertaking e-assessment using computerised software program for summative in-semester tests (MST);
- understand the advantages and disadvantages for students undertaking summative MST using e-assessment;
- build on existing knowledge of e-assessment in undergraduate Biomedical students.

The research study

The research, undertaken at a University in Victoria, Australia, involved students enrolled in two, second semester units in the Bachelor of Biomedical Science degree. The particular degree assists students to 'understand disease, how it occurs, what happens and how we can control, cure and prevent it' (University Website 2018). The overall cohort size of 550 enrolments had a familiarity with the Learning Management System (LMS), completing many tasks online; including formative assessments on a near weekly basis. Thus, using the software, on the same LMS platform, for this study was considered suitable. Increasing student enrolments and lack of appropriate large spaces at given times within the semester, has resulted in a need to look beyond invigilated paper-based assessments. Similar to the Hillier and Fluck (2017) study, the main drivers for implementation of e-assessment in this study was; academic interest in the scholarship of teaching and learning; innovation in assessment practice and; scale, size, and sustainability of increasing cohort numbers.

The chosen software program, Lockdown Browser, together with a supplementary add-on, Respondus Monitor integrated within the LMS, allows for various functions on the computer to be 'locked-down'. These functions include an inability to; print, email, capture screen content, and visit other web pages or apps during the testing period. The added bonus of multi-media (video and audio) recording, using a web camera, enabled accurate tracking that the right student was undertaking the e-assessment.

In semester 2, 2017, it was determined that two core first-year units, in the Biomedical Science degree would undertake the use of both products (outlined above) for the in-semester summative assessment (namely a mid-semester test). The table below indicates the timing, location, schedule and feedback provided to students for both units.

Table 1: Location, timing, Schedule and Feedback per unit

	Unit 1 Neurobiology (U1NB)	*Unit 2 Molecular biology (U2MB)*
Timing	Weeks 6 and 9 (45mins each)	Week 8 (45mins)
Location	Choice of : a) on-campus using a Monash device, b) off-campus using their own device, c) on-campus using their own device.	No choice - on-campus using a Monash device only
Completion Schedule	On the one day, but at various times. (*Approximately 10-14 students required a deferred assessment for various reasons - completed within the week following on from the original date of the in-semester assessment.)*	
Feedback	Summative grades and correct answer provided once the deferred assessments were completed.	

Methodology & Methods

It was determined that a 'pseudo-quantitative' study would be most appropriate and data was collected using previously validated questions from Dermo (2009) and Alsadoon (2017). All students enrolled in the two units became potential participants in the anonymous online questionnaire, which students accessed through Google forms. Likert scale questions covered the following six dimensions: affective factors (how students feel during e-assessment); validity (appropriateness for university studies); practicality (challenges and benefits); reliability and fairness (in comparison to paper-based assessments); security (in comparison to traditional assessments) and; pedagogy (importance in learning and teaching). Contact with students was via a general announcement in the LMS, which also contained the direct link to the questionnaire. The LMS also contained a dedicated information block on the right hand side of the unit page. The questionnaire remained open for approximately four weeks, with a reminder email sent out halfway through the timeframe.

Results and Discussion

In total, 39 students (7%) completed the questionnaire following their final in-semester assessment task using Respondus. Demographic data indicated a higher number of females (71.79%) completing the survey than males (28.21%). The majority of students were aged <19 years old (82.05%) followed by 20-24 years old (15.38%) and 30-34 years old (2.56%), reflective of the age demographic of the overall cohort.

For Unit 1 Neurobiology (U1NB) – Test 1, 61.54% of students chose to use a university device to undertake the test; this rose to 74.36% (Figure A) for Test 2. The reason for this was unclear however several students reported technical difficulties while using their own internet and/or devices at home which could account for this change. For Test 1, of the student who used their own device, the majority used them at home (28.21%), while the remainder chose to complete the test on campus (10.26%). The results showed a similar pattern for Test 2 with the majority of student who used their own computer completing the test from home (17.95%) and the remainder on campus (7.69%).

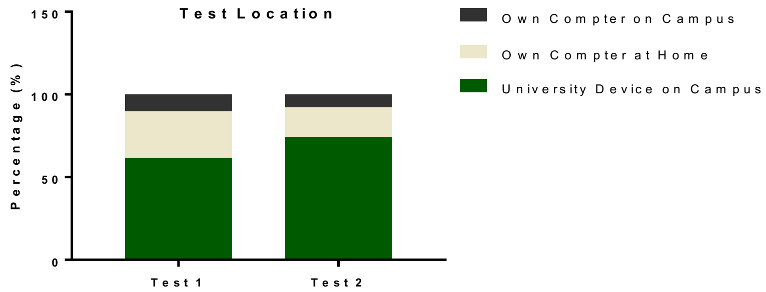

Figure A: Percentages of students in U1NB at each test location when given the choice to complete the test at home or on campus, either with their own device or with a university device.

In order to analyse the six dimensions of the Likert questionnaire, each item was coded to determine if students phrased it positively or negatively. Likert scores for negative statements were re-coded to align with the positive statements in each dimension, as per Dermo 2009. Statements scored less than three (3) were negatively perceived by students and scores greater than three (3) were deemed positive. Following this analysis, it appeared that 'Pedagogy' received the highest positive rating with a mean of 3.7 (Table 2). Cronbach's alpha assisted in determining the internal consistency of each dimension. Of the six dimensions, four received reliable Cronbach's alphas scores of >0.7: 'Affective factors', 'Validity', 'Reliability and Fairness' and 'Pedagogy' (Table 2), confirming consistency as described by Dermo (2009).

Table 2: Dimension-based analysis

Dimension	*n*	*Mean*	*SD*	*Cronbach's Alpha*
Affective Factors	39	3.3	1.3	0.841
Validity	39	3.3	1.3	0.753
Practicality	39	3.2	1.3	0.684
Reliability and Fairness	39	3.1	1.2	0.756
Security	39	3.3	1.1	0.317
Pedagogy	39	3.7	1.2	0.896

Responses from individual Likert scale items (Figures B & C) revealed that students expect e-assessment to be utilised at university (58.97%); believe that e-assessments play an important role in higher education (79.48%); is appropriate for Biomedical Science (79.48%) and; would like to see e-assessment implemented in further departmental modules (58.97%). Sorensen (2013) reported similar findings from a cohort of Chemical Engineering students. In our study, 33.33% of students stated that e-assessments is appropriate for all students. Further research such as focus groups would aid in determining why this is the case in this particular cohort.

From the practicality perspective (Figure B), students agreed that e-assessments were more accessible (58.97%) and that they did not require advanced technical skills (87.18%) to undertake the e-assessment. Students also agreed that e-assessments were just as secure as paper-based (53.84%) and that they did not facilitate cheating (53.84%). These findings are in line with previous studies into e-assessment (Alsadoon, 2017; Dermo, 2009; Sabbah, Saroit, & Kotb, 2012). As previously reported in the literature, one of the biggest concerns for students was the reliability of the technology (Deutsch, Herrmann, Frese, & Sandholzer, 2012; Sabbah et al., 2012). In the present study, 69.23% of students agreed that technical problems could make e-assessments impractical (Figure C). It is likely that the large proportion of students opting to do the test on-campus, on university devices, is due to this factor. This is clearly indicated by the statement '*I was too nervous to use the LockDown at home…' and '…the stress of whether the program is going to malfunction is a distinct and unnecessary source of unease'*. In contrast, some students found the greater stressor to be the exam setting itself stating that '*it was much less stressful and more convenient than having to come into university*' and that '*the stress of coming into the exam venue, public transport issues, difficulty finding the venue were reduced'*. This indicates that choice in location and device for the completion of e-assessment is important to this cohort of students.

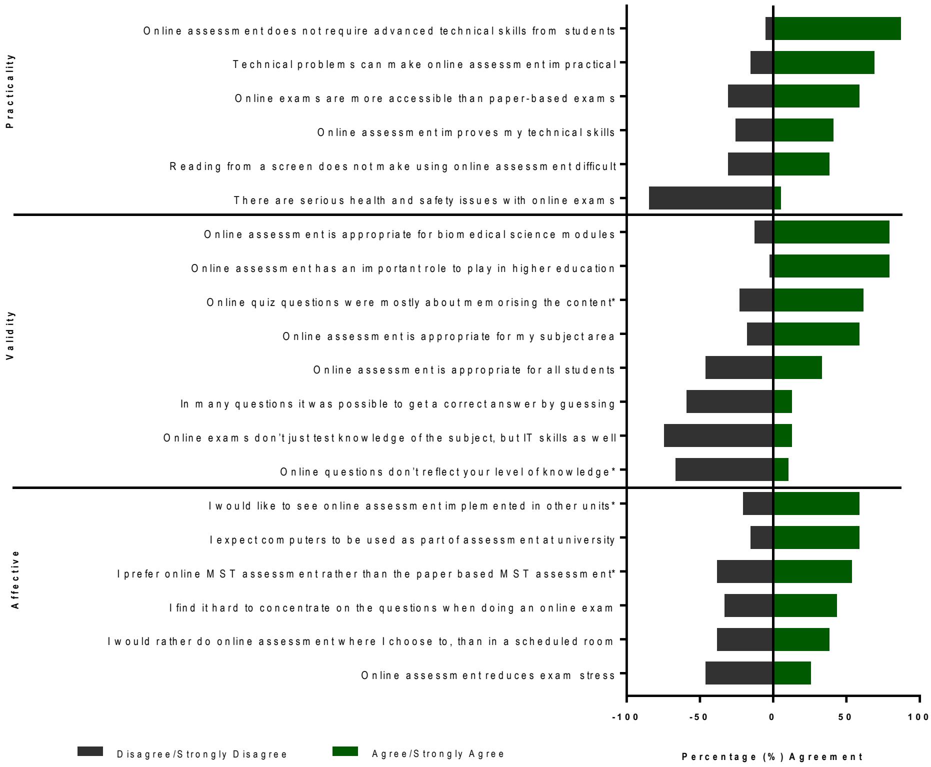

Figure B: Percentage of students (n=39) who agreed/strongly agreed with Likert scale items for the Affective, Validity and Practicality dimensions. ** = statement has been summarised for data presentation, appeared differently in the questionnaire.*

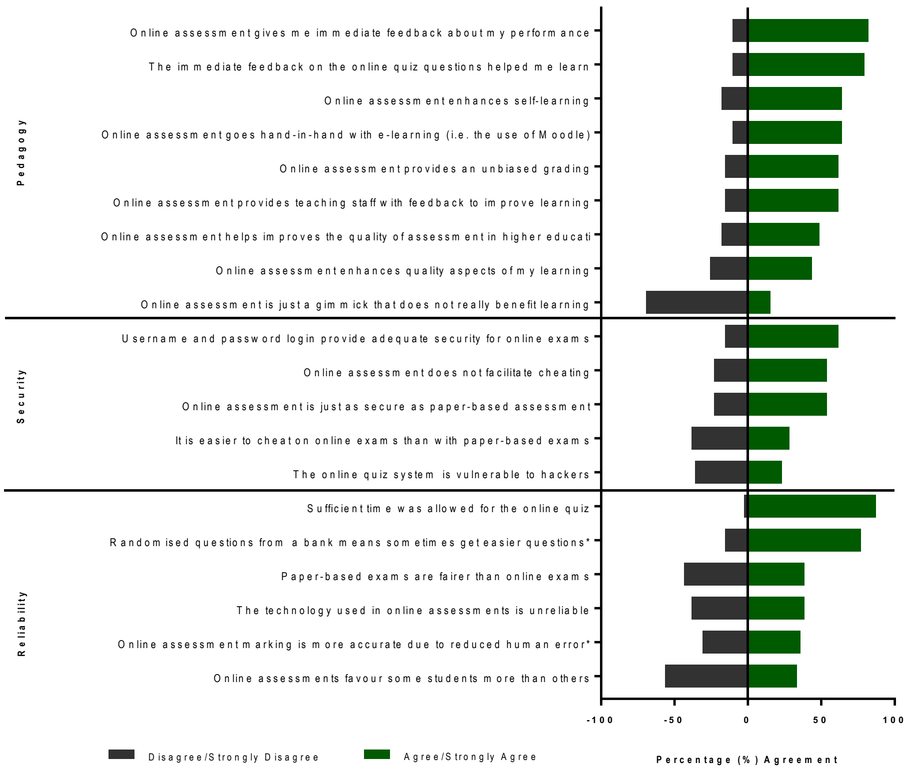

Figure C: Percentage of students (n=39) who agreed/strongly agreed with Likert scale items for the Reliability, Security and Pedagogy dimensions. ** = statement has been summarised for data presentation, appeared differently in the questionnaire.*

The majority of students (53.84%) agreed they prefer e-assessments to paper-based. However, a large percentage also disagreed with this (38.46%) indicating mixed preferences amongst the cohort. Furthermore, in response to the item '*I would prefer to do online assessments where I choose to, than in a scheduled room'*, it was evenly distributed between agree and disagree (38.46% each) (Figure B). The notion of choice appears again, with comments such as:

> *'It's a good idea to have an option/room for people without access to a computer to go to but the choice to do it at home would have been good too.'*
> *'It was great how students had many option to complete the assessment…'* and '*…please keep the option open of being able to do the MSTs at a university computer lab open'.*

In terms of the test itself, students felt that randomised questions, from a bank, meant that it was possible to get less difficult questions than their peers (76.92%) but disagreed that paper-based exams were fairer (43.59%) (Figure B). Dermo (2009) also found that fairness of question item banking was the biggest concern for students. The cohort in the present study has become familiar with online quizzes both formative and summative through the LMS and the general format of question banking. Students also had the option to complete the quiz in a semi-invigilated format, in on-campus computer labs so it is possible that this contributed to a reduced concern about the fairness of e-assessments.

Finally, from a pedagogical perspective (Figure C), most students felt that e-assessments enhanced their learning, with 69.23% of students disagreeing with that statement that '*Online assessment was just a gimmick that did not benefit learning'* (Figure C). Students agreed that e-assessments go hand-in-hand with e-learning (64.10%) and enhances the quality of assessment (43.59% agree, 25.64% disagree); and their learning (48.72% agree and 17.95% disagree). Students also agreed that e-assessments enhanced self-learning (64.10%) and that receiving immediate feedback (82.05%) assisted with their ability to learn (79.49%). Whitelock (2007) reported that due to the immediate feedback, students have the potential to become more reflective as learners. Students in the present study commented that '*they liked online testing as it allowed quick feedback… and made it easier to see we were lacking in terms of knowledge and preparation'* and that getting *"instantaneous" feedback allowed me to see gaps in my memory'* indicating that students do use feedback reflectively. It was noted by one student that the feedback '*is still really lacking',* highlighting a key area of improvement for the academics when implementing e-assessments.

Conclusion

E-assessments appears well received by students and their inclusion in the Biomedical Science curriculum was valued as an effective learning tool. Students showed no major concerns about cheating or fairness of e-assessment but were apprehensive about the reliability of the technology, prompting many to choose to do the e-assessment on-campus using University devices and/or internet connections. An apparent finding from this study was that students greatly appreciated the opportunity to choose the location (home or on campus) and the device (University-owned or personal). Students had mixed opinions about which option they preferred but the ability to choose appeared to reduce the stress they experience with this type of assessment. Similar to the findings in Hillier (2014) it appears that any form of e-assessment needs to be tailored for the specific discipline. If university administration of e-assessment can allow an opportunity for choice, then e-assessment is a very attractive alternative to invigilated, paper-based summative in-semester assessments.

The limitation of the study is its low response rate and lack of qualitative data collection to investigate further student perceptions of e-assessment. In future studies, it would be ideal to investigate perceptions before and after student's exposure to e-assessments. Given the high positive rating towards the pedagogical dimension, there appears to be a strong necessity to not only the inclusion of feedback, which is effective, constructive and immediate but also a need to ensure that there is a presence of higher order thinking questions.

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Return on investment in higher education retention: Systematic focus on actionable information from data analytics

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This article describes the human and technical infrastructure analytics capabilities that have evolved at a university in Western Australia, which have been applied to curriculum and learning data with a focus on the return on investment (ROI) of improving retention. The ROI approach has been used to highlight the benefits of further inquiry and action by decision-makers from the classroom level to school and faculty levels. The article will briefly describe the capability developed and methods underpinning continuous on-demand production of analyses and insights aimed to stimulate inquiry and action to improve retention.

Keywords: Return on investment; retention; learning analytics; data analytics

Introduction

Retention is often defined as the process that leads students to remain within the study program and higher education institution in which they enrol and earn a degree (Borgen & Borgen, 2016; Mah, 2016). Retention has been a subject of much discussion and research in Australian higher education since the early 1950's when government policy began to encourage enrolment. The *Higher Education Standards Panel* report of 2017 reviews that history and outlines current concerns including: raising expectations for completion rates, enhancing access to information, transparency and accountability; and improving articulation across the tertiary sector. In addition, the report points out the need for strengthening outreach, providing career advice and support services to assist with completion, creating intermediate qualifications, creating, embedding and sharing innovative practices including international models, and regulating the system for effective and efficient use of government resources (Higher Education Standards Panel, 2017).

The research program described here, situated in a large university in Western Australia, focuses on several of the above-mentioned concerns by calling attention to the human impacts and potential for 'return on investment' (ROI) to stimulate further inquiry and action. By ROI we call attention to the potential of a desired impact in relation to the effort needed to develop a causal intervention such as a new learning experience or an enhancement to an existing one (Psacharopoulos, 2014). In terms of retention at a university, ROI is often summarised as potential tuition retained and as a corollary, attrition as potential revenue lost. But ROI can also be expressed with other costs and benefits, such as *university reputation lost* if students return home unsuccessful and the news spreads by word of mouth to friends and community (Menon, 2014). The plan of the article is to describe information recently shared at a workshop for Heads of School and Unit (Course) Coordinators, which aimed to introduce the current status of and capabilities for data analytics for learning, teaching and curriculum design. That aim well suits the purpose of this article, which is to share information about how the university has recently focused on engaging curriculum leaders in developing their awareness, skills and interests in data-driven decision-making to improved university retention. The article describes the history of the capability build of the human and technical infrastructure, and presents a summary of analysis models as well as approaches to representing findings and its relation to ROI.

Building the human and technical infrastructure

Beginning in 2010, a pilot study showed that behaviours of students in a school of business could be grouped together to better understand the drivers of retention (Deloitte, 2010). The resulting model, termed the *Student Discovery Model* (SDM), utilised a self-organising map methodology (Kohonen, 1990) to create clusters of behaviours that helped analysts discover new relationships, raise additional research questions and test assumptions and hypotheses. For example, the cluster analysis enabled multiple hypothesis testing, since the groups had not been constrained by a single point of view or intervention. This led to a broader understanding of multidimensionality in certain university settings in which retention plays out differently than in others, and which is lost when students are treated as homogenous. The effort was extended in 2013 to the whole university, which involved creating clusters among 52,000 students over a five year period drawing from 15 data systems (e.g., finance, student records, learning management system) and was used to conduct initial exploration of hypotheses as well as to identify correlations that warranted deeper analysis (Gibson & de Freitas, 2015). By 2015, a pilot project in predictive analytics used machine learning to help make the case for the return on investment of building the university's capability in Student Retention Prediction (SRP) (Chai & Gibson, 2015). This effort was partially successful in that machine learning (ML) demonstrated its usefulness, but was unsuccessful in the sense that the target data or measure used by the ML was based on a timeline that was too long for 'student success workers' to make use of the insights during the current semester. In order to develop the capability for near-real time data needed to address this shortcoming, an investment in data architecture simultaneously established how the new exploratory data analytics would interact with managed data systems of the university (see Figure 1).

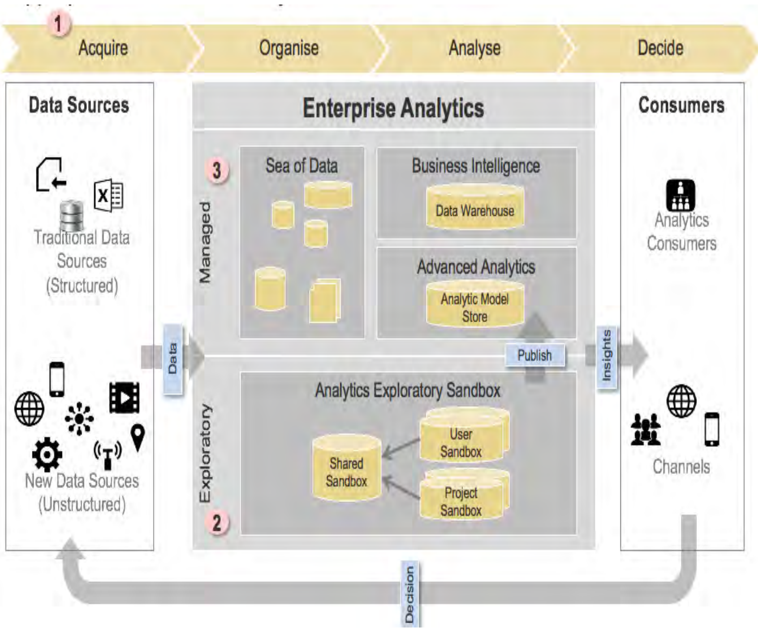

Figure 1: Infrastructure for data analytics includes 1) systems for acquiring, cleaning, organizing and storing; 2) sandbox areas for exploratory analysis; 3) managed data systems for engaging with data consumers

In the planning stage now are tools and processes to engage directly with students based on their own data and to apply the lessons learned to the unit or course level where more dynamic data is produced each semester. To help set the stage for these developments, faculty researchers have been conducting inquiries into the ethics and reactions of staff and students concerning the potential role of data analytics in academic life. An ethical framework has been developed that identifies key questions that require consideration during the process of introducing learning analytics within a university (Roberts, Chang, & Gibson, 2017). Another study explored students' knowledge, attitudes and concerns about big data and learning analytics through focus groups (Roberts, Howell, & Seaman, 2017). Staff registered concerns in a separate study with an overarching concern of coddling and acting in the role of 'helicopter parents' (Howell, Roberts, Seaman, & Gibson, 2018). But despite the challenges, academics saw scope for data analytics to be beneficial if there is collaboration between academics, students, and the university.

Methods, tools and reports underpinning analyses

The methods, tools and reports for accessing data analytics insights for learning, teaching and curriculum design are presented to consumers of university data in terms of products, descriptions, data sources, ease of use and periodic updates (see Table 1). Three primary sources of data are the Learning Management System (LMS), a shared data repository called the 'L Drive' and exploratory data sets created by the Universities Learning and Teaching Unit's learning analytics team. Ease of use reflects whether the user can access and make use of the data product without expert assistance. Updates to data vary depending on the data sources and the complexity of the data product (e.g., nightly, periodically, or on request). Further information and illustrations of the products are offered below.

Table 1: Access, usability and updates profiles of commonly used analytics tools and methods

Product	Description	Data Source	Ease of Use	Updates
Integrated Reports	Available to all unit coordinators within their LMS access. Regular communications to staff highlight use cases such as: item activity, unit access, engagement, contribution and performance, appeals	Blackboard LMS	Easy	Nightly
Disengaged Students List	Enables identification and contacting students who have not been assessing one or more of their LMS units, at key points of the study period (e.g., census, late withdrawal date).	LT Unit analytics	Easy	On request
SDM Retention Data Pack	Per-student Excel retention data, with multiple enhancements (e.g., handling of replacement packages and majors/streams)	L Drive	Difficult	Periodic
Pass Rates	Enables insights into pass rate, withdraw rate and average mark, unit enrolments, for different cohorts.	LT Unit analytics	Easy	On request
Enrolment Trends	Visualizing year-on-year trends	LT Unit analytics	Easy	On request

Integrated reports

Reports integrated with the LMS offer nightly updated views of student engagement with course materials combined with current grade scores and types of work submissions. Interaction totals for each week, with unit features such as accesses, interactions and minutes of access, allow a teacher to see individual student behaviour in one unit compared with average interactions for all other units being studied at the same time. When the engagement data is combined with current grade scores (see Figure 2) then patterns of academic quality emerge indicating that higher engagement correlates with higher grades. An ROI perspective on these aspects might suggest timing and topics for weekly teacher communications to call students' attention to their use of time and energy to improve their learning outcomes.

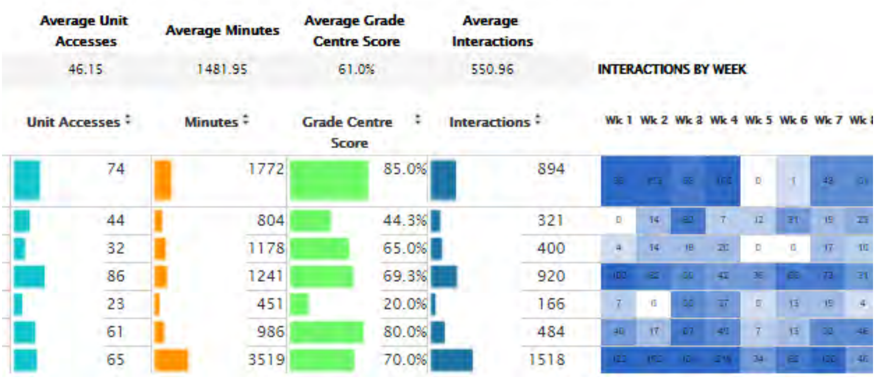

Figure 2: Interactions by week compared with current grade scores

The integrated reports can also be used for curriculum analysis, for example by examining the types of student work being produced at various times of the semester. Student work submissions by week shows peaks of use of academic integrity software in certain weeks and the level of engagement in weekly quizzes and final exams. An ROI perspective on student workload across a whole program might discover that with a shift of a few days, student performance might shift from being a competition among courses to a shifting focus of attention.

Student discovery model retention data pack

The Student Discovery Model (SDM) provides a backdrop for understanding clusters of student behaviours and similarities and also serves as a prepared data source for additional analyses. The preparation steps clean and combine information from 15 sources and place the raw and transformed tables into a production data store used by other data systems, such as for official reporting to the government and tracking the key performance indicators of the university. From the production data store, a data pack is created for each faculty area, with similar visualisation tools and automated analyses that facilitates training and support of decision-makers as well as comparing information and insights (see Figure 3).

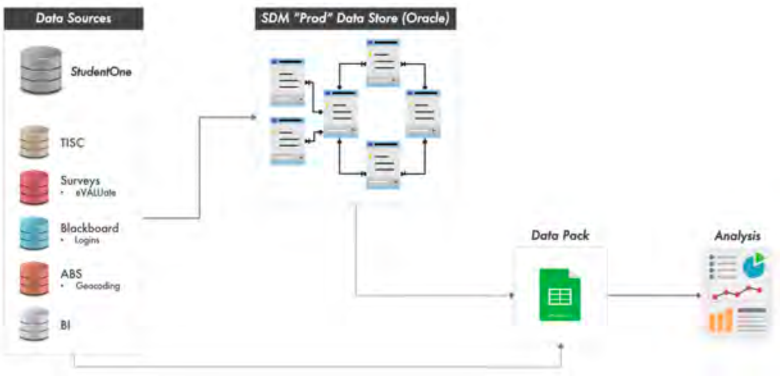

Figure 3: The student discovery model integrates data from 15 sources that flow into a production data store from which a flexible data pack is created for analysis and reporting

An example ROI-oriented product of the SDM created a priority list of programs with an estimated 'Lost Future EFTSL' of that program due to attrition (see Figure 4). In this case, there is a direct impact on school tuition resources that can be estimated as two or more years of lost revenue per student who drops-out in year one, a value estimated in some schools at about $40,000 per student.

University Retention Rate (Headcount)	Possible University Retentions (Headcount)	Lost Future EFTSL
89.5%	19	2.3
73.7%	19	11.1
78.3%	23	14.6
88.9%	18	6.6
100.0%	20	0.0

Figure 4: Retention rates, headcounts and lost future EFTSL (opportunity loss) based on recently historical data

Enrolment trends

Year-on-year comparisons of the dynamic relationship of a unit's enrolment trend with key transition points for attrition provide not only a model of growth (or decline) but also a week-by-week model of time periods when interventions might make a critical difference in retention (see Figure 5). For example, a yearly structural pattern emerges in which rapid drop-outs occur from the date of final enrolment until the census date each year. Sharing and discussing these views of the data helps raise questions about curriculum as well as learning processes. For example, does this pattern occur in all units of the degree program, or only some? Are there non-academic reasons for the pattern? What are the opportunity losses represented by this drop-off pattern? Once the census date has passed, which factors of retention are then most salient? Are there any interventions that might be considered?

Figure 5: Year-on-year enrolment patterns, showing key transition points

Conclusion

The human and technical infrastructure analytics capabilities of a university can be applied to curriculum and learning data with a focus on a 'return on investment (ROI) perspective' for improving retention. The ROI perspective highlights the costs and benefits of data visualisations and analyses for stimulating further inquiry and action by decision-makers at all levels. The production of easy-to-use data sets that can be explored with simple analysis tools has helped build a demand as well as a capability for raising and addressing a wide range of practical research questions across the university. Specific tools and examples are shared here in the hope of initiating professional conversations about data analytics for learning, teaching and curriculum design across universities.

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The voices of autism: Using MOOC technologies to meet the needs of vulnerable communities

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While Massive Open Online Courses (MOOCs) launched with great optimism and the promise of transforming higher education, their implementation has often failed to realise this potential. Across the sector, MOOCs typically attract an audience of already-educated participants with a curiosity for learning that ranges across multiple topics and issues; many engage with multiple courses. This community often do not present with the commitment required to expend the mental effort to achieve completion, and completion rates of 5-10% are not atypical. Given such low rates of completion, it has been argued that MOOCs are simply a fad, of poor quality and low retention (Haggard, 2013).

However, relatively few MOOCs have been developed within Australia that leverage the opportunities provided by free, large-scale educational platforms to address the learning needs of specific communities. This paper reports on the development and delivery of such a MOOC, focusing on raising awareness of the lived experience of individuals with autism, designed for and with the autism community. Utilising MOOC technologies to meet the information and support needs of a specific community demonstrated participation and completion rates significantly above those reported in traditional MOOCs, and points to new directions and purposes for large, open learning environments.

Keywords: MOOC, online retention, education for social good, learning technologies

Introduction

Massive Open Online Courses (MOOCs) offered the potential to transform traditional models of higher education participation; originating from the open education movement, such courses were designed to offer free, large-scale opportunities for any learners anywhere to engage with the kinds of learning models and technologies previously reserved for those enrolled in higher education. As has been noted elsewhere (Hone & El Said, 2016), MOOCs have been immensely popular with learners, with courses typically enrolling many thousands of participants from across the globe (Ebben & Murphy, 2014). However, completion rates are considerably lower than in 'traditional' higher education courses; typically, 5-10% (Ho et al, 2015).

This paper reports on the development and delivery of a MOOC that aimed to leverage contemporary technologies to engage with a specific group of 'non-traditional' learners, who shared a common interest and need around understanding autism. These learners were non-traditional in two senses of that term; first, they were generally mature-aged, with little or no previous experience of post-compulsory study; and second, very few of the cohort had previously engaged with a MOOC in any form. By exploring the cohort, the technologies and pedagogies used to engage them, and the outcomes in terms of retention and completion, this paper highlights the potential for a reconsideration of the role and purpose of MOOCs in higher education. As such, the aim of this paper is to present this case as the starting point for a disruptive conversation about the role of MOOCs and their benefits for education for social good and to service the needs of specific, vulnerable communities.

Understanding MOOCs: Audience and retention

It is important to note that MOOCs are no longer at the 'cutting edge' of educational technologies and practices, as the literature surrounding them is already reasonably extensive. However, this existing body of work is yet to reach consensus regarding the purpose and future of MOOCs; supporters highlight the potential for positive disruption of higher education and 'ownership' of associated knowledge and practice, whereas detractors describe MOOCs as a fad of poor quality and low retention (Haggard, 2013). Indeed, as noted above, typical retention rates for MOOCs are 5-10% (Ho et al, 2015), revealing that although many thousands enrol, considerably fewer complete. It has been noted that we are still in the early stages of understanding why this retention rate is so low, but that learner intention is a key factor in raising retention and completion rates, along with the use of engaging digital technologies and instructor presence (Hone & El Said, 2016).

With regard to learner intention, research to date presents a profile of the 'typical' MOOC participant as an individual who is already highly educated and engaged in employment. For example, Ho et al's (2015) study examined 64 traditional academic MOOC environments developed by HarvardX and MITx, and found that 68% of participants already held a Bachelor's degree or above, 43.5% were over 30 years of age, and 30% were female. Similarly, Christensen et al (2014) examined participation in 32 Coursera MOOCs and characterised learners in these as young, well-educated working adults trying to support current work or taking courses out of curiosity or interest, rather than to address a specific need. It has also been noted that MOOCs have been largely unsuccessful in engaging participants from the developing world (Hone & El Said, 2016).

Given this, it is reasonable to state that typical MOOC participants are experienced learners addressing an interest rather than a need, which may account for low rates of completion when faced with the significant mental effort and sustained time commitment required to engage with a new domain of learning. Indeed, research has indicated that commitment and intention to complete are two of the most reliable predictors of retention in MOOCs (Hone & El Said, 2016), and that most attrition occurs within the first half of a MOOC.

Given the above, we would argue that although MOOCs have to date been marginally successful as a tool for allowing a wide range of participants to explore topics that are of interest to them, the original dream of MOOCs as 'free education for all' and as a tool for social good has not yet been fully realised. In the remainder of this paper, we describe the development and delivery of a MOOC that aimed to engage with a very different group of learners, motivated by need rather than interest, and who have to date been underserved by traditional educational offerings. The results of this MOOC in terms of retention and completion offer insights into how a realignment of the purpose and audience might offer new, potentially disruptive, ways of viewing the potential and impact of MOOCs.

The MOOC

The MOOC described in this paper was developed primarily as an altruistic project by a small team of educators and researchers at a private university in Australia, and aimed to address the needs of a specific vulnerable community: individuals with autism, and their carers and support networks. It is important to note that the needs identified related primarily to raising awareness of the lived experiences of individuals with autism, to better support interactions and engagement with the wider community, and help to reinforce a message that individuals with autism are diverse, present with many strengths and challenges, and are ill-served by prominent perspectives of them as 'sufferers' defined by stereotypical traits. As such, the MOOC aimed to raise awareness by presenting the 'voices' of individuals with autism, structured around key issues, with learners scaffolded through an approach described as 'person first' to further develop their awareness of individuals with autism and the implications of these experiences for developing a more nuanced understanding of autism.

Autism Spectrum Disorder (ASD) is the most prevalent neurological condition in the world; 1 in 132 individuals are born into the condition (Baxter, Brugha, Erskine, Scheurer, Vos, & Scott, 2015). Research into the condition tends to focus on intervention and theory, with less attention given to pragmatic issues important to the autism community, such as educational intervention and developing broader coping mechanisms (Pellicano, Dinsmore & Charman, 2014). Given the statistics around prevalence and this existing research focus, more and more parents and carers are faced with the realities of caring for a child on the autism spectrum, often struggling to cope. Parents of children diagnosed with autism experience high levels of stress and the impacts can be social, emotional, and financial (Clifford & Minnes, 2013). Support needs for this community have been identified and include better information from health professionals, and a desire for social support from others in similar positions (Derguy et al, 2015), along with a need for greater social understanding as many issues arise through a lack of understanding and/or miscommunication. Similarly, individuals on the autism spectrum within the community are faced with common misconceptions regarding the condition, particularly as they engage with education and employment. There is an urgent requirement for awareness-raising within the general community, to ensure individuals with autism are better understood, and their needs considered more fully. As such, in developing a MOOC to enable learners to better understand autism, our purpose (education to achieve social improvement for a vulnerable community) and audience (those who engage directly with those on the autism spectrum, which is potentially anyone in society) differed markedly from those in more traditional MOOCs.

To address this audience and purpose, the development team utilised several key processes, focusing on enacting principles of co-design and transformative learning. Co-design was central to the process, as individuals with autism became key participants in designing the learning journey of the MOOC and also in determining the focus topics for each week and providing the stories of lived experience that learners would engage with to develop their understanding. Given the purpose of raising awareness of lived experience, the course did not focus on traditional formal 'academic' or theoretical material, but rather concentrated on key practical issues and experiences that were most important and relevant for understanding individuals with autism. The learning journey of participants within the course thus incorporated the following key pedagogies:

- **Video and audio vignettes** from individuals with autism and their immediate support networks on a variety of topics (presented as 'the voices of autism'), with learners choosing one or more subtopics based on personal interest or need;
- Authentic **scenarios** designed to enhance thinking skills, raise awareness of lived experience, and encourage learners to consider how their own understanding of autism was being reinforced, challenged, or extended;
- **Discussion forums** that provided scaffolded and structured opportunities for the development of learner presence (with participants divided into smaller groups for participation) and to apply learning to practical case studies; and
- **Weekly video summaries** by course instructors that highlighted key learnings, shared 'spotlight' discussion posts drawn from discussion board contributions, and provided extension questions for learners, keen to further extend and consolidate their understanding.

There was no assessment component incorporated within the MOOC, as the course is located outside of formal course structures (although the institution does offer postgraduate courses in this field of study). However, learners were issued with a certificate of completion at the end of the course, if they had worked through at least one subtopic and participated in one discussion each week. The intended volume of learning for the course was 8 hours; 2 hours per week. The MOOC was delivered via the *Open Education (powered by Blackboard)* platform.

The MOOC was structured around 4 weeks of learning, addressing the following key topics:
- Week 1: **Person first** (understanding the approach and challenging assumptions)
- Week 2: **Education** (lived experiences of education and challenges presented)
- Week 3: **Employment** (lived experiences of individuals transitioning to employment)
- Week 4: **Independence** (revisiting key assumptions about autism, considering how best to support individuals)

As such, the MOOC was designed specifically with the needs of the autism community in mind, around issues they had identified as most significant, and where there was greatest potential for improvement in support. Through this focus, and the use of the pedagogical components identified above, the MOOC incorporated many of the elements that have been proposed in the literature as most important for retention (Hone & El Said, 2016), including the use of engaging technologies (incorporation of multimodal scenarios and voices of individuals with autism), instructor presence (weekly summary videos), and clarity of learner purpose (opportunities for reflection and connection within discussions and scenarios). In what follows, we present the results of this MOOC in terms of retention/completion rates and learner motivations for studying, and discuss what these suggest in terms of how we might utilise MOOCs for social good.

Results

There are numerous ways of calculating retention statistics, especially in a course (such as this MOOC) that does not require students to formally submit an assessment task. Table 1 shows retention for each week of the course, based upon whether the student engaged in the content for that week, extracted from analytics data through observation of whether the participant logged in during that week. Weekly retention statistics indicate that approximately 24% of participants did not engage in any material and took no further part in the course after registration. Further attrition of approximately 14% after week 1 was observed, followed by attrition of 7% and 5% in subsequent weeks. Final retention calculated by numbers logging into week 4 was 49.6%. In order to earn a certificate of completion for the 'Voices of Autism' MOOC participants were required to complete at least 1 topic, including the learning activity each week and asked to tick a check box to indicate that they had completed these sections. Analysis of this data via analytics indicated a 41.2% retention rate when using this as the retention criteria. Further, 33.2% of participants ticked all check boxes indicating completion of *all* topics within the MOOC, indicating a strong interest well above minimum requirements for completion.

Table 1: MOOC retention statistics

	Number	Percentage of total enrolments
Total students enrolled	11987	-
Students engaged in week 1	9118	76.1%
Students engaged in week 2	7423	61.9%
Students engaged in week 3	6583	54.9%
Students engaged in week 4	5945	49.6%
Completed sections for Certificate	4937	41.2%
Completed all sections	3981	33.2%

Following completion of the MOOC all participants were surveyed to explore reasons for completing the MOOC and overall satisfaction level. The survey was completed by 1249 participants (return rate of 10.4%). Unfortunately, it cannot be argued that this is a representative sample due to completion bias, however it does give some indication of why individuals participated. Figure 1 shows that a large number of participants who responded to the survey did so to get a better understanding of autism (40%), worked with people with autism (35%) or had a family member with autism (14%). Taking these responses into account, only around 10% of respondents were taking the MOOC without a specific connection to autism (i.e. general interest participants).

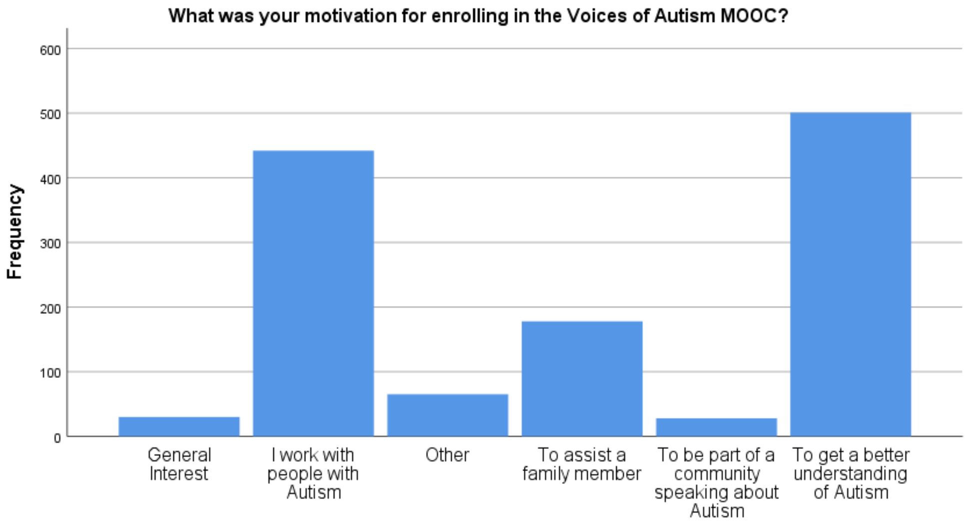

Figure 1: Survey respondents' motivation for enrolling in the MOOC

Discussion

Typical MOOCs show retention rates of between 5-10% (Ho et al, 2015), whereas the retention statistics for this MOOC show retention rates of up to 49%. Such retention rates can potentially be explained by enrolments that are driven by learner intention (Hone & El Said, 2016), as well as by the use of contemporary digital tools and pedagogies to 'drive' engagement within the MOOC. The motivation for enrolling in the MOOC data reinforces this and reflects the reasons why participants engaged with this MOOC as being due to a connection with the autism community and a practical desire to gain a better understanding of the individual. As such, this MOOC was largely successful in identifying the needs of a specific cohort of learners, and attracting these learners to the course, with approximately 90% of participants holding a connection to autism, and/or a specific interest in this topic.

More research is needed to explore the impact on perceptions and practice of participants who engage in such educational interventions and the indirect impact on the vulnerable community itself (e.g. individuals with Autism, parents, caregivers). If such research indicated the existence of even a modest positive impact, this would suggest that more scalable affordable educational interventions of this nature may be desirable to support the community across time and place.

Given the above, the results of this study go some way to validating the use of MOOC technology to support vulnerable communities. Further, the marked increase in retention and completion when compared to more traditional MOOC audiences offers some preliminary insight into how such large-scale open courses might be repurposed. We would argue that the future impact of MOOCs may not be in attracting 'general interest' audiences, who generally do not stay to completion, but rather in leveraging this platform for social good. Such MOOCs would identify specific communities, most likely those who are presently underserved by traditional educational offerings, and target the use of digital tools and pedagogies to the learning needs of these communities.

In a sense, this is a disruptive provocation, as it shifts the focus away from MOOCs as a platform where the kinds of knowledge and practices that would normally be encountered within more formal award courses are simply 'scaled up' for a larger audience. However, such a shift in focus and practice may perhaps offer a far greater opportunity to realise the transformational potential of this important educational movement.

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Fostering teamwork skills across the School of Engineering using online self and peer assessment

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Teamwork skills have been a recognised key employability attribute in university graduates for at least the last two decades, as analysed by Curtis and McKenzie (2002) and continue to be a significant key selection criterion of many Australian employers (Graduate Outlook, 2014). This paper outlines the implementation process, learning and future directions associated with the use of an online self and peer assessment strategy, aimed to develop teamwork skills in engineering students, at Deakin University. Initially student feedback from a pilot study was used to inform and justify a three-year trial of the strategy. Then consideration was given to the professional development needs of academics to support and foster the teaching and assessment of teamwork skills in the school. Into the future, teamwork skill development depends upon the evaluation of course learning outcomes and development of minimum standard descriptors of teamwork skills across all year levels.

Keywords: Teamwork skills, Self and peer assessment, Project-oriented design-based learning

Introduction

At Deakin University, the School of Engineering is in the third year of implementing the Project-Oriented Design-Based Learning (PODBL) method. This student-centred learning approach is underpinned by students working together on projects. These projects are designed to engage students in real-world problems and enable students to collaborate, learn and develop their capacity as engineers within a team environment (Chandrasekaran, S., et. al., 2013). Students begin their PODBL experience in first year and build on their skill set throughout their degree. The learning design aims to replicate the experience that many engineers have in the workplace - that is, working together within a diverse team of people, who bring together a range of skills, knowledge and experience to complete a project. Deakin's graduate learning outcome for teamwork states:

> 'Teamwork is essential for life-long learning and problem solving, to develop shared understandings and bring together diverse talents and disciplines. Successful teams recognise and use complementary skills and knowledge and collaborate.' (Deakin, 2018).

The challenge at a tertiary level is not only are students required to develop the discipline specific skills required by the engineering profession, but they must also apply their skill set as proficient members of a multiskilled team. For many, working and learning collaboratively is a new experience. Therefore, learning design within the PODBL environment necessitates the inclusion of teamwork skill development and supported opportunities to apply these skills within a team environment. To support the implementation of the PODBL method, the School of Engineering engaged the faculties 'Learning Support Team', to design a systematic approach to the teaching and learning of teamwork skills (Gunning, T, & Krishnan, S., 2017).

This paper presents an overview of the challenges, opportunities and learning experienced thus far, associated with the development and fostering of teamwork skills within the School of Engineering's PODBL methodology.

The pilot study

In 2015, a pilot study was initiated using a second-year, civil engineering unit. The original unit was redesigned using the PODBL method. It was identified from previous iterations of this unit, that student engagement in the group project was problematic. Student feedback had highlighted the fact that many students did not engage in the projects but received the same group mark as everyone else in their team. This surfaced as frustration from high achieving students who were required to do the majority of work if they wanted a good mark. The academic teaching team were also frustrated as the expected collaborative learning environment was difficult to monitor let alone assess, and therefore the individual student outcomes from the project perspective were hard to measure. Indeed, academics identified that they were not in the best position to assess teamwork skills, as the meetings and development stages of the projects often occurred external to the classroom and mostly online.

The approach

As a means to engage both on campus and online students in teamwork, an online 'self and peer assessment tool' was sourced that:
- Encouraged students to contribute equally to a project
- Assessed student's teamwork skills when they work in teams external to the classroom
- Collected evidence of teamwork skills in order to individualise a team mark

The tool of choice was SPARK^{PLUS} (https://sparkplus.com.au/how.php)(Willey and Freeman, 2006b). This tool was developed through the University of Technology Sydney, in response to tertiary student feedback. To support the implementation of SPARK^{PLUS}, into the pilot PODBL unit, the Learning Support Team provided one-on-one support at the academics point of need to ensure:

- unit learning outcomes included the assessment of teamwork skills
- the redesign of the project task to include self and peer assessment of teamwork skills
- training on how to use the tool
- setup and implementation of the tool
- in class support to introduce and justify the use of the tool to students
- analysis of results to individualise the project marks
- collection of student feedback about the tool and strategy

The assessment outcomes for teamwork skills in this unit were informed by the School of Engineering's Course Learning outcomes, which state:

> 'At the successful completion of this course students can:
> Undertake various team roles, work effectively within a team, and utilise effective teamwork skills in order to achieve learning goals.
>
> Apply interpersonal skills to interact and collaborate to enhance outcomes through shared individual and collective knowledge and creative capacity to optimise complex problem resolution.'

Students in this pilot unit were required to work in teams to learn and produce a project artifact for assessment. The academic team interpreted the course learning outcomes for this second-year unit and articulated it to students using the following Unit Learning Outcome (ULO):

> 'At the successful completion of this unit students can: Collaborate in a team to create a project brief, self-assess and peer assess team skills and reflect on their personal contribution to the team's project outcome.'

The results

With ethics approval, feedback was collected from students regarding their experience using the self and peer assessment strategy during the pilot unit (SCITECH Ethics Low Risk, STEC- 55-2015). Students responded to the survey questions using a Likert scale. 22% of students responded.

Summary of key points from the survey about the self and peer assessment strategy.
- 100% agreed that the tool was accessible and easy to use
- 93% agreed it was a safe way of providing feedback to team members
- 85% agreed it was an appropriate process to individualise contributions to the project
- 93% agreed the team task helped them to link the skills of Teamwork to their future career
- 85% agreed they would be comfortable using the tool again to self and peer assess against criteria
- 93% agreed that it would be valuable to receive feedback from their team during the project

In addition to the online survey, students were provided with the opportunity to raise questions and concerns with a member of staff not associated with the unit. A group of three engineering students challenged our team with the following question, ‘Why are you wasting our time with teamwork skills when we are here to learn how to be engineers?’ This highlighted a communication disconnect between the academic team and the students. The academic team had aimed to link the importance of working in a team with the professional environment of engineers. Additional clarity was required to help students make this link.

Feedback provided by the academic team confirmed the tool provided flexibility to create the criteria they determined important for their unit. They were also appreciative of the paper free analysis of ratings, which was faster than manually sorting through student responses associated with contribution to the project. The conclusion was that the strategy enabled academics (with support) to confidently individualise a team mark for students.

During our end of unit reflection, the teaching team identified that while the tool was initially implemented as a strategy to engage students in a team-based assessment task, and to inform assessment outcomes, it was clear that the tool had additional value as a learning tool, as previously observed by Willey & Gardner, 2009. By constructing criteria and requiring students to consider it at the beginning, midway and at the end of the project, we were exposing students to what the academic team valued about teamwork and what that would look like in action. The giving and receiving of formative feedback against those criteria also provided a platform for students to conduct self-reflection and experience how to construct constructive feedback to help their team members improve their skills.

The above responses provided the necessary support to proceed with a trial of self and peer assessment of teamwork using SPARK^{PLUS}, in the first stage of PODBL implementation. A three-year trial was designed to test the logistics, effectiveness and scalability of the self and peer assessment in PODBL units.

The trial

Preparation

To support the implementation of self and peer assessment in PODBL units, a student resource was created. Its purpose was to guide the students to use the tool, explain how the teaching team uses the results and addressed the key student concerns from the pilot. The resource was created as a power point to be delivered by a member of the teaching team. The content aimed to explicitly link teamwork skill development with the Deakins Graduate Learning Outcomes and the world of work. A quote from Engineers Australia stating the importance of teamwork in the engineering profession was added to ensure students were clear about why we were expecting them to place a high importance on the development of teamwork skills. An overview of how to give and receive constructive feedback was also included, to support students to provide appropriate comments to substantiate their ratings of each other. It also addressed how to read and act on feedback received. An optional resource, ‘Your Social Style in Teams’, was provided to all academics in the trial, to help their students think about how they are perceived by others, and how they may need to manage their social style.

Due to finite human resources, the PODBL units chosen to trial self and peer assessment were based upon the interest shown by academics. Collegiate conversations with many academics revealed that while they were particularly competent in their subject matter knowledge, they sought support in areas of pedagogical knowledge - for example, strategies to engage learners in the content, utilising new technologies, and introducing work integrated learning opportunities. Interestingly, the development of student’s teamwork skills was not considered part of the unit chair’s responsibility, and academics often referred to teamwork skills as ‘soft skills’. The teaching of ‘professional skills’ was reserved for specialists in that area and was treated as an add-on to the unit design - the assumption being that by providing the opportunity to work in teams would inherently result in the building of student’s teamwork skills.

The implication of this approach was that the ‘soft skills’ associated with teamwork were deemed not as important as the ‘hard skills’ of the academic’s speciality. Concerns about lack of time to address additional criteria in an already crowed curriculum and the stress associated with teaching and assessing a topic outside their comfort zone were also highlighted.

It was clear that in addition to supporting students to develop their teamwork skills, professional development would be required to support academics to teach and assess teamwork skills. Referred to as ‘early adopters’, the academics chosen to participate in the trial, were willing participants who were keen to work collegiately with the Learning Support Team to design and implement the strategy into their unit. This way, time associated with ‘selling’ self and peer assessment of teamwork skills was removed. The support team were then able to provide the one-on-one support required at each academic’s point of need.

The design

While the implementation of the PODBL method occurred over two years, trialing the self and peer assessment strategy occurred over three years, as shown in Table 1. The first two years were aimed at supporting ‘early adopters’ in second, third and fourth year PODBL subjects. If the trial proved successful in the first two years, then a key first year PODBL unit would be included in the trial. This unit was of particular importance as all first-year students are required to pass this unit. The unit therefore sets the expectations around PODBL and teamwork for the rest of their course.

Table 1: The number of PODBL units, across the year levels, that trialed self and peer assessment of teamwork skills, from 2016 -2018.

Year	First year units	Second year units	Third year units	Fourth year units
2016		4		2
2017		3	1	1
2018	2	3	2	1

Future Directions

The success of the trial in the first two years provided the confidence to trial self and peer assessment of teamwork skills in a first year PODBL unit. The trial ends at the end of 2018 and at that point a final analysis of the strategy as a teaching, learning and assessment resource will be undertaken and presented to the School of Engineering. Both student and academic feedback will be used to inform the continued role and the scaling up of this strategy into additional PODBL units. Evidence will be gathered through online surveys and focus group interviews.

Professional development needs are also a priority. To foster teamwork skill development in the school, it is essential that academics are provided with point of need support to develop their confidence to teach and assess teamwork skills. Collegiate interviews will be conducted with the academics who were supported during the trial. The support provided will be evaluated to ascertain the pedagogical value, the quality of service and to determine where improvements and efficiencies can be made.

Throughout this pilot and trial period, the assessment of teamwork skills has been guided by the descriptors underpinning the course learning outcomes for teamwork. Using the trial units, an attempt was made to scaffold student learning outcomes in teamwork across the years, which was difficult given the small number of units trialing the strategy. Our aim is to evaluate and update the current course learning outcomes for teamwork and clearly define minimum standards for each year level. Assessment will then be designed to enable students to demonstrate proficiency at the defined minimum standards for each year level, as they develop their skills towards the attainment of their course learning outcomes. This task will require the collaboration of all course directors in the school to come to a shared understanding of the importance of developing teamwork skills and to elevate its importance as a skill set in the School of Engineering.

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Digital badges - what is the state of play within the New Zealand Higher Education sector?

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The importance and influence of digital technologies as a mediator and facilitator of learning is fundamentally changing education; what it encompasses, what counts as learning, who has access, where and when it occurs, and the ways in which skills, knowledge and capabilities are recognised. One technological innovation that has emerged within the last few years is digital badges. Developed to act as indicators of accomplishment, skill, or interest, they are being used in a variety of contexts for purposes such as to motivate, capture achievement, or credential learning. Digital badging is a technology that has the potential to change how we engage learners, deliver content and acknowledge learning. Internationally, digital badge use is growing particularly in Higher Education. However, to-date, it is difficult to determine how many institutions are using digital badges and for what purposes. This is particularly true within the New Zealand Higher Education context where little research is currently available. The focus of this study was to identify the 'current state of play' of digital badge use (i.e. which tertiary institutions are using badges, and the perceived benefits and drawbacks associated with their use) within the public New Zealand Higher Education sector.

Keywords: Digital badges, Technology, Higher Education, Tertiary, Learning, New Zealand.

Background

The importance and influence of digital technologies as a mediator and facilitator of learning is fundamentally changing education; what it encompasses, what counts as learning, who has access, where and when it occurs, and the ways in which developed skills, knowledge and capabilities are recognised. One technological innovation that has emerged in recent years is digital badges. Digital badges are "a representation of an accomplishment, interest or affiliation that is visual, available online, and contains meta-data including links that help explain the context, meaning, process and result of an activity" (Gibson, Ostashewski, Flintoff, Grant, & Knight, 2013, p. 404). Digital badges have the potential to open up new possibilities for engaging learners, innovative assessment practices that capture various kinds of achievement, recognition of learning and sharing accomplishments.

Badges can be used to complement existing formal accreditation systems (Reid, Paster, & Abramovich, 2015). However, it is their ability to recognise non-formal, informal and professional learning achievements, via the capture of meta-data associated with the achievement, which presents new learning opportunities (Fields, 2015). For example, digital badges can be used to acknowledge achievement of the learning and development of meta-skills such as critical, systems or strategic thinking, or communication skills at the granular level (Ahn, Pellicone, & Butler, 2014; Finkelstein, Knight, & Manning, 2013). They also allow learners to determine in which virtual contexts (e.g., social or professional networking sites) they choose to share their accomplishments or competencies (O'Byrne, Schenke, Willis Iii, & Hickey, 2015).

Internationally, digital badge use is growing particularly in Higher Education (Grant, 2016). Pilot studies indicate that current adoption practices vary considerably and range from use at the micro level to promote learner motivation, engagement and signal progress within stand-alone courses, all the way through to the introduction and implementation of entire badging systems for institutional recognition and beyond at the macro level. However, to-date, it is difficult to determine how many institutions are using digital badges and for what purposes (Grant, 2016). This is particularly true within the New Zealand Higher Education context where little such research is currently available. Given the increasing interest and use of digital badges, coupled with their disruptive potential "there is a need for a comprehensive research agenda" (Grant, 2016, p. 9) that identifies which institutions are using digital badges, who decides if and when they are used and for what purposes.

Methodology

This project represents the starting point for a programme of research that centres on digital badge use in various education and learning contexts. Specifically, it seeks to explore new digital technologies (i.e. digital badges) in terms of how and why they are currently being adopted and used to promote, support and recognise learning. The overall project uses a mixed methods research design, specifically, an explanatory sequential design (Creswell & Plano Clark, 2011), where phase one involves a national survey of current digital badge use within New Zealand public tertiary institutions and phase two complements and enhances the survey dataset with a series of follow-up, in-depth interviews. This paper reports on initial findings from the phase one survey.

The focus of this first phase was to identify the 'current state of play' of digital badge use and implementation (i.e. which tertiary institutions are using badges, which tertiary institutions are using badges, and the perceived benefits and drawbacks associated with their use) within the public New Zealand Higher Education sector. An anonymous online survey was distributed to staff in all 27 public tertiary institutions within New Zealand (i.e. 8 Universities, 16 Institutes of Technology and Polytechnics (ITPs) and 3 Wānanga[1]). The survey questions were developed with reference to the digital badge literature and comprised two sections. The first section consisted of demographic questions of an individual (e.g. age, gender) and professional nature (e.g., qualifications, professional role, employing institution etc.). The second section asked questions related to the respondents' knowledge and use of digital badges (note: only a subset of the findings are reported here). The final survey question asked respondents if they would be willing to take part in a follow-up interview (phase two of the overall project). The survey was hosted via suverymonkey.com and was pilot tested prior to distribution.

Intended participants were academic and professional staff in the public institutions who had some knowledge or experience of the implementation and/or use of digital badges as part of their professional role. Late in 2017, an invitation to participate in the survey was distributed, via email, to key people within each institution (e.g. e-learning managers/directors, academic/professional development managers, teaching and learning directors, educational support staff) and a request made for them to disseminate the invitation to staff within their organisation. The email contained a direct link to the survey. To ensure a broad representation of individual and institutional views, informal networks were also used for survey dissemination These included the researcher's contacts with professional networks such as the Flexible Leaning Association of New Zealand (FLANZ) and social media channels such as Twitter and Facebook.

Preliminary Findings

A total of 124 responses were received from 24 of the 27 New Zealand public tertiary institutions. Staff from two of the wānanga and one of the ITPs did not respond to the survey. Not all respondents answered every question. The number of responses is stated when this is the case. In terms of the breakdown across different types of institutions, 58% of the 119 responses (five skipped the question) came from the university sector, 37% from the IPT sector and 1% from the wānanga. The remaining 4% of responses consisted of people who did not identify with a specific institution because they worked for an organisation affiliated with the tertiary education sector more generally (e.g., Ako Aotearoa - a government-funded organisation that supports New Zealand's tertiary sector educators). Respondents worked in a range of disciplines including Education, Business, Health, Foundation Studies, Science, Humanities and Social Sciences, and Arts and Design.

The majority (90%) of respondents listed their age as 40 years old or above. The gender mix of the group was 60% female, 39% male and 1% preferred not to say (1 person skipped this question). Respondents were asked to identify their highest qualification and results indicated that 91% had completed a postgraduate qualification ranging from a postgraduate certificate or diploma (18%), master's degree (45%), or a doctorate (28%). Figure 1 shows the breakdown of the professional roles of respondents with the majority holding academic, academic development, education support or leadership roles.

Over 54% of respondents indicated that their institutions were using digital badges or planned to do so in the future (see Table 1). Of those who responded, 15% were unaware of whether their organisation was using badges or not or whether they planned to do so in the future. For participants who answered 'other', comments such as "only if individual lecturers choose to use them" and "some programmes/courses, with no centralised organisation to use" were indicative of responses received.

[1] A *wānanga* is a publicly owned New Zealand tertiary institution that provides education in a Māori cultural context.

Survey participants were also asked about the platform being used to implement digital badges within their organisation (see Table 2). Of the 107 responses, 43% used Moodle, 23 % did not know, 15% chose other and 10% used Mahara. Responses in the other category identified a range of systems including iQualify, EdX edge, Credly, BadgeOS, and PeerWise.

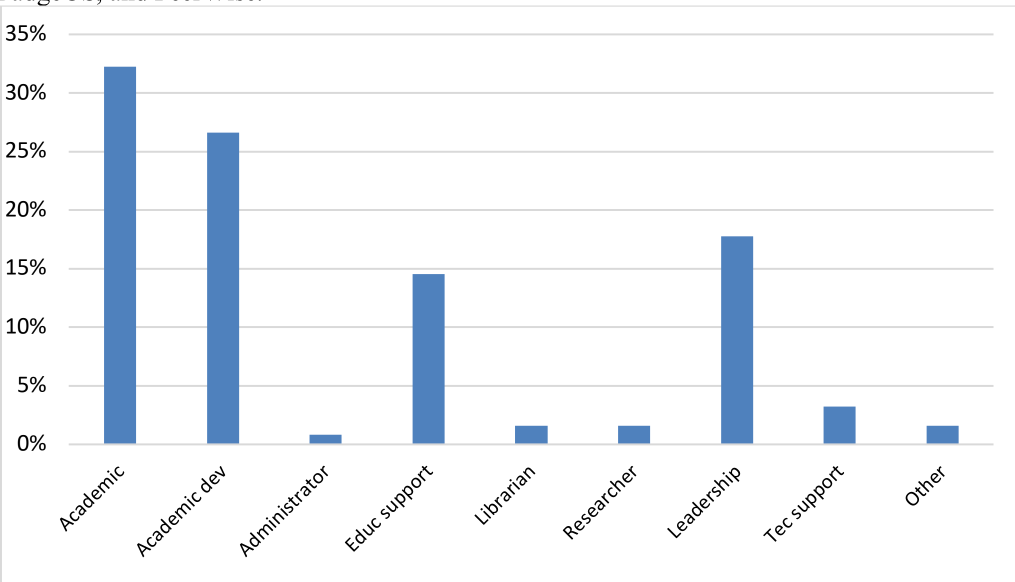

Figure 1: Professional role of survey respondents (n=124)

Table 1: Institutions' digital badges use

Answer	Responses	
Yes	37.1%	43
Plans to implement in future	17.2%	20
No	18.1%	21
Don't know	15.5%	18
Other	12.1%	14
	Answered	116
	Skipped	8

Table 2: Digital badge platforms used

Answer Choices	Responses	
Moodle	43.0%	46
Don't know	23.4%	25
Other	15.0%	16
Mahara	10.3%	11
Blackboard	5.6%	6
Canvas	4.7%	5
In-house system	2.8%	3
Totara	0.9%	1
Not applicable	16.8%	18
	Answered	107
	Skipped	17

Respondents were asked to indicate (choosing all statements that applied) what value digital badges offered (see Figure 2). Over half of the 110 respondents rated the following as valuable aspects of digital badges: as a display of achievement, as a motivation aid for learners, as digital evidence of leaning, encouraging participation and as recognition of informal learning. Only four people indicated they had no value. Of the 18 who chose other, responses included “all OERu micro-credentials are mapped to official academic credit”, “immediacy of feedback & recognition” and “allows recognition of contributions to community/society” suggesting badges have value at both micro and macro levels.

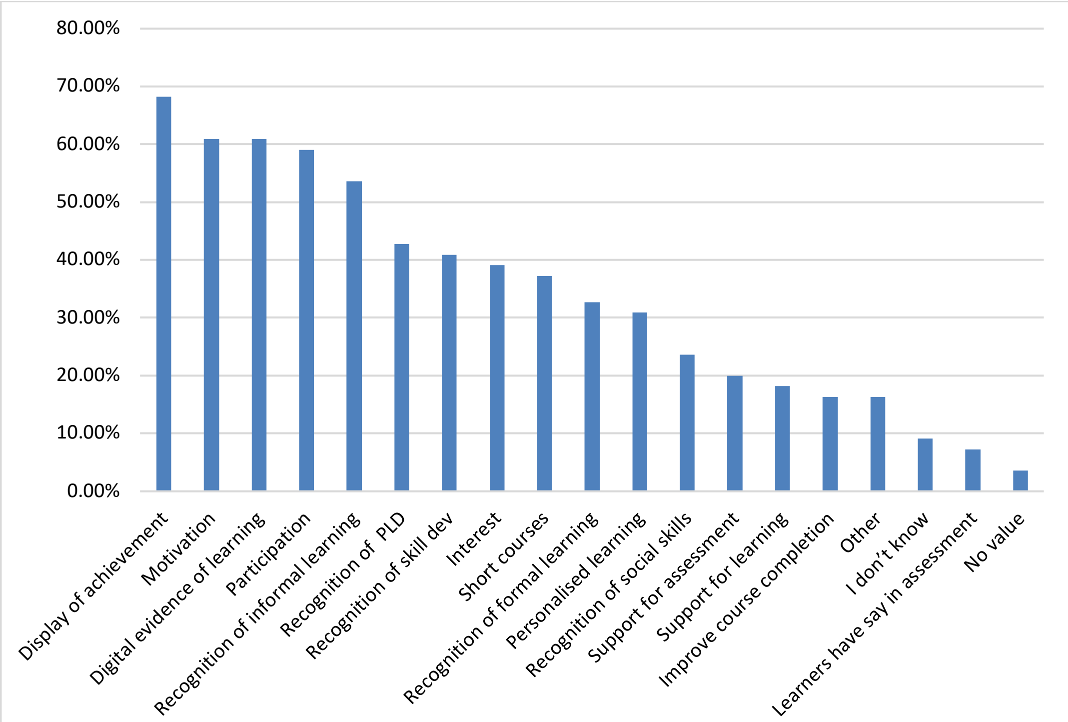

Figure 2: Perceived value of digital badges (n=110)

Respondents were also asked about the main drawbacks of digital badges (see Figure 3). Over 40% of respondents rated the following as the main drawbacks of digital badges: lack of (personal) knowledge, inconsistent use and lack of formal recognition. In addition, lack of regulation, the lack of wide recognition and lack of training were considered drawbacks by over 35% of respondents. Five participants saw no drawbacks associated with digital badges. Of the 20 who chose ‘other’, responses included “some teachers have never heard of e-badges let alone considering implementing it into their teaching. In fact, when I raised this possibility of recognition of soft skills (in the faculty of science) some mockingly said why not display those on the lab coat”, and “badges as used on quizzes as 1:1 analogues for score. Other poor uses that put students off, as they see through the "game" mechanism as manipulation. That's a sure sign of poor implementation”.

Discussion and Conclusion

Survey responses were received from 24 of the 27 public tertiary institutions in New Zealand. Participants were predominantly in academic, academic/education development or in leadership roles, were 40 years or older and the majority held a postgraduate qualification. Comparison with the Ministry of Education (2017) workforce figures show that university staff were slightly under-represented in the survey (58% versus 69% of the tertiary sector workforce); ITP staff were slightly over-represented (37% versus 26%) and wānanga were under-represented (1% versus 5%).

Findings show that over half of respondents indicated that their institutions were already using digital badges or planned to use them in the future and a range of badging platforms were being utilised. Digital badges have a range of valuable attributes according to the majority of survey participants. The most prominent being as a display of achievement, as a motivational aid for learners, as digital evidence of learning, encouraging participation and as recognition of informal learning. These findings reflect the literature that highlights the potential of badges to positively impact learner motivation (Abramovich, Schunn, & Higashi, 2013), as evidence of learning (formal/informal) and achievement in digital form (Fields, 2015; O'Byrne, et al., 2015) and to encourage participation (Chou & He, 2016). Badges were also seen to have some notable drawbacks that included a participant’s own lack of knowledge and training, inconsistent use, as well as the lack of formal recognition and regulation. The fact that tertiary education professionals are aware of potential drawbacks with using digital badges is an important finding and highlights that badges need to be an integral part of the learning experience to ensure they are not simply viewed as tokens (Abramovich, 2016).

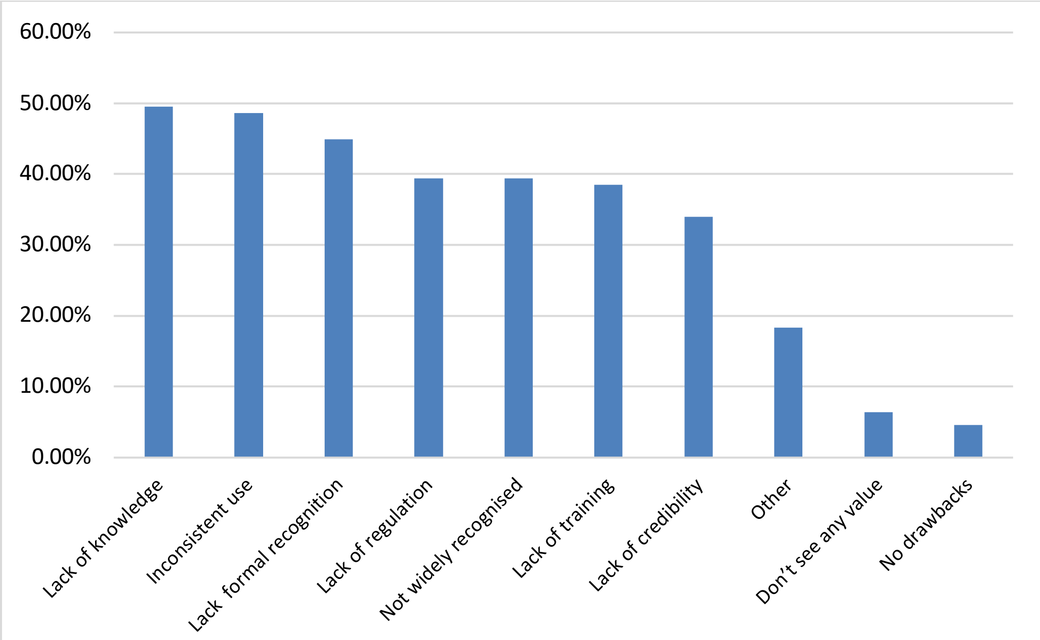

Figure 4: Main drawbacks of digital badge use (n=109)

While these preliminary findings cannot be considered representative of the tertiary education sector that includes a workforce of over 30,000, of which 60% are classified as non-academic positions (Ministry of Education, 2017), they do offer some valuable insights into current digital badge use, their perceived value and potential drawbacks. As a result, they represent an important first step in identifying and understanding digital badge use within the New Zealand public tertiary Education system. These findings will also help to inform subsequent phases of research as current digital badge users within the higher education community are well-placed to identify issues requiring further investigation.

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Back to the future with old-fashioned conversations: building relationships and individualising support with educational technologies

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Recent advances in ICT have had a profound effect on tertiary education. However, critical and social theorists caution that the relationship between teacher and student is still central and educational research over many years suggests that some of the most successful pedagogical methods are those which strengthen the relationship between teacher and student and which support student development of relatedness, competence and autonomy. In this paper, we propose a new approach to course design and organisation which builds on lessons from the past while taking advantage of the affordances of contemporary technology. We summarise data from interviews with teachers and learning support staff and conclude with our hopes for the future.

Keywords: STEM, first year teaching, personalized system of instruction, Keller plan

Introduction

In university teaching of undergraduate courses and in particular, first year STEM course teaching, it is worth reflecting on the past, asking what has changed, what has been achieved and what directions teaching could take in the future. Our focus in this paper is on a proposal for the future, grounded in solid evidence from the past, about what works in tertiary learning and teaching. Thus far, we have sought feedback on our proposal from a small group of educators; the next step will be to seek input from students.

Advances in communication and information technologies have had a profound effect on tertiary education. While wholesale adoption by institutions and educators within these institutions takes considerable time, some technologies have become firmly embedded. Learning management systems (LMS) are leading the way, with close to 100 percent of institutions embracing LMS and use among teachers and students in the 80 percent range (Brown, Dehoney, & Millichap, 2015). New technological developments continue to challenge the education sector. The 2017 NMC Horizon Report names adaptive learning technologies and mobile learning as having current impact, the Internet of Things and next-generation LMS as challenges for the next few years, and artificial intelligence and natural user interfaces as technologies with a four to five-year adoption timeframe (Becker et al., 2017). The report also names significant challenges surrounding the adoption of technology. Among those are the disparity in learning outcomes for students from varied backgrounds, the advancement of digital equity and the need for rethinking the role of the educator (Becker et al., 2017). These challenges highlight the crucial role of human factors in the adoption of technologies. Notwithstanding practical, efficiency and related pedagogical gains from technology adoption, Tamin and Bernard (2011) remind us that 40 years of educational technology research has, overall, left us firmly on the fence in terms of demonstrable learning gains.

Accepting that teaching and student learning are intimately related, it is worth reflecting on the advice of Biesta (2013, p42) that, "the gift of teaching … depends on the fragile interplay between the teacher and the student". How do we strengthen that 'fragile interplay' so that the 'gift of teaching' can be realised for all students? If Hattie (2015) is correct, then about 20-25% of the variance in learning outcomes at tertiary level is within the control of the teacher. In other words, what teachers do, from course planning and design to classroom interactions and feedback, matters. And yet, perversely much of the focus on learner-centredness and technology enhanced learning may diminish the role of the teacher. For example, Bayne (2015) sees the focus on technology closely linked to market-oriented concerns in education where efficiency is a driving factor. McDonald & Loke (2016) warn of the dangers of casting tertiary teachers and teaching as 'old' and 'negative' in the context of wholesale promotion of technology enhanced learning. We argue for the need to heed the warnings issued by the social and critical theorists in relation to contemporary educational practice and the focus on technology; the 'gift of teaching' is at risk.

Having established that potential danger lurks in the 'waters', we renew the search for what works and why with a firm focus on the role of the teacher and personal and meaningful interactions with students. In doing so we by no means argue against educational technologies. To the contrary, we regard their use as a given in today's blended learning contexts. Our search has taken us back to the 1970s and 1990s, to the work on the Personal System of Instruction (PSI; Keller, 1968) and Self-Determination Theory (SDT; Ryan & Deci; 2002). In the next section we briefly describe PSI and SDT and our plans for their renewed adoption, adjusted to 21st century needs. We also draw on interviews with educators that highlight both the importance of the 'personal touch' and of supporting technologies. We then shift the focus to the essential role of communication and learning technologies in supporting our approach.

Drawing on student-teacher conversations guided by PSI and SDT

Our context is the teaching of first year, semester-long university courses in mathematical, science or technology disciplines. We address both on and off campus students. Our approach might also be suitable for other disciplines, such as finance or accounting, as well as for courses beyond first year. The focus is on guiding students towards solid learning skills and subject knowledge that will serve them well in subsequent years. Specific components of our approach include:

- Variable start and completion times.
- Personal study plan: When starting a course, students have to prepare their personal study plan with support from staff.
- Pacing: It is up to students how they progress through a course. Progress is dependent on fulfilling course requirements. No deadlines are enforced.
- Course material: All course material is provided for self-study in formats such as video recordings or written material. Exercises and review questions are provided.
- To pass a course a student must demonstrate achievement of all learning objectives.
- To achieve a learning objective requires an assessment conversation with a member of the teaching staff. If a teacher decides the objective is not achieved, the student revises their work based on the feedback in the assessment conversation.
- Purpose of the final test: The final test examines the student's overall understanding of the course material and determines the passing grade a student receives.
- Support: Staff are available for individual student support. Students can seek help via direct contact or class-based tools (e.g., discussion forums).
- Students will be provided with open learning spaces or virtual spaces that can be used for self-study, conversations with peers and occasional group class activities.
- Students will be encouraged to work together on course material and tasks.

Learning and assessment conversations are at the centre. From day one the focus is on building relationships between students and teaching staff as well as among peers. In part this is achieved by assisting students in the development of personal study plans, charting their proposed progress through the course and providing the basis for staff to assist with progress monitoring. Passing a course is based on the achievement of learning objectives. This is tested in assessment conversations with teaching staff, which are requested by students and are held one-on-one. Student and teacher discuss the work the student has prepared in regard to the learning objective. The teacher probes, challenges and extends the student's understanding. With reference to a marking rubric the teacher decides if the student has achieved the learning objective or needs to revisit aspects of the material. In the latter case the student builds on the feedback received until ready for a further learning conversation. All learning objectives need to be mastered to earn the right to sit a final test that is available on demand. This test consolidates learning across all learning objectives and determines the student's passing grade (passing all learning objectives gives a pass mark independent of the test). The approach provides the flexibility required to cater for students of diverse backgrounds and study contexts. It puts the responsibility for learning into the students' court but with appropriate nurturing and support from teaching staff and peers. A side effect of this flexibility is that traditional semester times lose their importance. Some students will complete courses earlier, others may require more than the semester to complete.

Our approach builds closely on the Keller Plan or Personalised System of Instruction (PSI; Keller, 1968) which was highly popular in the 1970s and 1980s. In his reviews of studies that had used experimental methods to compare PSI with conventional courses using other forms such as lecture, lecture-discussion, and group discussions, Taveggia (1976) concluded that PSI is superior. In 1991 Buskist, Cush and DeGrandpre revisited the major research reviews on PSI and confirmed the strengths of PSI compared to traditional methods. At its core, the strengths of PSI lie in insisting on mastery of learning objectives in combination with giving students feedback and time to learn from this feedback. In their original form PSI courses had no time completion limits (students could continue work on uncompleted units in the next study year). For some students the lack of external pressure led to procrastination. This prompted changes to course designs that counteracted the essential core features of PSI (Sherman, 1992; Buskist et al., 1991).

Our ideal is to stay true to the original concepts of PSI and allow for as many attempts as practical for students to achieve the learning objectives. To realize this, we want to strengthen the learning partnerships between students and staff by putting a stronger focus on shared planning and discussion. In this endeavour we are guided by the research on Self-Determination Theory (SDT; Ryan and Deci, 2002). We strive to create learning environments that support the development of self-regulated motivation through addressing student needs for autonomy, competence and relatedness

Despite solid evidence of its positive impact on student learning the uptake of PSI had declined sharply by the early 1990s. Reasons included a reluctance to change conventional teaching approaches (e.g., insisting that live lectures are essential) and reputational damage done by modified courses violating key PSI principles (Sherman, 1992). Practicalities also contributed to the decline of PSI – imagine carrying out all the bookkeeping and scheduling tasks required for several hundred students with at best rudimentary computer technologies! We undoubtedly have made huge strides in communication and information technologies and should be ready to attack the practicalities.

Using 21st century learning technologies to support PSI courses

In the fifty years since the inception of PSI, learning technologies have become common place and LMS have found universal adoption. They function as a course home for students and teachers, facilitate the delivery of administrative information and study material, provide discussion spaces, allow for online tests and management of assignments; in short, the tools for effective facilitation of PSI based teaching are now readily available.

In replacing live lectures, PSI emphasized written, well-crafted study material that students could use for self-study and to work through at their own pace. We now have the technologies to record live lectures, automatically transcribe them and let students stream and review lectures on-demand. We have desktop-based tools to record lectures and demonstrations in our offices, capturing details down to keystrokes and mouse pointer movements. While the technical and creative production values of our material might be relatively low, academics, in general, can master the technologies. The vast majority of our students have access to equipment and internet bandwidth to play the material.

The assignment tools in LMS provide the basis for the PSI assessment conversations. Criteria recorded in marking guides signal to students what they have to achieve. The teacher can record outcomes and feedback, addressing the needs of record keeping and guidance for the student. Using the LMS provides transparency, for students and members of the teaching team. Advanced features, such as recording of audio feedback, open up possibilities. For example, it could be part of the assessment conversation that the teacher records feedback and the student expresses their understanding of what to work on for the next iteration of the assessment conversation. This emphasizes the cooperative nature of the teaching approach and also puts the ball into the student’s court, planning the steps they have to take to improve their understanding. As practicalities are important, recording feedback as part of the assessment conversation provides time savings compared to having to formulate and type feedback post-meeting.

Our version of PSI requires a tool for personal study planning. Students are in charge of their own plans but teaching staff require access, to assist with planning advice and to check if students are falling behind their own expectations and require support. While many tools, from calendar to word processing or spreadsheet, fulfil basic requirements, more sophisticated project management tools are also available and may be an option in some situations, e.g. task planning and monitoring in team settings. The ability to setup alerts in all types of planning tools are now commonplace. These can be used to warn both student and teacher of upcoming milestones and potential deviations from the agreed schedule. This fits with the PSI approach of self-imposed deadlines the student needs to take responsibility for.

The days of video conferencing with dedicated systems and complicated setups are largely over for most settings. Desktop and smartphone video conferencing are ubiquitous in social settings. While we are not quite at the same level of adoption in teaching contexts, talking to our off-campus students face-to-face is now very feasible. Using these technologies, we suggest interacting with off-campus students just as with their on-campus counterparts. One-on-one conversations are easy to setup and provide near to the same level of closeness as being in the same physical room. E.g., Desktop sharing makes it feasible for teacher and student to examine and discuss study material and the student's work together. Group conversations with multiple participants are easy to manage once basic skills are mastered. In effect, online video conferencing brings off-campus students into the on-campus environment.

The PSI approach mandates that students have already achieved a minimum standard (i.e. passed the course) when they reach the final test. This test provides an opportunity to demonstrate excellence as the achievement of learning objectives has already been attested. Delivery of final tests online, typically via the LMS, are a better option than the traditional approach to exams, held in specially prepared venues and supervised by human invigilators. Carefully crafted question banks allow the creation of large numbers of different yet equivalent tests. Students can take the tests on their own devices in their own study environments. Specialised invigilation services are increasingly available and innovation in developing test questions can ensure integrity of the examination process. For example, alternative, media-rich question and answer formats; LMS already provide for test questions that require the student to speak or video their answer. Spreading a few such questions throughout a test would allow staff to verify who is taking a test. Making the timing between question presentation and answer requirement tight would narrow down the option of seeking help from others. Integrity issues aside, such question formats would follow more naturally from the discussions on learning materials held during a course.

Learning analytics have become a hot topic in teaching and learning research in recent years, especially in relation to retention and progression. We see increased potential for learning analytics in a PSI approach compared to traditional teaching. A fundamental issue with learning analytics is that while students who are struggling may be identified, discovering exactly why they are struggling or how to help them to catch up is still reliant on personal contact. Even if issues are identified and can be addressed, students may then face the challenge of having to work on follow-up or additional material in parallel to the material they are already struggling with. The inherent flexibility of the PSI approach makes the information learning analytics can provide more valuable as the course design allows for the student to catch up.

Finally, newer developments around LMS offer better integration of the types of tools required to fully enable the promise of PSI. The EDUCAUSE Learning Initiative talks about 'next generation digital learning environments' (NGDLE; ELI, 2015). Those systems are to provide component-based approaches that focus less on administrative tasks and instead provide better support for the exploration of new learning models. Key dimensions promised are interoperability and integration; personalization; analytics, advising and learning assessment; collaboration; and accessibility and universal design.

Interviews with Educators

Through a series of in-depth, semi-structured interviews, nine tertiary teachers and student learning consultants, with significant experience in one-to-one interactions with students, provided feedback on our proposal. All nine interviews were transcribed and analysed independently by two researchers who then negotiated and combined their findings. The results echo the literature reviewed and we have documented participant endorsements, cautions and insights with respect to potential implementation. A full report on findings from the interviews is currently in preparation for Ako Aotearoa, New Zealand. In brief, the educators we talked to see potential for assisting students based on their individual needs and for ensuring that students move on with solid knowledge foundations and study skills. In particular, they emphasised the need for clear communication around objectives and expectations as well as the importance of integrating study skill development into courses rather than simply expecting students to arrive with these. There was concern about the potential for procrastination with movable deadlines but it was felt strategies could be put in place to offset this. What came across strongly is the passion educators have for helping students and the satisfaction they gain from direct contact with students.

In terms of learning technologies, the interviewees confirmed the use of a wide range of tools for scheduling appointments, communication and teaching support. In particular it was emphasized that conversations conducted via video conferencing can be as effective as being located in the same room. What is important is to allow time for the initial setup and sorting out of equipment. Especially for repeat conversations the technology merges into the background. The learning consultants see students from wide areas across the university. For repeat conversations it is beneficial to keep notes to provide continuity in giving advice, particularly when students see different advisors. As LMS are course-based they are not a natural fit for keeping such notes. This might be an area where next generation digital learning environments bring benefits.

Conclusions

Much of our tertiary education has become anonymous. Our learning designs make it too easy for students to stay at a transactional distance. This is less a question of study mode, on- or off-campus, than of not actively seeking the opportunities for meaningful exchange with teachers and peers. In our approach to course and learning design based on PSI and SDT, technologies play an essential role in supporting meaningful conversations and connections between learners and teachers. While we have engaged with educators on this project, we have yet to evaluate the approach with students; this is an essential next step in this research. Finally, our belief is that while essential, technologies should stay in the background and support learning centred on human interactions. By asking for a return to old-fashioned conversations we emphasize relationship building and individualized support. This is what distinguishes local tertiary providers from international anonymous providers.

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Developing a design-based research methodology for designing MR technologies for mountain safety

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This paper outlines the first stage of a design-based research (DBR) project exploring the literature and establishing a research methodology for the design of mixed reality (MR) environments to enhance informal learning in preparation for engagement in high-risk environments. The context of the project is mountain safety education for expert climbers to prepare them for the critical risks involved in extreme mountain climbing environments. The paper outlines the scope, background, proposed research methodology and initially identified design principles for designing MR technologies for mountain safety. The research draws upon literature applying new pedagogies for informal learning, including heutagogy or self-determined learning.

Keywords: Design Based Research, Mixed Reality, Informal Learning, Heutagogy, Authentic Learning.

Introduction

High altitude mountaineering is a high-risk environment requiring high levels of preparation and risk awareness. CNN reported on 24 May 2016 that avalanches killed 35 climbers on Mount Everest during the previous two years including 16 in one devastating day in 2014 (Dewan, 2016). At least one person has died climbing the mountain in Nepal every year since 1900. "Everest is a mountain of extremes", said Jon Kedrowski (Huffingtonpost, 2012), a geographer and climber who summited Mount Everest in 2012, when 10 climbers died. At altitude, the body can deteriorate in a variety of ways. For example: Eric Arnold, 36, of the Netherlands, died at night while heading back after a successful summit on Everest. A heart attack was suspected. Arnold was a triathlete based in Rotterdam. Also, an australian woman, Maria Strydom started suffering altitude sickness. She had reached Camp 4, the final camp before the summit but she died from high-altitude cough and acute mountain sickness. Subash Paul, 44, died at Base Camp from altitude sickness and Seema Goswami suffered severe frostbite injuries near Camp 4.

All mountaineers are wary of risk factors in the mountains but there are still fatal accidents happening every year despite of an awareness of risk factors. The risk increases in high altitude mountains (above 5000m) such as Himalaya ranges and Andes ranges, as mountaineers are more exposed to deadly dangerous risk factors including altitude sickness, endless crevasses, ice cliffs and frostbites. Even though most mountain climbers have a great range of experiences and are well trained, they often have less experience in high altitude mountain ranges due to financial difficulties and difficult accessibility to adequately prepare for these high-risk environments.

A search of the current literature relating to education strategies for high risk environments reveals that there is a gap in this research area. Therefore, there is a significant need to develop new learning strategies for these high-risk environments. Hence this research explores ways of better educating climbers of the very real risks of high-altitude mountain climbing. It can be extended to other high-risk areas such as firefighter and police force's working environments.

New media technologies such as **Augmented reality** (AR) and **Mixed reality** (MR) provide the potential to design and deploy highly authentic learning environments (Birt, Moore, & Cowling, 2017; Cochrane, 2016; Cochrane, Narayan, & Antonczak, 2016; Edmonds & Smith, 2017). **Augmented reality** (AR) provide a live direct or indirect view of a physical, real-world environment whose elements are augmented (or supplemented) by computer-generated sensory input such as sound, video, graphics or GPS data. **Mixed reality** (MR), is the merging of real and virtual worlds to produce new environments and visualizations where physical and digital objects co-exist and interact in real time. Augmented/mixed reality are technologies that layer computer generated enhancements atop an existing reality in order to make it more meaningful through the ability to interact with it. The key term for AR and MR, is flexibility. MR offers learning environments combining physical and virtual worlds. It is flexible and portable compared to the three-dimensional real physical world, and provides a low risk environment in which to explore high-risk real-world environments. Dunser, Steinbugl, Kaufmann, & Gluck (2006) argue that researchers can create environments in which users can act without being exposed to certain dangers that potentially occur in real environments. According to them, “using VR enables researchers to create exactly the same stimulus conditions for all participants or to vary certain environment variables in real-time and thus gives researchers more control over experimental settings” (p. 126).

Using a design-based research methodology, this research explores the design of an App which uses these MR and AR technologies to create high altitude environments, therefore, enabling mountaineers to experience and troubleshoot risky obstacles such as altitude sickness, endless crevasses, ice cliffs and frostbites within a safe simulated environment. In terms of Vygotsky’s (1978) zone of proximal development, these new technologies enable the mountaineers to learn themselves in informal settings through the App acting as a virtual more experienced peer.

Literature Review

In this section we identify some of the key literature that informs this research, including foundational learning theories that inform the research project. The research emphasises the importance of constructivist learning, problem solving, critical thinking and collaboration in learning environment. Designing AR and MR technologies for mountain safety is perfectly situated to integrate these very important pedagogical elements into an interactive environment. The proposed app based on AR and MR technologies will provide the learners the opportunity to discover their own knowledge, through individual learning, reflecting and collaborative learning.

Foundational Learning Theories

In today’s complex rapidly changing world new technologies enable new pedagogical approaches in diverse learning environments. There are no university degrees in high altitude mountaineering, thus self-directed and self-determined approaches are needed in the development in new teaching and learning strategies to prepare mountaineers for these potentially life-threatening environments. Learning theories such as Behaviourism and Cognitivism are not fully sufficient to prepare learners for the critical life-saving decisions that must be rapidly made in these rapidly changing and diverse environments. As a result, the proposed research conducts a study of Constructivism, Social Constructivism and heutagogy as foundational modern learning theories for developing a design-based research methodology for designing learning experiences for high-risk physical environments.

Constructivism is one of modern learning theories and heutagogy is self-determined learning that builds upon Constructivism and Social Constructivism. Constructivism is a learning theory that “equates learning with creating meaning from experience (Bednar et al., 1991). Learning is more meaningful to students when they are able to interact with concepts in the learning process. Constructivism states that learning is an active, contextualized process of constructing knowledge rather than acquiring it. Knowledge is constructed based on personal experiences and hypotheses of the environment. Constructivism utilizes interactive teaching strategies to create meaningful contexts that help students construct knowledge based on their own experiences. According to Ertmer and Newby (1993); “Learners do not transfer knowledge from the external world into their memories; rather they build personal interpretations of the world based on individual experiences and interactions.” (p. 63) Constructivism is active in the learning process and helps engage and motivate students by making them take a more active role in the learning process. It is also reflective so the students control their own learning process, and they lead the way by reflecting on their own experiences. Also, it is collaborative and evolving in the learning process.

Building upon Constructivism, Social Constructivists view that learning is meant to be a social process that occurs when individuals take part in social activities. Meaningful learning occurs when individuals are engaged in social activities such as interaction and collaboration. Social Constructivism emphasises the importance of culture and context in the process of knowledge construction. According to Vygotsky (1978), knowledge is constructed through social interaction and is shared rather than an individual experience. He states that human beings create meaning from an educational experience by learning with others. He views interaction with peers as an effective way of developing skills and strategies within the Zone of Proximal Development. Vygotsky (1978) defines the Zone of Proximal Development (ZPD) as; "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem-solving under adult guidance, or in collaboration with more capable peers" (p. 86). He insists that teachers use cooperative learning exercises where less competent learners develop with help from more skilled peers.

Heutagogy is self-determined learning that builds upon Constructivism, Social Constructivism and Andragogy. According to Hase and Kenyon (2001), Heutagogy is a self-determined learning and it involves the primary changes in the role of the teacher. The learners have the primary role in heutagogical learning environment and are learner-centred as opposed to teacher-centred learning. "Heutagogy, the study of self-determined learning, may be viewed as a natural progression from earlier educational methodologies - in particular from capability development - and may well provide the optimal approach to learning in the twenty-first century" (p. 2). Self-determined learning is more concerned with how people develop the capacity to navigate the unknown and enable learners to have the ability to manage their own learning environment to meet their learning needs. It has a focus on what the learners want to learn. According to Hase and Kenyon (2001), self-determined learning provides the learner empowerment, capabilities and open-ended learning environments. Also, reflective practice is one of important characteristics of heutagogy.

Methodology

Initial Design Principles identified from the literature:
- Utilising a DBR methodology
- Social Constructivism and the ZPD
- Informed by heutagogy
- Utilising frameworks for mobile AR and VR learning environments

Amiel and Reeves (2008) argue, educational or design-based research involves the identification of design principles that are tested through implementation and evaluation of a design prototype app, that is then iteratively redesigned with further evaluation and feedback from users through generic process for conducting design research in education, leading to the development of transferable design principles that can be applied to other knowledge contexts. Therefore, this research will benefit educational contexts beyond that of Mountain Safety. Figure 1 shows the process of Design-based research as Amiel and Reeves (2008) described.

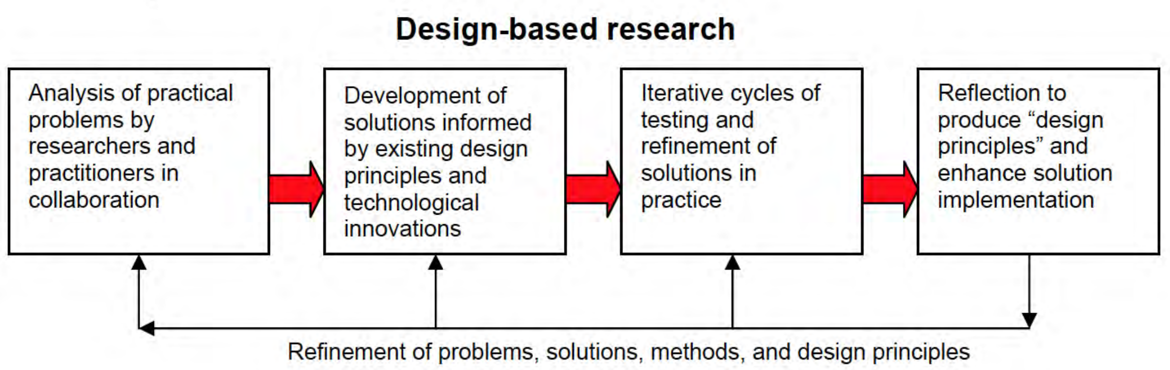

Figure 1: Design-based research, from Amiel, T & Reeves, T. (2008, p34).

Vygotsky (1978) insists that the learners can learn beyond the limits of what they can on their own when aided by a more experienced peer within the Zone Of Proximal Development. The role of App could be a virtual more experienced peer in this case. The App will enable mountaineers to be well prepared before their actual climbing journey.

Design of the Study

Research questions
- What are the key design principles for developing MR applications for high risk educational environments?
- How can MR applications be most effectively utilised to enhance learning in extreme outdoor situations?
- How can MR applications influence climbers' learning experiences compared to when they are in real environment?
- How do climbers respond to risk factors in extreme outdoor situations after using MR applications?

Methodology

This proposed research methodology is a design-based research project, that will produce a prototype App based on AR/MR technologies for the new educational strategies for high risk environment. This research will be undertaken in four iterative phases that align with the four stages of the DBR methodology (McKenney & Reeves, 2012).

- The first phase, analysis and exploration, will be focused on review of the literature in relation to identifying design principles for education around mountain safety and risk factors in high altitude mountain ranges, and the principles of AR/MR design. Feasibility interviews with climbers from climbing communities in New Zealand.
- The second phase, design and construction, would be producing a prototype app based on AR/MR technologies and also it involves 1st evaluation and analysis on 1st prototype app. As a result, I will redesign 1st prototype app based on 1st evaluation and analysis.
- The third phase, evaluation and reflection, will be focused on 2nd prototype app development and evaluation on 2nd prototype app. The final stage of the third phase will be refinement of the app. The research explores the learning behaviour while the learners use the app. This will involve multiple iterations of redesign and evaluation and the refinement of the design principles.
- The final phase, maturing intervention and theoretical understanding, will be mainly focus on recommendations and design research principles on successful safe climbing in real environments using the app.

Participants

This proposed research will be conducted with small focus groups from NZAC (New Zealand Alpine Club), NZ Mountain Safety Council, DOC (Department of Conservation), Sherpas, expedition groups in Himalaya range, local guides from Europe Aps and Patagonia range and climbers from various countries. They will be invited to take part in the research. After developing a prototype app, it will be used both in non-climbing situation and climbing situation. The climbers will encounter possible situations in high altitude mountain environments through the app even though they are not in the mountain ranges. However, the climber also uses the app in real locations such as base camps in high mountain ranges while they are preparing summit push. The climbers do self-learn through the app. The app will show not only deadly dangerous risk factors such as altitude sickness, endless crevasses, ice cliffs and frostbites, but also a live direct or indirect view of a physical, real-world environment in high altitude mountain ranges, which are augmented by computer-generated sensory input such as sound, video, graphics or GPS data.

Ethical considerations

The research will not put the participants in situations where they might be at risk of harm as a result of their participation. Also, there are no conflicts of interest and misconduct as there is no hierarchy relationship between the researcher and the participants. The research data, results and the app will be shared once developed in the public domain.

Data collection and analysis

The research conducts methodological triangulation to measure learning outcomes. This involves using more than one method to gather data such as interviews, questionnaires and biometric feedback. For biometric feedback, the research uses Gear VR to detect heart rate and gather data so I can compare their responses before and after using the app.

1. Developing 1st prototype app.
2. 1st evaluation, feedback and analysis on 1st prototype app
3. Redesign 1st prototype app based on 1st evaluation, feedback and analysis.
4. 2nd evaluation and analysis on 2nd prototype app.
   Redesign 2nd prototype app based on 2nd evaluation, feedback and analysis.
5. Finalising the app and design research principles in the field.

Anticipated/possible challenges

One of the possible challenges will be getting people to respond through the app evaluation/feedback process. It will be also challenge to form a focus group as a few of them are living in remote areas where communications are limited. Video conferencing for remote focus group participants will be available.

Conclusion

This paper outlines the foundational learning theories and research methodology behind the development of mobile mixed reality environments for high risk learning environments. The ASCILITE Conference presentation will outline the research progress and elicit expert feedback from the conference attendees to help refine the research methodology.
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Utilising learning analytics for study success in higher education: A systematic review

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This study examined the utilisation of learning analytics to support study success in higher education. The main research question was to identify whether there is a link between learning analytics and the respective intervention measures to increase study success at higher education institutions. The systematic review included empirical studies conducted during the past five years. Search terms identified 6,220 articles from various scientific sources. After duplicated articles were removed, there were 3,163 articles remaining. Each of the articles were screened and the inclusion criteria (e.g., peer-reviewed, rigorous research findings) limited the key studies to 41 articles. This paper presents an overview of the results of this systematic review. It is concluded that evidence can be found supporting the use of learning analytics to support study success in higher education. However, study success may not be exclusively the result of the use of learning analytics but also some additional means of technological or institutional support. The findings also suggest a wider adoption of learning analytics systems as well as work towards standardisation of learning analytics procedures which can be integrated into existing digital learning environments.

Keywords: Learning analytics, study success, dropout, systematic review

Introduction

Mining data for insights to improve education enables an additional level of evidence-based research into learning and teaching. Currently, promising learning analytics applications are being developed which utilise data produced in the educational context (e.g., Pistilli & Arnold, 2010; Gašević, Dawson, Rogers, & Gašević, 2016). From a holistic point of view, learning analytics use static and dynamic information from digital learning environments, administrative systems, and social platforms for real-time modelling, prediction, and optimisation of learning processes, learning environments, and educational decision-making (Ifenthaler, 2015). Accordingly, learning analytics are expected to provide benefits for all involved stakeholders (i.e., students, teachers, designers, administrators, etc.) at higher education institutions. Various research methodologies and techniques are currently being implemented on different categories of learning analytics (such as descriptive, predictive and prescriptive) and offer different insights into the design and deployment at higher education institutions (Berland, Baker, & Bilkstein, 2014). Descriptive analytics use data obtained from sources such as course assessments, surveys, student information systems, learning management system activities, and forum interactions mainly for reporting purposes. Predictive analytics utilise similar data from those sources and attempts to measure onward learning success or failure. Prescriptive analytics deploy algorithms to predict commonly the study success and whether students retain on their courses as well as suggesting immediate interventions (Baker & Siemens, 2015). The main motivations of utilising learning analytics for higher education institutions include (a) improving students' learning and their motivation in learning, hence, retaining their studies on courses and reducing dropout (or inactivity), as well as (b) attempting to improve the learner's learning process by providing personalised and adaptive learning pathways (toward specific goals set by the teacher or student). However, the success of learning analytics in improving higher education students' learning has yet to be proven systematically and based on rigorous empirical findings. Only a few works have tried to address this but limited evidence is shown (Suchithra, Vaidhehi, & Iyer, 2015). The current study aims to form a systematic review of empirical evidence demonstrating how learning analytics have been successful in facilitating study success in continuation and completion of students' university courses. The overriding research question is as follows: Is it possible to identify a link between learning analytics and related prevention and intervention measures to increase study success in international empirical studies?

Study success and learning analytics

Study success includes the successful completion of a first degree in higher education to the largest extent, and the successful completion of individual learning tasks to the smallest extent (Sarrico, 2018). The essence here is to capture any positive learning satisfaction, improvement, or experience during learning. As some of the more common and broader definitions of study success include terms such as retention, persistence, graduation rate and the opposing terms include withdrawal, dropout, non-completion, attrition and failure (Mah, 2016).

Learning analytics show promise to enhance study success in higher education (Pistilli & Arnold, 2010). For example, students often enter higher education academically unprepared and with unrealistic perceptions and expectations of academic competencies for their studies. Both, the inability to cope with academic requirements as well as unrealistic perceptions and expectations of university life, in particular with regard to academic competencies, are important factors for leaving the institution prior to degree completion (Mah, 2016). However, Sclater and Mullan (2017) reported on the difficulty to isolate the influence of the use of learning analytics, as often they are used in addition to wider initiatives to improve student retention and academic achievement.

An extensive systematic literature review of empirical evidence on the benefits of learning analytics as well as the related field of educational data mining was conducted by Papamitsiou and Economides (2014). They classified the findings from case studies focussing on student behaviour modelling, prediction of performance, increase self-reflection and self-awareness, prediction of dropout as well as retention. Their findings suggest that large volumes of educational data are available and that pre-existing algorithmic methods are applied. Further, learning analytics enable the development of precise learner models for guiding adaptive and personalised interventions. Additional strengths of learning analytics include the identification of critical instances of learning, learning strategies, navigation behaviours, and patterns of learning (Papamitsiou & Economides, 2014). Another related systematic review on learning analytics was conducted by Kilis and Gülbahar (2016). They conclude from the reviewed studies that log data of student's behaviour needs to be enriched with additional information (e.g., actual time spent for learning, semantic rich information) for better supporting learning processes. Hence, learning analytics for supporting study success requires rich data about students' efforts and performance as well as detailed information about psychological, behavioural and emotional states.

Method

Preparation and literature search

The preparation of the systematic review followed the eight steps proposed by Okoli and Schabram (2010). First, the goal for the systematic review, i.e., an overview of international studies utilising learning analytics to support study success was defined. Second, the inclusion criteria for the studies were determined. Third, international databases including Google Scholar, ACM Digital Library, Web of Science, Science Direct, ERIC and DBLP were searched. Search terms included "learning analytics" in combination with "study success", "retention", "dropout prevention", "course completion", and "attrition". In addition, specific journals such as Journal of Learning Analytics, Computers in Human Behaviour, Computers & Education, Australasian Journal of Educational Technology and British Journal of Educational Technology were searched. Searches were conducted using the above-mentioned terms, matched to the databases' subject headings and as keywords in the title and abstract. Fourth, the selection criteria, i.e., clear theoretical foundation, research methodology and implications were defined. Fifth, benchmarks for quality assessment, i.e., presentation of findings, sampling technique, methodological procedure were set. Sixth, relevant information from the individual studies (e.g., empirical evidence, implications) were extracted. Seventh, the extracted information from the individual studies were merged together to draw conclusions. Finally, the findings of the systematic review are being reported in this contribution.

Inclusion criteria

Retrieved articles were restricted to studies that (a) were situated in the higher education context, (b) were published between January 2013 and December 2017, (c) were published in English language, (d) had an abstract available, (e) presented either qualitative or quantitative analyses and findings, and (f) were peer-reviewed. 6,220 articles were located and after duplicated papers were removed, 3,163 articles were remaining. The number of key studies identified was 374 (in the first round) then limited to 41 (due to substantiality of empirical evidence).

Results

Summary of key studies

The 41 key studies included in this systematic review were conducted in USA (*n* = 13), Australia (*n* = 6), Brazil (*n* = 2), Ireland (*n* = 2), UK (*n* = 2), Taiwan (*n* = 2), India (*n* = 2), South Korea (*n* = 2), Sweden (*n* = 1), Israel (*n* = 1), The Netherlands (*n* = 1), Pakistan (*n* = 1), Columbia (*n* = 1), France (*n* = 1), Spain (*n* = 1), Japan (*n* = 1), and Saudi Arabia (*n* = 1). Most articles were published in 2017 (17) followed by five articles in 2016, 2015 (7), 2014 (8), and four articles in 2014.

The key studies utilised adequate data analytics methods such as binary logistic regression, decision tree analysis, support vector machines, logistic regression and classification systems. Many of the key studies applied several statistical methods in order to determine which one can achieve the most accurate prediction of study success and/or dropout. The main predictions forecasted in the key studies were on course completion, grades to be obtained, and dropout. In addition, empirical evidence from articles which were not eligible to form the key studies in this systematic review (due to incomplete work/lack of depth) are available. Still, these studies provide additional supporting evidence in the ways learning analytics can be used to increase study success.

Evidence of learning analytics supporting study success

Table 1 shows example findings of the systematic review (the complete table of findings will be part of the conference presentation) including the bibliographic information, origin of the study, sample size, data collection and analysis, as well as key indicators.

Table 1: Example findings of selected Australian key studies

Author(s) & Year	**Country**	**Sample size**	**Data collection sources**	**Data analysis methods**	**Key indicators**
Chai & Gibson (2015)	Australia	23,291	University datasets	Cross-validation technique	Three types of machine learning techniques were tested with a focus on retention: Logistic regression, decision trees and random forests. The models were evaluated using precision and recall metrics. Logistic regression gained the best performance and user utility (*67% precision, 29% recall*).
Dawson, Jovanovic, Gasevic, & Pardo (2017)	Australia/ UK	11,160	Student information system, LMS interactions and assessment	Common statistical methods	Positive association between the intervention and student retention was identified using common statistical analysis. Higher variability in the data (over 99%) can be achieved using more advanced statistical methods, e.g., mixed-effect methods.
Rogers, Colvin, & Chiera (2014)	Australia	2,332	Variables from online systems (demographic, performance)	Regression	An index method was utilised which could make accurate predictions of dropout.

The 41 key studies provided the following evidence of learning analytics for supporting study success in higher education:

1. Study success can be achieved by students who utilised learning analytics interventions.
2. Engagement of students is a predictor of study success.
3. Recommender systems produce positive effects toward study success.
4. GPA and financial status characterise study success.
5. Predictive power / prediction accuracy can be manifested and increased through data on course completion, dropouts, achievement level, study achievement, total study time, interaction with colleagues, frequency of

regular learning intervals, and number of downloads from the learning environment.
6. Prediction accuracy for study success increases over time (80% from week 12 of a semester).
7. Reduction of dropout rates and prognosis of dropouts can be based on the specific courses attended.
8. Strong correlation between CGPA and pre-set grades. CGPA serves as a study success indicator.
9. Small positive relationship between student satisfaction with the use of the learning analytics dashboard and their study success.
10. Students who completed a course expected better performance feedback.
11. Various online learning systems are reliable and can produce solid predictions for study success.
12. Indexing methods can be utilised which produce accurate predictions of dropout and study success.

In addition, the findings of the integrative review provide insights into predictors to indicate study success, available predictive models (algorithms), pedagogical models toward personalized learning and integration of data visualisation for study success.

Discussion

Attrition and course incompletion rates often do not inform whether the student dropped out due to personal, financial, academic or course quality reasons. Different measures and intervention strategies need to be set in place and to individualise student support services for various learners due to the different reasons of dropout and also different intervention strategies may work for some and not for others (Mah, 2016; Sclater & Mullan, 2017). A high completion does not necessary inform of the quality of the course, whether students' learning outcomes were achieved and how motivated the students were intrinsically or extrinsically, causing more difficulties to support the student to complete the course.

The findings of this systematic review on learning analytics and study success highlights the demand of personalised learning environments as well as tailored education packages offered by higher education institutions. This requires rich data about the student's personal profile which includes information such as socio-demographic background, previous qualifications and academic achievements, engagement in the recruitment journey as well as dispositions about learning and motivation (Ifenthaler & Widanapathirana, 2014). In addition, the findings obtained in this systematic review so far suggest that there is a considerable number of sophisticated learning analytics tools which utilise effective techniques in predicting study success and at-risk students of dropping out. However, standards for implementation in productive digital learning environments at higher education institutions are missing. Further, as learning analytics are of growing interest for higher education institutions, it is important to understand students' expectations of learning analytics features to be able to align them with learning theory and technical possibilities before implementing them (Schumacher & Ifenthaler, 2018; Marzouk et al., 2016). One suggestion is to leverage existing learning theory by clearly designing (quasi-)experimental studies based on theoretical frameworks and connect learning analytics research with decades of previous research in education (Marzouk et al., 2016). The systematic review also indicated that over the past two years, several reviews and reports have been published which document policy recommendations established for policy-makers, administrators and course conveners. This line of research demands more work on ethical and privacy guidelines supporting learning analytics when implementing learning analytics at higher education institutions (e.g., West, Huijser, & Heath, 2016). Another demand is a well-facilitated change management within the higher education institution including institution-wide acceptance of learning analytics, the integration of all stakeholders as well as rigorous guidelines and policies focussing on data protection and ethics for learning analytics applications (Ifenthaler, 2017).

Conclusion

The findings obtained in this systematic review suggest that there is a considerable number of sophisticated learning analytics tools which utilise effective techniques in supporting study success and at-risk students of dropping out. Limitations of this study include the difficulty in comparing results of different studies as various techniques and algorithms, research questions and aims were used. Although much empirical evidence is documented in these articles, many studies are still works-in-progress, experimental studies, and limited in external validity. The key studies discuss how learning analytics can work to predict study success. However, the implications how to support stakeholders at higher education institutions in utilising learning analytics to support study success are under-documented. The questions raised are for example: Will students be able to respond positively and proactively when informed that their learning progress is hindered or inactivated?; Will instructors be able to influence the at-risk students positively so that they will re-engage with the studies? In addition, ethical dimensions regarding descriptive, predictive and prescriptive LA need to be addressed with further empirical studies and linked to study success indicators (West et al., 2016).

To sum up, empirical evidence on a large scale to support the effectiveness of learning analytics actually retaining students onto courses are still lacking. It is therefore imperative to leverage existing learning theory, psychological methods and connecting them to advances of learning analytics research for designing (quasi-)experimental studies including theoretical frameworks and sound empirical methodologies.

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Building institutional cultures of innovation in technology enhanced learning: UCISA findings on current challenges and developments in UK higher education

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This paper discusses recent developments in technology enhanced learning (TEL) across the UK higher education (HE) sector and considers the extent to which innovative practices have been able to flourish. In the context of an increasingly competitive marketplace for student recruitment, we explore the tension that HE institutions are now facing between establishing consistency in course provision as a way of satisfying student expectations, whilst at the same time encouraging academic staff to experiment and innovate with learning technologies, with the accompanying risks that this may present to the reception of learning methods.

Keywords: innovation; technology enhanced learning; institutional culture

Introduction

Transformational learning outcomes are commonly associated with the use of digital technologies in learning activities, but to what extent is this vision being realised within higher education? Whilst there has been strong investment in TEL services and tools across the UK HE sector in recent years, the evidence suggests that there has not yet been a major impact on academic practices (Price & Kirkwood, 2014; Selwyn, 2014; Walker, Jenkins & Voce, 2017). Drawing on the data from the most recent Universities and Colleges Information Systems Association (UCISA) TEL surveys (https://www.ucisa.ac.uk/bestpractice/surveys/tel/tel), this paper considers the progress that has been made by UK HE institutions in promoting creative uses of technology and the factors influencing changes in academic practice.

The UCISA Surveys

The UCISA TEL surveys have been monitoring the management and implementation of technology-enhanced learning across the UK HE sector since 2001. The surveys have been completed by institutional heads of e-learning with responsibility for the delivery of learning and teaching services and have served a dual purpose in tracking longitudinal perspective of technology-enhanced learning (TEL) developments across the sector, whilst at the same time capturing new trends and developments. The survey tool contains 60 questions, which include multiple choice, Likert scale and free text answers, and covers a range of topics such as drivers and enablers for TEL, strategies influencing TEL adoption, tools, evaluation of TEL, support for TEL and future challenges. Questions have been refined or developed over time in conjunction with the TEL community to ensure new trends are captured, whilst still ensuring that longitudinal analysis is possible to enable the identification of transformative practice over time. The most recent survey report (Walker et al., 2018) represents the ninth survey in the series. The survey will be complemented by a set of case studies that draw out details on how institutions are supporting and developing academic practice and provide examples of how themes emerging from the survey are being addressed in specific contexts (https://www.ucisa.ac.uk/bestpractice/surveys/tel/tel).

Each survey has taken place within a particular national context, with the 2018 survey tracking TEL developments within an increasingly competitive marketplace for student recruitment. We have observed how institutional decision-making has focused on the role of educational technology in supporting standings in ranking schemes such as the Teaching Excellence Framework (TEF) (http://www.hefce.ac.uk/lt/tef/) which awards institutions a gold, silver or bronze rating, based on evidence derived from student progression metrics, student satisfaction instruments such as the UK National Students Survey, and graduate-level employment outcomes. Given this context of TEF and university league tables, how can higher education institutions create cultures of innovation in the use of TEL tools, encouraging academic staff to experiment (and perhaps fail) whilst at the same time ensuring consistency in baseline provision to students?

Looking back at sector guidance over the years, the revised e-learning strategy from the Higher Education Funding Council for England (HEFCE, 2009) has encouraged institutions to focus on three types of interventions for TEL to support the development of innovative practices: efficiency, enhancement and transformation. Flavin and Quintero (2017) have proposed an alignment of these three types to Christensen's theory of disruptive innovation, such that innovation can be sustaining or disruptive. Innovation is therefore defined in this paper as having two aspects, namely: (i) *efficiency and enhancement*, whereby existing processes and systems are either improved or become more efficient through cost or time saving developments; and (ii) *transformation*, whereby innovation introduces new systems or processes that radically change the ways that things are done and potentially disrupting the status quo.

Transformative change might come in a variety of forms, such as through the development of new design methods that reverse traditional instructor-learner roles, engaging students in knowledge creation activities, or through novel approaches such as immersive learning or the use of student-led analytics, which may provoke major changes in the way that students learn (Ferguson et al., 2017). Using the UCISA survey data as a frame of reference, we will discuss how far the sector has come in relation to these dimensions of efficiency & enhancement and transformation through the use of TEL tools and services.

Establishing a baseline - ensuring efficiency and enhancement

The HEPI report (Davies, Mullan and Feldman, 2017) reported that almost all UK HE institutions now provide a baseline of TEL provision, which has provided a degree of efficiency in the management and support of student learning. Fig 1 reveals the top five TEL services that institutions have invested in to support their course delivery. The key development since the 2016 survey has been the rapid 'top-down' deployment of lecture capture tools across the sector, which are included for the first time in the list of top-five TEL tools deployed by UK HE institutions.

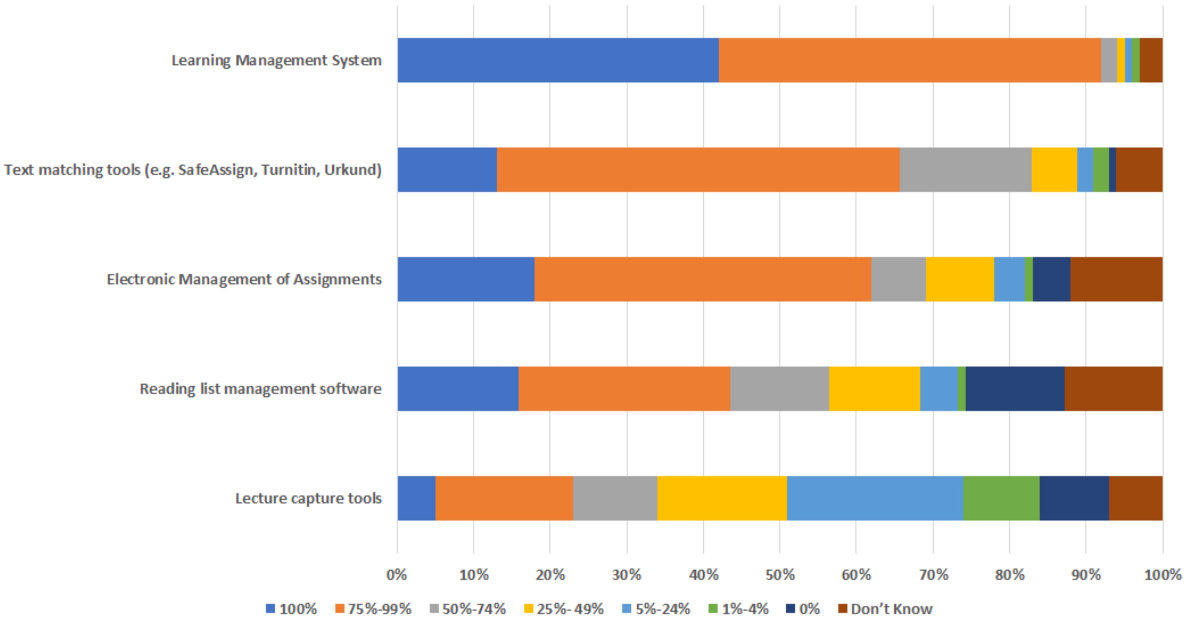

Figure 1: Percentage of institutional courses using TEL tools within the UK HE sector
Source: 2018 UCISA Technology Enhanced Learning Survey (Walker et al., 2018)

Our findings show that this baseline provision is constantly under review; since 2012 the data has indicated that around half of institutions have reviewed a major TEL system in the past two years. In 2018, 47% institutions reported that they had undertaken a review with the majority focusing on their Learning Management System (LMS). Outcomes of these reviews have included decisions to move to alternative vendor solutions, as well as to enhance current systems through upgrades or migration to outsourced hosting provision.

One way of ensuring a baseline use of TEL whilst incrementally enhancing staff pedagogic practices has been through the introduction of usage policies, primarily aimed at the LMS. In 2018, 58% institutions reported having a minimum requirements policy for the LMS. The UCISA TEL Case Studies (UCISA, 2016) highlighted consistency of student experience as a key driver for institutions in the production of these policies. Institutions such as Aberystwyth University and Edge Hill University indeed have reported that they have provided their staff with guidelines on how to develop an enhanced LMS module site presence ‘beyond the baseline’, although it is unclear what impact this guidance has actually had on lecturers’ online instructional practice to date.

Are we transforming academic practice?

What impact has this investment in TEL tools and services had on pedagogic practices and student learning? Has the establishment of baseline provision led to transformative changes? The 2018 findings do not suggest that much has changed in this respect, with blended learning delivery focusing on the *provision of lecture notes and supplementary resources* to students still representing the most commonly supported activity; 73% of respondents indicated that this mode is offered extensively across their institution. In contrast, only 18% of institutions reported that the design of their courses actually required students to engage in active learning online (e.g. through active participation in collaborative or assessed tasks).

Moreover, there appears to be little progress in the evaluation of TEL practices at institutional and departmental levels to explore the impact of technology usage on the student learning experience. Only 43% of institutions had conducted evaluations, and those that did tended to focus more on levels of satisfaction with TEL services by tracking the take-up and usage of TEL tools, rather than on the contribution of TEL services to student learning – no doubt with a view to securing higher NSS ratings which in turn contribute to TEF metrics. The evaluation of impact of TEL on pedagogic practices attracts even less attention, with only 21 instructions engaged at all in this activity. The 2018 data shows that where evaluations are taking place, they are largely being undertaken as part of a general review of TEL services, rather than as a review of teaching methods supporting innovative practices.

However, in cases where evaluations have focused on the digital capabilities of staff, the evidence points to varying levels of technology adoption beyond the minimum requirements of LMS usage with limited skills and confidence levels, as captured in the following free-text commentaries from survey respondents on outcomes from their own institutional studies:

> “..the academic staff survey revealed that basic technology is used widely across the University but there is significant scope to use/adopt ‘added value’ tools and services.”
>
> “(LMS) is central to the delivery of all modules but some aspects of delivery need further support – e.g. support for more interactive resources, general learning design approaches particularly in relation to fully online delivery.”

This is further reflected in the 2018 survey results which have flagged a lack of academic staff knowledge as one of the top five barriers to the development of TEL.

Creating an environment for innovation

So how can we develop an environment for more transformative innovation through the use of TEL? Since 2003 the UCISA survey has reported on the influence of institutional strategies on the development of TEL, with Teaching, Learning and Assessment strategies being the most prevalent. The 2018 report indicates that 34% of institutions retain specific TEL or e-Learning strategies. Whilst strategies may be seen as an important way of influencing the development of TEL within HE institutions, Flavin and Quintero (2017) have reported that the majority of TEL strategies focus on innovation in the form of enhancement and efficiencies rather than transformative innovation.

Thanaraj and Williams (2016) highlight instead the importance of ensuring that academics feel encouraged to experiment with their teaching, and advocate a “bubbling-up” of innovation in conjunction with a more institutional approach which ensures efficiencies of scale. The 2018 survey data on barriers to TEL development highlights the role of institutional and departmental/school leadership in establishing the right culture for academic buy-in to technology adoption and experimentation. However, there is a need to ensure that there is adequate support to support both enhancements and transformation (Gunn, 2010). The 2018 data suggests that the scope to embed and develop TEL practices is linked to the availability of technology enhanced learning support staff at an institutional and local level, and this once again tops the list of encouraging factors identified by respondents. The availability of support can be seen to address academic staff know-how, time and resourcing levels, which represent three of the leading barriers to TEL development that have been identified by survey respondents over the years, as illustrated in Figure 2. The lack of stability in central TEL support provision in this respect is a concern, with 80% of institutions having changed their provision in the last two years and 38% of institutions indicating that they have undergone a restructure or reorganisation.

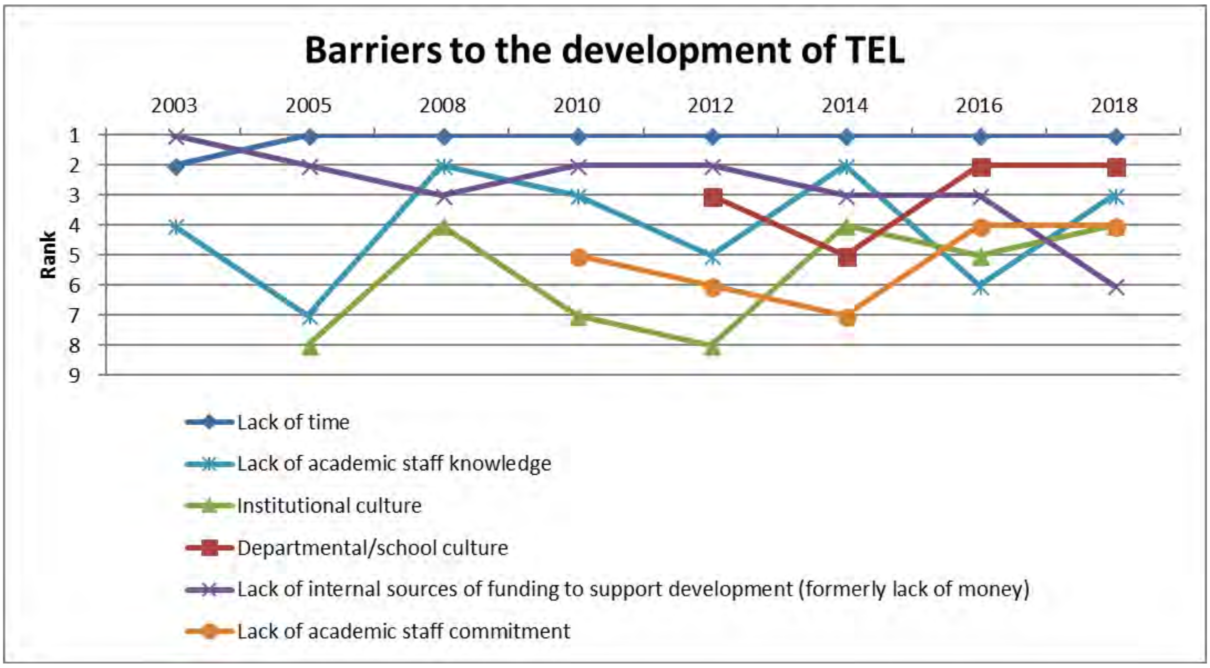

Figure 2 - Graph showing the barriers to the development of TEL from 2003-2018

Setting the vision for digital education, through appropriate strategies and providing the right level of resources, support and incentives to trial new approaches to course delivery are all facets of leadership which we believe are key to innovation with TEL. This leadership approach is neatly summed up in the following survey response on the factors behind the TEL activity 'above the institutional norm' by one school within an institution:

> "The school has a clear vision for digital education and the resources to enable TEL – a dedicated budget and two learning technologists in house."

Illustrations of effective institutional approaches to innovation that we have observed across the sector therefore combine both resourcing and pedagogic vision as dimensions of technology adoption and include student partnership schemes such as those promoting the use of student technology ambassadors and student video production team (Jisc, 2015; LSE, 2016; Walker, 2017). Conversely where there has been limited support from senior management and a lack of learning technology assistance, the UCISA survey feedback shows that it is much harder to shift the academic culture towards greater experimentation with TEL, as captured in the following comment:

> 'Cultural (sic) is at Departmental level, resulting in lack of engagement and hence output of TEL usage.'

Conclusion

Our findings underscore the importance of strategic leadership in fostering TEL developments, and align with the conclusions of Bates (1992) who observed that '*technological decisions need to be preceded by policy and educational decisions*'.

Using Flavin and Quintero (2018) as a frame of reference to interpret developments, the UCISA data reveals that institutional investment in TEL over recent years appears to have been directed towards efficiency and enhancement improvements, with a keen focus on meeting student expectations and ensuring high satisfaction levels with TEL services. This approach appears to have had a negligible impact on academic practice, beyond ensuring staff conformity to baseline standards of technology usage. As Selwyn (2014:9) observes, '*many of the fundamental elements of traditional learning and teaching have been neither transformed nor ruined by the waves of digital technologies'*. In Selwyn's estimation the rollout of TEL services has followed a technologically deterministic model, without serious critique as to how technology is actually being used in practice. The UCISA survey data supports this analysis to some degree, illustrating the lack of institutional scrutiny on TEL services and their impact through evaluation studies, with a clear gap between provision of services and understanding of their use.

We conclude that for transformative change in academic practice to take root, institutions will need to address this gap, outlining a compelling vision for the use of TEL tools in support of student learning. At the same time they should be encouraging academics to experiment and critically engage with TEL tools and services as part of a proactive and sustainable strategy for effective TEL usage in course delivery. This evidence-based approach would mark a significant departure from the current reactive stance that institutions are following, which in our estimation appears to be short-term in focus - prioritising the rapid rollout of services to satisfy the expectations and perceived needs of students.

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Mining digital reality: exploring the virtual activities of undergraduate students

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This study explored the computer usage behaviour of undergraduate students, by using Reality Mining techniques to capture naturally-occurring digital traces. We harvested over 14,000 hours of computer usage data from 21 undergraduate students at a New Zealand university over the period of one semester. Our preliminary analysis has given us some insights into: 1] what applications students use most frequently, 2] how much students use their computes during the semester, 3] the multi-tasking/task-switching behaviours of students, and 4] the times most common for students to use their computer devices. These results, which are from a larger ongoing study, point to interesting areas for future research around the complexities of student digital behaviours, and illustrates the potential of new research methods to capture data about student practices.

Keywords: Reality Mining, computer usage, student behaviour, higher education

Introduction

It is generally accepted that higher education today incorporates a great deal of computer technology, and that students use digital devices in virtually all aspects of their academic life, from accessing their lectures online, to conducting research, to writing and publishing scholarly work. Most of the current undergraduate student cohort (referred to as Generation Z/Gen Z, the iGeneration or Post-Millennial) use multiple technologies on a daily basis; have had access to the internet since a young age; and are generally comfortable adopting new technologies and digital behaviours (e.g. interaction on social media). However, the lines between academic and non-academic technology use are also becoming increasingly blurred for GenZ students. Conole et. al. (2008) declare that the students' use of technologies is intermingled with social or leisure activities, and is almost indistinguishable from their academic use. Sim and Butson (2013) found that undergraduate students were typically unable to accurately judge how much of their technology use was for academic or non-academic purposes. Several studies have reported that students are likely to multi-task with technology when studying, constantly switching between academic and non-academic activities (e.g. Weimer, 2012; Burak, 2012).

Today, it is still relatively unclear exactly how students are using computer devices in their day-to-day life, and to what extent academic and non-academic activities are intertwined in their digital practices. A decade ago, Conole et al. (2008) wrote that digital technologies were changing student academic practice, particularly in terms of "anytime, anywhere" learning. However, other studies report on the negative impact that technology use can have on academic performance (see Wentworth & Middleton, 2014 for a review of the literature). These studies in particular correlate heavy internet use and social media use with lower performing students. These conflicting pressures present challenges to teachers and educational designers who want to provide environments and experiences that effectively cater to students' digital educational needs.

The problem is that most studies related to student computer use are based on self-reports rather than measures of actual practice. For example, Wentworth and Middleton (2014) conducted a large-scale survey to determine the effects of technology on student performance, but concluded by saying:

> …measures of technology use may need to be refined. Student self-reports may have been biased, either positively or negatively, due to memory errors and lack of awareness of their actual frequency of using technology. (p310)

However, we are now able to capture naturally-occurring behavioural data at precise temporal resolutions (e.g. down to seconds), which offers unprecedented insights into student computer activities. This has given rise to a new phenomenon of self-tracking typically termed the Quantified Self (Wolf & Kelly, 2014). The ability to self-monitor across a range of data forms could give students access to, and control over, learning and social related behaviours, leading to self-transformation.

This short paper reports on a study in which 21 undergraduate students at a New Zealand university had their daily computer behaviours monitored for one semester (approximately 4 months). This study is part of a larger doctoral research project investigating student experiences using new and emerging digital devices and research methods. In particular, we employ a Reality Mining technique (Pentland, 2009) which seeks to unobtrusively gather digital traces or footprints of students as they go about their daily routines. This research is exploratory in nature, and as such we do not have explicit research questions. We present here the method used to capture student computer usage data, preliminary findings, and future research directions.

Method

Computer activity data was generated from the personal digital devices (i.e., laptops and tablets) of 21 undergraduate health science students from a New Zealand university, over the course of 1 semester (February 2017 – June 2017). The data was gathered using a computer application called RescueTime (https://www.rescuetime.com). RescueTime is a personal time management application for logging and tracking digital activity hours. It sits in the background of the device without causing any interruptions to normal computer use, and records the date, time, duration and type of computer programmes used, as well as the date, time and duration of websites visited. Note that the software does not collect the content of documents or websites. This type of data capture is consistent and yields more authentic information rather than relying on student recollections of computer use, which are likely to be less accurate. RescueTime has been used to capture productivity measures of computer programmers (Meyer et. al., 2017), and similar activity tracking software has been used before in higher education to compare students' perceptions of computer use with actual use data (Sim, 2016).

In this study, participants were given full control over the software, including the ability to turn it on and off and to delete any data they did not want included in the study. As well as having access to the raw data throughout, participants were also emailed summary reports of their weekly activities. This was deemed an important part of the research design—since data tracking at this level has "Big Brother" overtones, we believed it was essential that students felt they were in control of their privacy and owned their data. We also wanted to encourage them to find utility in the data being generated, and learn more about their own practices. In this way, they were able to engage as co-researchers in the project.

Data was analysed using pandas, a library for statistical data analysis (McKinney, 2011). All computer usage data was cleaned of any identifying features to ensure anonymity prior to publication. Ethical approval for the study was obtained from the university prior to the commencement of data collection (Ethics 16/160).

Findings

This research generated over 14,487 total hours of students' computer usage data. While we are still in the early stages of analysing this dataset, we can report on a number of preliminary findings and interesting elements for future research.

Application use

First, we wanted to gain an overall appreciation of undergraduate use of computer devices. In particular, one that was based on actual rather than reported data. Namely, we wanted to know: what applications do undergraduate students use over the course of a semester? We achieved this by undertaking a word frequency analysis of software application names (including websites, which were classified as simply URL_ADDRESS). Overwhelmingly, for all students the most common activity was internet browsing. Note that we are not making any distinctions here between the kinds of websites students were visiting, thus we cannot say whether these were for academic or non-academic purposes (this will be a focus of future analysis). However, interestingly, the second most frequent occurrence was Microsoft OneNote, which is highly likely to be associated with academic use. OneNote is an ideal collaborative application for taking notes, and organising information.

Other frequently occurring applications included the traditional applications of email and media players, which suggest an intermingling of leisure (i.e. networking and entertainment) with study activities.

Computer use over time

The RescueTime data also gave us an overview of how the students' computer usage changed over the course of the semester. The students exhibited different usage patterns: some appeared random, while others showed trends over time. For example, Figure 1 shows a third year student's daily usage, steadily increasing over the semester.

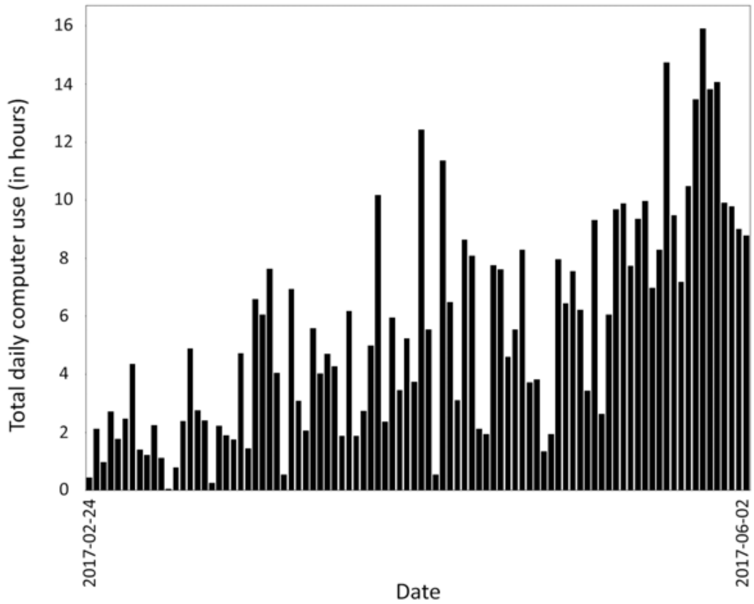

Figure 1. Daily computer usage (in hours) over a semester for one undergraduate student (note the start of semester is February, and end is June).

Possibly not surprisingly, many students showed their heaviest usage in the last couple weeks of the semester, likely when their final assignments and exams were due.

Multi-tasking and task-switching behaviours

As described before, students are constantly engaged in computer activity throughout the day, so it is not surprising to see frequent multi-tasking by students. Junco and Cotten (2012, p505-506) describe multi-tasking as "divided attention and non-sequential task-switching". Figure 2 shows an example of task-switching behaviour observed from one student: the darker the band, the greater the number of *different* activities taking place in that hourly slot. As with the daily computer usage, more task-switching was generally observed towards the end of the semester.

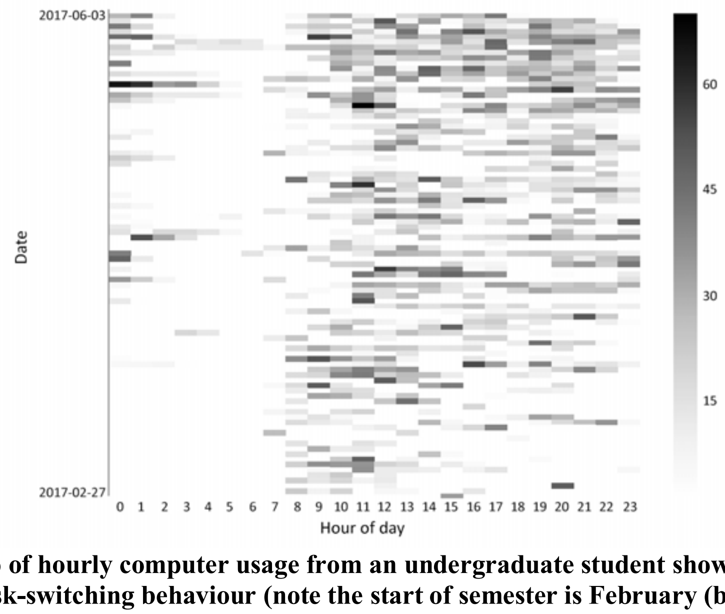

Figure 2. Heatmap of hourly computer usage from an undergraduate student showing a high degree of multi-tasking or task-switching behaviour (note the start of semester is February (bottom of graph), and the end is June (top of graph)).

Anytime, anywhere technologies

The findings also revealed how much activity the students engage in throughout the day. Most students generally showed more activity between 5pm and 12pm. It was interesting to note that several students showed considerably more activity around 10pm than any other periods of the day. Figure 3 shows an example of total computer usage over the semester for one student, broken down by hour.

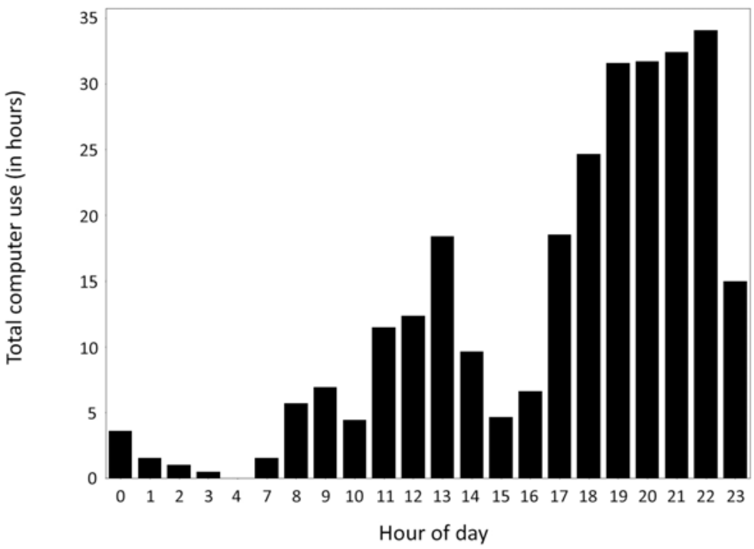

Figure 3. Example of total hourly computer usage for one semester from one participant.

While dissections of academic or non-academic activities have not been analysed at this stage, this finding shows computer devices play a significant role in students' 'awake' time.

Conclusions and future research

This research extends the notion of understanding student experience by better capturing student digital behaviour. This paper reported on undergraduate students' use of computers over the period of one semester. Overall, the extent to which this cohort of undergraduate students utilised their computers in their daily lives was extensive. Internet use was by far the most common computer activity of students. The students showed the most computer usage towards the end of the semester, and their heaviest hours of usage were in the latter part of the day. Students also exhibited frequent multi-tasking/task-switching behaviours.

These findings are in no way exhaustive, but merely offer a glimpse into the digital behaviours that can be captured through Reality Mining methods. Our future research includes categorising and quantifying academic and non-academic digital behaviours, further interrogating the usage data for patterns, and looking for evidence of producing and consuming behaviours in relation to learning (Sim, 2016). Finally, we want to raise awareness of these methods in the higher education community. In particular, we believe students can benefit from using self-monitoring software such as RescueTime to learn more about their own behaviours and make changes where necessary. Ultimately, the tensions concerning the place of technology in 21st century education may be resolved by the students themselves.

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Designing online orientations for higher education music students: A proposed framework

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Online orientations can provide university students with helpful introductions to relevant knowledge and skills they will need over the course of their studies. While traditional models of university orientation focus on face-to-face lecture delivery and often depend on individual, time-specified events, the online environment can be used for more interactive and discipline-specific orientation. The adoption of an online orientation approach can further provide students with information accessible in manageable time frames and supportive practical applications. Aligned to research literature, this paper proposes a framework for developing an online orientation program for higher education undergraduate and graduate music students. The framework brings together the design benefits of the online environment in conjunction with literature on effective practices of orientation programs. As such, the framework identifies four components of influence when designing an online orientation: Purpose; Audience; Design construction; and Content topic considerations. Areas for future research are also highlighted.

Keywords: university, orientation, music, online delivery, instructional design, undergraduate, graduate

Introduction

A traditional lecture-style university student orientation often requests students from a particular faculty to attend a day-long series of workshops. These workshops can be overwhelming for students as they receive information about course requirements, university services, upcoming events and conferences, technology information and faculty introductions. Due to a variety of reasons, such traditional orientations may not be effective for students (Hansen, Clark, McCleish & Hogan, 2009). An online orientation, for use by face-to-face or online students, can provide students with needed orientation information in an effective learning model with flexibility of information access. Furthermore, an online orientation can be used to provide support for students to develop basic digital learning and soft skills (e.g., time management) in a low-stakes learning environment. Online orientation models have evidenced increased student retention as well as grade improvement (Jones, 2013). Given these positive outcomes for students completing an online orientation, this paper explores research literature to identify components involved in developing an online orientation with specific alignment to the discipline of music. This could then provide direction for future research on the development of generic and discipline specific higher education orientation programs.

The overall goal of an online orientation for first year undergraduate and graduate music students is to support students with a suite of resources that introduce a range of general and discipline-focussed support services. The orientation should be complimentary to their program, and supportive to their long-term achievement of professional (i.e. future employability) success. It is understood that more in-depth subject-specific library and academic skill workshops and online modules would be offered by the faculty, or department. In general, the creation and content of the orientation would involve input from multiple groups including academics, librarians and students. Together, the input from these groups are the foundation for the development of a student-centred orientation that addresses the proposed framework: 1) Orientation purpose and objectives; 2) Audience; 3) Design construction; and 4) Content topic considerations.

Literature overview

The brevity and restrictions of this paper do not allow the inclusion of all the publications discovered with a full literature survey to inform the development of this proposed framework. A selection of relevant research was selected from this survey to support the proposed framework. The strategies undertaken utilized the key academic online databases including Academic Search Complete, Education Research Complete, RILM

Abstracts of Music Literature, Music Index, and Google Scholar. Keywords and subjects included broad terms: “first year students”, orientation, online pedagogy, university, “higher education” and then more specific to music, although there is little written specifically. Inclusion of elements of online information literacy for music were included as there is more literature in this area and is a key conceptual element of the framework.

Orientation purpose and objectives

There are a variety of forms of orientations that can be created. Knowing the purpose and plan for the specific goal of an orientation becomes key to both success and long-term uptake. Online orientations can support the building of community support networks, digital literacy skills, online learning expectations and self-regulation skills (Author, Date). For the purposes of this context, the orientation will be viewed as a skills development support mechanism for students. Within this orientation model, students will equip themselves for learning music as performers, educators and researchers within the context of an online environment.

Within music conservatories, students gain community networks and self-regulation skills specific to the development of their musical art form. That is, music students perform with other students wherein they develop their community networks. Further, the level at which achievement of music performance requires a considerable amount of self-regulation. Given these unique attributes, an online music student orientation should provide students with opportunities to develop digital literacy skills for generalist and music-based contexts, and articulate online learning expectations.

To design a meaningful online orientation, specific objectives should be identified prior to the development of the actual module and are often associated with the choice of content topics (see below). Each objective should have both a time frame for completion and have relevant ways for demonstrating attainment of that objective. For example, one objective could be: Within a seven-day orientation period, students will be able to actively demonstrate online communication etiquette. Further, overarching objectives should help guide students to: learn to help themselves; develop community support networks; and establish a starting place for student successful learning.

When creating an online orientation for music students, one challenge paramount to the success of student completion is discovering the appropriate and opportune week for student participation. In a study by Taylor, Dunn and Winn (2015), retention rates and grade improvement were a result of an online orientation embedded within "gateway courses" (p. 3). Questions to be considered can include: Should it take place during Orientation Week when students are already enrolled and on campus?; Should it be a hurdle requirement with a particular date of completion?; Should enrolments and platform access be made available so that students who are keen to commence their course, can complete the orientation before arriving to campus? While there are many other questions to be considered regarding timeliness of offering, responses to these three questions will help determine a delivery method specific to the faculty and institutional culture.

Overall, online orientation modules provide an active learning opportunity while encouraging adoption of a positive, proactive learning posture. Such opportunities support students to build confidence. Further, low stakes learning opportunities within online orientations allow students to undertake activities and assessments that can assist their transition into university study (Kift, 2009).

Audience

There is a need for online orientations to be specific for their intended student audiences (Vaill, 2013). Building on this notion, we suggest that the key to ensuring relevance of the proposed program for new music students is consideration of its cohort diversity. For example, the university music student can be categorised in a number of ways. Some backgrounds are similar to academic counterparts in other faculties. However, the backgrounds held by the various instrument/voice performance practices of music students encompasses a full spectrum of knowledge. The nature of music performance practice itself indicates a range of experience with some students commencing university having learnt their musical practice from an early age, while others arrive having only been learning their particular music practice for a few years. These are important considerations for the design and choice of activities used within the orientation itself.

Considering the diversity of student backgrounds, the following factors should be explored when developing an online music orientation:

- Domestic/International students (e.g., training backgrounds, language skills and familiarity with university systems)
- Education backgrounds (e.g., differences in rural versus urban education settings; private versus state school opportunities, etc.)
- Musical pathways (e.g., students' choice of jazz and improvisation, classical music, music theatre, etc.)
- Age of students (e.g., young prodigies, teenagers straight from school, mature age students, etc.)
- Musical knowledge at university entrance (e.g., Depth and knowledge of music history and music theory can be diverse. Consider an option in the orientation program based on skill level.)

Design construction

The design construction of the online orientation can take many routes. The use of collaboration across a faculty network has been found helpful in the development of online orientations (Welch, Cook & West, 2016). Prospective collaborators may include: academic co-ordinators, lecturers, tutors, administrators, librarians, educational technologists, and academic skills staff. These foundation experts should address the ways in which assessment, discipline alignment, technology use, and interaction will be shaped.

Design construction for online orientations has used instruction design models such as the ADDIE model (Analysis, Design, Development, Implement, & Evaluation) used by Jones (2013) or Universal Design for Learning (UDL) as used by Author (Date). Further, Cho (2012) suggests that construction should follows "systematic design and development process in four phases: analysis, design, development, and evaluation" (p. 1053). Each of these phases allows for unique faculty and student attributes to surface and be addressed within the orientation product.

It is also important to note student voice is an integral part for developing a successful online orientation (Cho, 2012). That is, formative feedback and ongoing evaluation from students is a key component of the module development and ongoing delivery (Booth, 2005). This evidenced-based approach further suggests the importance of the student voice providing assistance in building inclusivity and community (Ung & Rossiter, 2018).

Content topics

Content topics in an online orientation should be addressed and aligned in an appropriate manner for the form of learning that students will be using (e.g., blended or online learning), as well as address needed technical skills. Furthermore, content topics are planned to include content and guidance from the areas outlined above and following. Continuous evaluation will be applied, and topics adjusted accordingly to student feedback. In the development of online student orientations, Cho (2012) identified four specific topics of content found within online orientations:

> Online students develop understanding about the nature of online learning; Online students use Blackboard skilfully for their own learning; Online students solve technical issues they may encounter while using Blackboard; and Online students develop self-awareness about learning skills required for online learning (p. 1055).

Building on Cho's research, and further supporting the need to address audience specificity within its design construction, an online orientation by Author (Date) was described by Werklund School of Education (2018) as aligning to four areas: "Familiarize students with online learning tools used in the program; Introduce students to best practices for online learning; Orient students to online learning; Provide students with various supports and resources to assist with learning online within a [faculty] context" (para. 4).

As we look to the specific discipline of music, an integral content topic would be how students locate music resources. This topic is discipline specific and would generally be different than other academic disciplines. "Music students work in a unique landscape of information" (Myers & Ishimura, 2016). They need to understand and source a wider range of resources for their textual and performance-based studies, than the average humanities student. Skills in sourcing books, journals, music scores (relevant scholarly, authentic editions) sound recordings and videos (music performances) – online and paper-based - are required to support their studies. It is a complex and incredibly rich information environment that the students are entering (Scott, 2016).

An introduction to scholarly, music-specific literacy skills and resources is essential for students in these early days. As identified earlier, students come from diverse backgrounds of music knowledge which suggests content should be carefully developed to bring students up to a standard that will allow them to feel comfortable sourcing materials for their first-year history, music language and performance studies. An important element of this content is that it needs to be available when the student is undertaking assessment tasks later in semester. Library staff utilise relevant frameworks e.g., *University of Melbourne Library Digital and Scholarly Literacy Framework* (2017) with its capabilities around scholarly literacy requirements: searching, evaluation, organisation, creation, and connection. These capabilities support the construction and development of online activities to assist the students in the information management.

Awareness of available academic support resources is essential to the development of a student's portfolio of support tools, which can establish confidence throughout their course that support is at hand when needed. This could include promotion of services for the Library (collections, online subject guides, chat/email/face to face support); Academic Skills (support via online resources and face to face tutorials); counselling services; student advisers (to assist with course advice); careers counselling and other relevant support programs.

Other examples of potential content topics may include the following:

- Online communication etiquette (e.g., exploring university citizenry, how to ask good questions, regular checking of email, appropriate use of texting and social media, etc.)
- Online Learning - what is it and how is it different from face-to-face learning? (e.g., developing student network; proactive student wellness; building community support network, etc.)
- Learning with Technology (e.g., identification of responsible digital citizenship, highlighting tools to be used specific programs, etc.)
- Assessments and Feedback (e.g., Exploration of typical forms of assessment and feedback, etc.)

Components of an online orientation

From the above discussion, the following components form key factors when establishing a student-centred framework on which to base the construction of online orientations and their modules:

- Purpose: Establish clear statement of purpose and aligned objectives required for each module
- Audience: Consider the proposed audience to undertake the module and adjust construction and content accordingly
- Construction: Using the aforementioned factors, consider the appropriate construction approach to ensure relevancy and alignment to relevant learning styles; engaging design and delivery is approached through interactivity, incentives, and support across the modules.
- Content: Align the above factors to position and create content that is relevant, up-to-date, and reflective of the purpose and objectives. Ensuring that the collaborative process of creating the content by the expert staff involved is edited and distilled to ensure key content is focussed.

Together, these components form a framework for developing an online orientation (Figure 1).

Figure 1: Components of an Online Orientation

Future research

There are a number of relevant areas to be considered for future research on developing higher education online orientations. Overall, researchers should take up studies to address the design of the orientations themselves, and the learning outputs that may result. Within these two areas, there are various stakeholder perspectives that should be considered to provide both and breadth and depth to the research.

More specifically, future research could explore the idea of mandatory orientations. For example, research on orientations may include investigation of music students being "time poor" as a result of long hours for performance, rehearsal, and practice commitments. Further demands may include building friendships and socialising, studying, practicing, working, and travelling as prioritized by each individual student. Therefore, developing orientations as a hurdle requirement may provide a more successful outcome. However, such assessment governance would require further administration and possible time delays. Research questions could examine: To what extent should online orientations be mandatory?; If an online orientation is not mandatory, will students undertake the program?

Other research questions may pertain to activities and application of the orientations themselves. Such inquiry may ask questions such as: What are appropriate activities that align with short, low-stakes orientation programs?; To what extent should other components be considered in a framework for developing an online orientation?; and To what extent does an orientation impact future student learning outcomes and attrition? Together, these questions demonstrate the large gap of research yet to be investigated in the field of online orientations.

Conclusion

The use of online orientations and their specificity to a program discipline can be an important initial learning tool for new and incoming students. Specifically, music students new to the online and blended subject formats may find that they are able to identify important community connections and organization approaches for their future studies from a well-designed online orientation. Content would be developed collaboratively with student-driven experience data from current students as well as identified supports from academic, administration, library information literacy skills and academic skills staff. The topic considerations for the online modules are often general, yet provide student with appropriate expectations for their upcoming learning scenarios. While future research is needed to explore the use of online orientations across larger institutional groups, it can be posited that the use of an online orientation can help support student adoption of digital learning skills specific to the student's discipline.

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Dipping our toes into the Open Seas: Introducing a renewable assignment to improve authenticity and student learning

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Adopting Open Education Practice is one example of innovation in online and blended learning. This paper describes how combining a desire to improve student experience and learning, with educational technology use and Open Education Practice led to development of a renewable assignment for a fully online course. The collaborative process is explained, outlining the impetus for the change, the context of the course and the steps taken to design and develop a new assignment utilising Open Education Resources. The assignment, a video presentation, is one component of a major course redevelopment that has been occurring iteratively over a number of sessions. The impetus for the course redesign was a need to improve student retention, results and experience and the process was supported by a DOER Fellowship. Both the Educational Designer and academic involved in the development gained new skills and knowledge of Open Education Practice and early anecdotal evidence is that students appreciated the new assessment and believe this had deepened their learning in the course. Lessons learned include the importance of collaboration across a diverse team and that there are likely to be some minor issues that need to be rectified following initial offerings.

Keywords: authentic assessment, digital literacy, Open Education Practice, renewable assignment

Impetus for the change

This paper outlines the motivations and processes involved in a collaborative project which combined a desire to improve student experience and learning, with educational technology use and Open Education Practice, to develop a renewable assignment for a Science Fundamentals course which is offered in a fully online modality. The course described in this development is a first year Science Fundamentals course designed for students aiming to become science teachers, primary school teachers of science, or science communicators, which is offered in a fully online mode. Through the course, students need to demonstrate a working knowledge of core scientific principles and how to apply these to real world situations, as well as how to communicate these to an audience of a particular age group. Prior to this project the course had low levels of retention, student engagement and satisfaction and poor results and hence was identified as needing to undergo a major course redesign. The original assignment did not explicitly address the course objectives and was only marginally related to the content and as such there was little evidence of constructive alignment in the course (Biggs, 1996). In addition, the textbook being used for the course was expensive (approximately $150) and only partially relevant to the course. Thus started an ongoing collaboration between the Course Examiner and Educational Designer to iteratively improve the course over a period of several semesters. This paper concentrates on one specific improvement; changing the initial assessment from a traditional scientific report format, using data provided by the examiner, to an authentic, education focused video presentation.

A further impetus was an invitation to apply for a Designing with Open Education Resources (DOER) Fellowship that offered support and recognition for developing three related assessment tasks, utilising Open Educational Resources (OER). OER are defined as “educational materials which are licensed in ways that provide permissions for individuals and institutions to reuse, adapt and modify the materials for their own use. OERs can, and do include full courses, textbooks, streaming videos, exams, software, and any other materials or techniques supporting learning” (OER Foundation, 2011). Along the way other professional support staff have been included in the project providing advice and support as needed on areas including ICT issues, the affordances of the LMS (in this case Moodle), innovative implementation of educational technologies and effective adoption of Open Education Practice.

Authentic and renewable assignments

Whilst authentic learning and authentic assessment have been researched in higher education for quite some time now (eg Herrington & Herrington, 2006), fostering authentic learning still features as one of the six meta-categories of themes driving learning and teaching and creative inquiry in the 2017 New Horizon Report (Adams Becker, Cummins, Davis, Freeman, Glesinger Hall & Ananthanarayanan, 2017.) The idea of renewable assessment is a more recent notion, defined by Wiley (2016) as assignments in which "student's work won't be discarded at the end of the process, but will instead add value to the world in some way". Combining these two ideas was the framework for the design of this assessment and involvement in the Fellowship project.
The assignment presented to students in this course was a revision of the one included in our deliverables for the Fellowship. This is an example of embracing the Revise element of the 5Rs of OEP (Retain, Reuse, Revise, Remix and Redistribute) (Wiley, 2014). Making the completed assignments openly and freely available exemplifies the redistribute element.

DOER Fellowship

The DOER Fellows Program is funded by The William and Flora Hewlett Foundation and administered by the Open Education Group with the express goal of increasing instructional designers' capacities to design effective and engaging learning experiences with OER. Educational, Learning and Instructional Designers were invited to partner with subject matter experts to apply for small grants, supporting the creation of renewable assignments based on the principles of OER-Enabled Pedagogy and designed to be used with specific open educational resources. OER-Enabled Pedagogy is the set of teaching and learning practices only practical in the context of the 5R permissions characteristic of open educational resources. (Open Education Group, n.d,). The authors were fortunate to be awarded one of 26 fellowships for 2017-2018 and were the only recipients outside North America. All details of the Fellowship (http://openedgroup.org/doer-fellowship) as well as our completed submission, and those of 14 other Fellows (http://openedgroup.org/doer-fellows-renewable-assignments) are openly available at the Open Education Group website.

This paper focusses on the first assignment created as an output for the Fellowship as this has been implemented in the course. The second and third assignments are being considered for implementation in future offerings. The second assignment requires students to create multiple choice questions based on application of scientific concepts studied in the course and rate questions created by their peers. The third assignment asks students to design and complete an experiment or activity based on one of the concepts discussed in The Physical Sciences and Space Sciences Modules, and complete a written report on the experiment/activity and guidelines for others in conducting a similar experiment. The experiment/activity must be simple and safe and utilise readily available resources and equipment.

The new assignment

The assignment was introduced in Semester 1, 2018 and was an adaptation of the original assessment submitted for the Fellowship. It required students to create a 5-10 minute audio/visual recording of a PowerPoint presentation that included slides, audio and video (of the student) on "What happens to the rest of the Food Web when one of the Primary Consumers becomes extinct from an Ecosystem?". By addressing a specific scientific question, the assignment was designed to develop students' skills in scientific research, and required them to display an ability to apply a scientific concept to a real-world example and skills in scientific communication of that knowledge to a selected audience using both audio and visual means. This assignment was considered authentic and relevant for this particular cohort as they are aiming to become science teachers or science communicators who will need to be able to explain scientific concepts to their students or audiences. The assignment thus meets the characteristics of an authentic assignment. Whilst this specific assignment is relevant only to similar courses, being able to apply a theoretical concept to a real-world situation and present this to a specified audience are skills that are important across a range of disciplines.

OpenStax (https://openstax.org/), was chosen as the OER for the Fellowship outputs and OpenStax Biology in particular for this assignment for a number of reasons including:

- Site has already developed a strong reputation as a reliable and authoritative source
- Materials are relevant for the course
- Materials are aimed at an appropriate level

To encourage students to engage deeply with the assessment task, and in keeping with the requirements of the Fellowship, they were advised that after assessment, all presentations with a grade of Distinction (A) or higher would, with the student's permission and full attribution, be uploaded to a USQ Open Education Practice website and linked to the Open Educational Resources (OER) Commons where they can be accessed under Creative Commons licence. This collection will in future provide a 'package' of resources that will grow over repeated semesters of offering and will have uses beyond the immediate course:

- Students can use these videos as the basis of teaching plans whilst in the workplace, or whilst undertaking practicum teaching placements;
- Students will have access to videos of their own and other cohorts; as such they can access a range of videos which will have different focus and perspectives, which they can use for planning and teaching;
- Students in future cohorts can access the videos as examples of completed assignment. This will contribute to more transparent assessment practices, and potentially reduce student anxiety and confusion (especially relevant given that this cohort is first year, and transitioning into university culture);
- Students in future cohorts (or other courses) may be given assignments that provide opportunities for remixing, reusing, and re-purposing the work of other students (with appropriate reference to the original material of course!); and
- Teachers around the world will be able to access and use these resources.

Benefits of implementing Open Education Practices

McGill, Falconer, Dempster, Littlejohn and Beetham (2013, p5) noted 5 broad areas of motivations, or perceived benefits, of adopting OEP:

- "building reputation of individuals or institutions or communities
- improving efficiency
- cost and quality of production
- opening access to knowledge
- enhancing pedagogy and the students' learning experience
- building technological momentum"

This project has seen benefits across several of these areas:

- participation in the Fellowship program has enhanced the reputation of both individuals as well as the institution, especially as we were the only recipients outside North America
- utilising OpenStax as the main resource has provided access to additional knowledge for the students and openly sharing our resources as well as high quality student outputs has added to the knowledge base for other academics and teachers
- inclusion of the new assignment has improved the pedagogy of the course and students learning experiences. Early indications from student feedback is that they found the assignment relevant and contributed to their learning in the course. This assignment also serves to improve digital literacy skills which have been identified as essential for success in the workplace (Adams Becker et al., 2017; van Laar, Van Deursen, Van Dijk, & De Haan, 2017). Skills that need to be demonstrated in this assignment include having to work with a software package (Powerpoint); write a script and then record utilising Zoom video conferencing, (or similar video recording software), uploading and sharing the video and moving forward compressing the video.

In addition, both the Educational Designer and academic involved in the development gained new skills and knowledge of Open Education Practice. The support and knowledge sharing from the fellowship providers through webinars and discussion forums was invaluable in developing some of the finer points of the assignment

Hitting a few waves along the way: Lessons learned

A multidisciplinary team approach proved to be beneficial for us. No one person can develop all the necessary skills and knowledge. With the academic having the content knowledge, the Educational Designer having ideas for assessment design we drew on the expertise of:

- Manager, Open Education Practice: for advice on the intricacies of ensuring all resources meet Creative Commons licencing requirements and resources as well as student assignments are stored in an appropriate location
- ICT support staff: for advice on compressing and uploading videos and support in creating guidelines for students
- Liaison librarians: for support in sourcing Creative Commons images and appropriate OER.
- Manager, Educational Futures: for advice and support in selecting appropriate educational technologies

Feedback on the assignments from the fellowship providers was both constructive and positive, gently pointing out that some of the images we had used in the exemplar assignment were copyright and hence the video could not be considered an OER. As students had already completed the assignment when we received this feedback some of their videos could also not be granted a Creative Commons licence (National Copyright Unit, n.d.). Students who met the qualification of receiving a high grade were instead offered the opportunity of having their assignment shared on the StudyDesk (LMS) site for future offerings. Students were also advised that they could upload their assignments directly to the LMS, which caused problems, particularly for those in areas with low bandwidth and when most students were trying to upload at the same time. The solution for this in future is to provide students with guidelines on how to compress their video files and to upload to their U Drive (university) account then provide a link. These issues highlight the need to provide clear, explicit and accurate guidelines to students for creating and uploading videos.

Most students embraced the assignment and received generally high results, with 29 of 31 students who submitted an assignment receiving a grade which met the requirement for publication. This suggests that the advantages of an authentic and renewable assignment were an incentive for students. Comments provided in the Course Evaluation survey also suggest that the assignment contributed to student learning and increased satisfaction levels. The academic discovered some minor issues with the rubric during marking of the initial iteration of the assignment, and these are being rectified for the next offering. A flow-on effect was also noted in that students' performance in exam questions related to this assignment showed deeper levels of knowledge than in previous years.

The future – diving in deeper

The authors wish to acknowledge the support of the Open Education Group through provision of the DOER Fellowship which allowed this project to proceed. As we move forward and dive deeper into the world of OEP we will submit an ethics application to allow us to research the impact of this approach and the renewable assignment on student outcomes and learning experiences. A range of data will be used for this ongoing research including student feedback and course evaluations, student results in this assignment and the course, and usage reports from the LMS. Further renewable assignments, as developed as part of the Fellowship will be incorporated into the course and the academic is considering how to incorporate OEP into other courses, particularly the use of OpenStax as the text for those courses. It is hoped that showcasing the course and the renewable assignment as well as sharing our experience both within our institution and more widely will encourage others to follow this pathway to OEP and help others avoid some of the waves as they head for the smooth OPEN waters.

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Towards the use of cognitive load theory as a diagnostic tool in online learning

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This paper examines cognitive load theory in online learning. The central idea of the paper is that by identifying instances of cognitive load in online courses, educators can make practical adjustments in the design and teaching of courses in order to minimise the cognitive load experienced by learners and thereby increase the likelihood of successful cognitive processing. The presentation brings together current thinking in cognitive load theory and descriptions of key aspects of contemporary online learning to identify and describe of potential instances of cognitive load experienced by online learners.

Keywords: cognitive load theory, cognitive load, online learning, online teaching, learning design

Cognitive load theory (CLT) seeks to understand the cognitive effort required to complete a learning task relative to the capacity of the short-term memory (Sweller, 1988, 1994). It provides a framework for understanding practical implications for both learning design and teaching. CLT has supported the advancement of educational theory and practice by aiding in the explanation of a large set of experimental findings (see de Jong, 2010). The premise that underpins the application of CLT foreshadows a role for CLT as a diagnostic tool: By recognising and addressing instances of cognitive load in learning situations educators can potentially pre-empt cognitive overloads and thereby support learning.

This paper considers CLT in online learning and seeks to provide guidance in the identification and description of instances of cognitive load in online learning so that they can be addressed through design and teaching practices which specifically aim to reduce cognitive load. This paper is part of a wider body of work which is addressing two broad questions:

- How does cognitive load manifest in online learning?
- How can cognitive load be addressed through online educational practices?

Background: Cognitive Load Theory

CLT proposes that the short-term memory has a limited capacity and exceeding this capacity may hinder learning (Chandler & Sweller, 1991; Sweller, 1988, 1994). The theory attempts to resolve this issue by promoting educational practices that reduce the demands placed on the working memory and also by maximising the available resources of the working memory when processing information (Sweller, Van Merriënboer, & Paas, 1998).

CLT identifies three types of cognitive load: intrinsic, extraneous and germane loads (De Jong, 2010). Intrinsic cognitive load is the essential load associated with successfully performing a learning activity. While it has historically been considered *fixed* and not subject to influence, intrinsic load is increasingly viewed as potentially dynamic. When intrinsic load is viewed as a feature of the relationship between a subjective learner and a learning task, it can be influenced by manipulating the relationships between the learner, task and subject matter (Paas, Renkl, & Sweller, 2003). Germane cognitive load is associated with processing information, the development of schemas and the automation of information processing. Cognitive activities such as interpreting, differentiating and organising information are considered germane load (Richard E. Mayer, 2002). This load can be affected by the design of learning tasks. This type of cognitive load can be seen as both a necessary to the acquisition of knowledge (Ayers, 2006) and also a hindrance to learning when the addition of germane load exceeds the capacity of learners' working memory. Extraneous cognitive load is the load that is not associated with achieving the intended learning outcomes (De Jong, 2010). Extraneous load is generated as a consequence of the presentation of the learning material as the learner attempts to make sense of information presented to them. This form of cognitive load can be altered by changing the design and presentation of the learning tasks.

Two strategies are commonly used to address cognitive load. The first is to *reduce cognitive load*. Careful attention to instances of cognitive load and alteration to the design and presentation of instructional materials can reduce the levels of cognitive load (see, for example, Chandler & Sweller, 1991; De Jong, 2010; R E Mayer & Moreno, 2003; Paas et al., 2003). The second is to *increase the cognitive capacity* of the learner. CLT views cognition operating on parallel *controlled* and *automatic* pathways (Paas & Van Merriënboer, 1990; Sweller and Chandler (1994). The controlled pathway is conscious, slow and requires more effort. The automatic pathway is non-conscious, faster, and relatively effortless (Feldon, 2007). The effect of a particular automatized activity on cognitive load is present, but limited, reducing the load on working memory bypassing working memory (Mousavi, Renkl, & Sweller, 2004, p.319). The development of automaticity is a mechanism to increase learners' cognitive capacity by shifting cognitive processing from demanding controlled pathways to less demanding automatic pathways.

Focus

The ongoing work from which this paper is drawn is concerned with identifying cognitive load in online learning situations so that it can be addressed through design, delivery and facilitation practices. Of interest in this paper in the diagnostic role of CLT, which is applied here to identify aspects of online learning that have the potential to introduce additional cognitive load based on the nature of online environments and technology-mediated activity. Identifying key features of online learning which distinguish it from other learning situations, particularly placed-based contexts which may have been the subject of previous CLT research, has the potential to help online educators identify and address sources of cognitive load and thereby support and facilitate learning.

Identifying Cognitive Load in Online Learning

In terms of improving learning outcomes for networked learners, the focus of CLT is twofold: First, there is a responsibility for designers and teachers to identify and then address instances of cognitive load. By rationalizing the cognitive load that learners experience, educators have an opportunity to better structure and support learning processes. Second, there is an opportunity to support learners' cognition by supporting the development of automaticity in cognitive processes and thereby reducing the load learners' experience when confronted with complex tasks.

Steeples, Jones, and Goodyear (2002) describe an architecture for online (networked) learning environments in which the following are also situated: a) the learning environment, which is where learning activity takes place; b) learning tasks, which provide a specification for learner activity; and c) learner activity, which is the actual activity undertaken by learners as part of learning processes. These features of the online environments provide a framework to describe the sources of cognitive load that networked learners encounter.

Cognitive Load in Networked Learning Environments

Online learning environments present learners with a several potentially challenging features, including the use of mediating technologies; the demands of working in highly connected, media rich environments; a potentially unfamiliar social environment; and the demands of computer-mediated communication.

First, mediating technologies add multiple demands on learners' cognitive processing. For novice online learners, the use of multiple technology interfaces in computer operating systems, learning management systems, computer-mediated communications tools, social media platforms and content-specific computing applications create significant demands on learners' ability to make sense of and use a variety tools that comprise the learning environment. As highlighted by Morrison and Anglin (2005), the load of learning about technology concurrent with learning about subject matter should not be underestimated. Learners can be overwhelmed by loads introduced by the demands of navigating hypertext environments with complex non-linear relationships between information (Kalyuga & Liu, 2015; Zumbach & Mohraz, 2008) and the possibility of technical failure with one or more of the required technologies.

Second, online learners experience cognitive load managing large amounts of rich, multi-modal information in hypertext environments. The additional load is a result of complexity. When there is a potentially excessive number of elements or there are complex interrelationships between the elements (high element interactivity), working memory may be overloaded, impairing the acquisition and automation of schemas (Paas et al., 2003). For online learners engaged in high element interactivity, information processing is more difficult and requires more working memory resources. As Sweller (2010) suggests, "The more elements that interact, the heavier the working memory load" (p. 124). Therefore, there is the potential for online learners to experience overload when dealing with both the quantity and quality of information available; making choices about which information to use; and the management of that information for ongoing use.

Third, in addition to the more technical requirements of online learning, there are important social and cultural implications of mediating technologies. Technologies introduce social and psychological distance between participants in interactive exchanges (Riva, 2002). This distance creates a need for learners to reconsider the degrees of structure in their interactions; the type, amount and focus of their interactions; and the levels of autonomy they are required to exercise in managing their learning activity (Dron, 2007; Moore, 1972, 1973). Online learning environments are social spaces and online communication and social activity are learned skills. The presentation of self, the cultivation of online social presence, the acts of identifying, interpreting and responding to others' virtual presence and they operation of social-relational mechanisms which support the development of technology-mediated interpersonal relations all present new learning for novice online learners (Caples, 2006; Kehrwald, 2008; Murphy, 2004; Swan & Shih, 2005; Tu, 2002). Orienting to this new social space and overcoming the social and psychological distance introduced by technology adds cognitive load.

Fourth, computer mediated communication, which may be the only communication channel available to online learners, poses a risk of cognitive overload. Online communication requires familiarity with computer-mediated communications tools, often across different media. It requires a different set of communication skills, understanding of difference communication protocols, and interpretative skills. Researchers in online learning have documented the demands of technology-mediated communication including the need to learn to read and interpret online social cues (Kehrwald, 2008; Kreijns, Kirschner, Jochems, & Van Buuren, 2004; Murphy, 2004); the establishment of communication protocols (Palloff & Pratt, 1999, 2001; Preece, 2001); the development of social-relational mechanisms in online interpersonal interaction (Kehrwald, 2010; Murphy, 2004); and the pressure of goal-oriented online collaboration. As Kehrwald (2008) points out, online communication is a learned activity and thus it represents an additional load.

Notably, these sources of cognitive load are additional to the cognitive load associated with learning subject matter (Morrison & Anglin, 2005). The important implication of this point is that educational designers have a responsibility to mitigate the potentially massive additional load introduced by online learning environments.

Cognitive Load in Learning Tasks

Learning Tasks represent a critical opportunity to influence learner activity. Thus, they are a key mechanism to address cognitive load with attention to the presentation of information, the creation of supportive structure, anticipation of learners' needs and facilitation of productive learning activity.

The literature of CLT is rife with examples of extraneous load that emanates from presentation of information (Brunken, Plass, & Leutner, 2003; R E Mayer & Moreno, 2003; Moreno & Valdez, 2005). The presentation of information without attention to cognitive load theory frequently results in high levels of extraneous cognitive load (Chandler & Sweller, 1991). Given the variety of media and modes of presentation that are employed in online learning, the presentation of information is a potentially common source of extraneous cognitive load. Specific research has been undertaken investigating the relationship between cognitive load and multi-media. Of interest for online learning is the effect upon learning when multiple sources of data were concurrently being treated by the working memory. The use of text, video, audio, still imagery and interactive multimedia derived from a variety of sources and used in combination as part of comprehensive packages of learning materials presents a significant risk in terms of the introduction of cognitive load (Brunken et al., 2003; R E Mayer & Moreno, 2003; Moreno & Valdez, 2005).

An important aspect of schema acquisition in multi-media learning is the splitting of a learner's attention across mutually dependent information sources. Schema formation and learning can be negatively affected when even one more sources of data are used concurrently (Chandler & Sweller, 1991; Kalyuga, Chandler, & Sweller, 1999). Notably this occurs when the sources of information do not synchronize or support each other, and the learner is therefore required to search for semblances of connectivity between the data sources. Where text and diagrams are used, the *split attention effect* can be overcome by strategically placing the text at an appropriate position, in relation to the diagram, synchronizing both the text and diagram in a single integrated source of data, maximizing the reinforcing effect of the text+visual combination and supporting meaning making.

A further effect upon schema acquisition occurs when texts and diagrams are accompanied by an auditory source. This is the *modality effect*. Researchers such as Richard E. Mayer, Moreno, and Pressley (1998) found that the "multi-media learners can integrate words and picture more easily when the words are presented auditorily rather than visually" (p. 312). The modality effect affirms that when information is instructionally designed to minimize cognitive load and is presented from two differing sources, such as an auditory and visual source, schema formation and learning can be enhanced.

As with the use of mediating technologies, the presentation of learning tasks provides an opportunity for the introduction of, or, the mitigation of, additional cognitive load. As described by Steeples et al. (2002) learning tasks specify and elicit learner activity. Each task "needs to be sufficiently well-specified that the changes of the learner engaging in unproductive activity are kept within tolerable limits" (Steeples et al., 2002, p. 332). The focus on limiting unproductive activity highlights the potential for learning tasks to introduce additional cognitive load. When considered in combination with the presentation of information, the use of mediating technologies and the skills required for productive online communication, the presentation of learning tasks represents an opportunity to address a number of potential sources of cognitive load.

Central to the design of learning tasks is consideration of a learner's prior knowledge. Vygotsky (1978) suggests learners' schema acquisition benefits from tasks a) that provide them engagement sympathetic to their previous experiences and b) within their zone of proximal development. It is critical to understand the network of relations between a) the subjective learner, who has a unique perspective, based on experience and prior knowledge, b) the learning task, which mediates subject matter, introduces structure and influences activity and c) the online learning environment which provides a social and cultural context. Ideally, these relations support learning by giving the learner access to people, resources and tools which support learning. However, the complexity of these relations and learners' abilities to make use of the relations (based on their unique combination of experience, skills and prior learning) make it very difficult to cater to each individual. Designers need a repertoire of strategies to a) appreciate the complex relations present in online learning situations; b) identify and accommodate the diversity of learners in a given online learning situation and c) address instances of cognitive load arising in the learner-task relation. The design of learning tasks should acknowledge their past experiences and activate existing schema that can be recalled automatically. Using the principles of CLT to enhance the design of technology-enhanced learning while considering the prior knowledge of the learner, invites the reduction of cognitive load that may enhance the acquisition of schema.

Cognitive Load in Learner Activity

Learner activity is central to the identification of cognitive load; all cognitive load is predicated on learner activity. The nature of online learning activity presents potentially novel demands on learners' cognitive processing abilities including learners' efforts to *learn to learn online*.

Learning to learn online is a phenomenon which may be better understood through CLT. In his study of learning to learn online, Arbaugh (2004) highlights that "while most indicators of online learning quality and effectiveness increase significantly as students take subsequent online courses, much of this increase occurs between the first and second online course" (Arbaugh, 2004, p.179). While Arbaugh did not indicate causality between student perceptions and cognitive load, cognitive load offers possible explanations. Central to the notion of learning to learn online is learners' abilities to automate common learning activities, thereby freeing up capacity in their working memory. As learners orient themselves to highly-connected, media-rich online learning environments, they develop both skills and ways of working which become automatic as they gain experience. They become adept at navigating learning management systems; they develop habits for accessing and returning to key information; they adopt protocols for online communication and they quickly adapt to rationalise their study time in ways that are personally productive. While the initial learning curve may be quite steep for novice online learners, the automation of online learning activity reduces cognitive load as learners become more familiar with and more skilled at working in online environments.

The second factor is a shift from traditional roles in teaching-learning relationships to a more learner-centric arrangement with shared control, differing levels of learner autonomy and interdependence (see, for example, Garrison, Anderson, & Archer, 2000; Palloff & Pratt, 1999, 2001). This arrangement creates the possibility of a much wider range of roles that learners play in online learning that is potentially more open, more democratic, more participatory and even more emancipatory than other highly educationalised forms types of learning (Fox, 2002). However, with different or novel learning arrangements comes an associated need for learners to identify, understand and learn to act in new roles. So, in addition to learning about technology and its use in online learning, novice online learners must also learn to be productive in technology-mediated social environments and take on potentially new roles.

Conclusion and directions for future research

We believe CLT is a useful diagnostic tool to help online educators identify, understand and address difficulties experienced by online learners. Using CLT as a lens to identify and understand online learners' experiences has the potential to help educators refine their online educational practices and, by extension, support learning.

However, understanding of CLT in online learning is far from complete. Further work is needed to both understand the operation of NL environments and the application of CLT to activity in those environments. In order to help researchers continue the important work of applying CLT to online, we offer the following suggestions for further research:

- Revisit the application of key media-related research into CLT in the context of contemporary media applications, including social media.
- Continue efforts to understand the demands of learning to learn online as an entrée to improving success rates for new online learners, and
- Further explore the practical implications of CLT and refine notions of good practice in design, development, teaching and learner support in online learning.

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'From [virtual] classroom to boardroom': Coaching students to use a research approach to address contemporary issues in their workplace

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The Australian Institute of Business (AIB) exclusively serves the needs of working adults and seeks to deliver life-changing experiences for students through a contemporary and practical curriculum delivered online. A key feature of its MBA is a final capstone subject whereby students apply the knowledge acquired during the degree to a business issue in a professional context. Adult learning has been found to be most effective when knowledge is constructed based on workplace problems. However, as industry practitioners, many students find this challenging and have historically struggled with the research-based nature of the capstone subject.

This paper reflects on how the MBA Project was re-conceptualised to help students navigate the challenging waters of a final research project. Guided by a coaching mind-set, we experimented with a range of online tools within an andragogical framework to create effective learning activities and engage students to address contemporary issues in their workplace. Not only did this revised capstone achieve the highest completion rate of all the MBA subjects offered, it had a positive influence on student engagement, learning and their overall educational experience as more than 90 percent of students 'safely reached port' and completed their MBA.

Keywords: adult learning, capstone, authentic assessment, coaching, online education, MBA

Background

The Australian Institute of Business (AIB) is the largest MBA provider in Australia. It exclusively serves the needs of working adults and seeks to deliver a life-changing experience for students in more than 90 countries. Workplace learning has been seen to be most effective for adult learners when knowledge is constructed based on workplace problems and when they can reflect on their personal learning experiences (Cunningham, 1998). There is also widespread scholarly support for the benefits of connecting academic learning with workplace learning (Cunningham, 1998; Fung, 2017; Zuber-Skerritt & Abraham, 2017). As a result, the 'university of the future' must have greater industry engagement and embrace the notion of lifelong learning (Cawood, 2018).

While this paradigm shift presents a challenge, and the sector faces increased disruption, Fung (2017) claims that all university study should give students "the chance to connect academic learning explicitly with the areas of knowledge, skills and approaches needed both for professional work and for their future lives in society [developing] capabilities and personal attributes for life and work in a changing world" (p. 84). As such, it should come as no surprise that many institutions now seek to connect curriculum to practice in order to provide a more 'authentic' educational experience. This presents a longstanding challenge, and educators often struggle to take adult learning from the 'classroom to the boardroom', yet this is precisely what AIB students demand. As a result, its MBA leverages the involvement of industry partnerships and sees students complete a business research project that applies their newly-acquired knowledge to a business issue in a professional context.

Evolution of the MBA Project

Application and integration of knowledge is an essential part of a Masters qualification and AIB graduates are required to complete a capstone subject. The fundamental characteristics of a capstone fall into six categories: i) integration and extension of prior learning, ii) authentic and contextualised experiences, iii) challenging and complex scenarios, iv) student independence and agency, v) critical inquiry and creativity and vi) active dissemination and celebration (Australian Government Office for Learning & Teaching, 2015). Thus, students are required to identify a workplace-based issue, conduct a small literature review, engage in data collection, analyse the data and then present findings in a formal business research report. However, as industry practitioners, many students struggle with such a subject. In early 2017, over 1,400 students had been enrolled in the capstone subject for over six months and so the decision was made to re-conceptualise the MBA Project to create more effective learning activities for our student cohort and better mirror authentic professional practice.

Considering these challenges, trials were conducted between May and August 2017; the first with 21 students, the second with 252. Based on positive early success, the revised capstone was officially rolled out to students in September 2017. Guided by a teaching philosophy – a coaching mind-set informed by extensive industry experience – we experimented with a range of andragogical and technological tools to develop a suite of resources: instructional and coaching videos, formative feedback mechanisms and an online discussion forum with dedicated 'coaches' to help our adult learners navigate the challenging waters and 'safely reach port'.

A Series of Instructional and Coaching Videos

AIB's student cohort displays many of the characteristics of adult learners: self-direction, internal motivation, experience, readiness to learn and goal-orientation (see Knowles, 1984; Knowles et al., 2015). However, as industry practitioners, not only are they largely unfamiliar with academic research techniques, they are time poor with full time work and family commitments. Andragogy is centred on the idea that the educator should act as a facilitator in the learning process and students are actively encouraged to participate by drawing on their own experiences (McGrath, 2009). It was therefore imperative that the re-designed MBA Project successfully <u>connected</u> academic learning with workplace learning and delivered effective learning activities and assessment to facilitate a more 'authentic' educational experience. Authentic assessment sees students complete tasks that mirror what they do beyond university and applies what they learn to solve complex problems like in professional practice (Arthur, 2017). If learning is authentic, they are likely to be more motivated as they can connect the new material that is being learned with prior knowledge (Mims, 2003). As Mueller (2016) explains, authentic assessments integrate teaching, learning <u>and</u> assessment so that students are "learning in the process of developing a solution, teachers are facilitating the process, and the students' solutions to the problem becomes an assessment of how well the students can meaningfully apply the concepts." Therefore, the MBA Project's assessment and learning materials were 'building blocks' in the preparation of their final report, i.e. how can you integrate and then apply what you've learned during the degree to a contemporary issue in your workplace?

Where previously AIB delivered a blended online model, complemented by labour intensive, synchronous one-on-one coaching, we developed a fully online asynchronous approach to allow large numbers of students from all over the world to complete the capstone within seven weeks. Technology is also able to provide a more student-centric environment that can engage and inspire students to learn and support 21st century learning (see Spector et al., 2016; Ravitz, 2002). As such, we created a series of ten videos, tailored to the task at hand, to help make complex and difficult concepts easier to understand. Tasks required to complete their final Project Report included: Introduction (involving a formative 'Project Statement' assessment, capturing the background, topic and project purpose); Literature Review; Methodology; Data Collection and Analysis; and Writing the Report (including findings, reflections, implications, recommendations and conclusion). Some of these videos were purely instructional whereby students were given new skills, while others were coaching tools and showed students how to use these skills to improve. A summary of these videos can be seen in Table 1.

Table 1: A summary of the types of videos used in MBA Project

Topic	Type	Learning	Engagement	Experience
Welcome Subject Overview Recording	Coaching		X	X
Project Plan and Weekly Progress Report	Coaching			X
Project Statement - Overview	Coaching	X	X	X
Project Statement - Example	Instructional	X	X	X
Project Statement - How to Find Secondary Data	Instructional	X		
Data Collection - Private Organisations	Instructional	X		
Literature Review - What is a Literature Review?	Coaching	X	X	X
Literature Review - Example	Instructional	X	X	X
Project Analysis	Coaching	X	X	X
Project Structure - Putting it all together	Instructional	X	X	X

Video has supported education for many years and can create a multisensory learning environment, especially in online courses. Consistent with research that describes the efficacy of videos for adult learners (Hibbert, 2014), the ten videos were directly linked to the subject's assessment. They used conventional language and humour and drew on the past career-related experiences of the presenters to convey information that students could not just read in the learning material. The videos averaged 13 minutes in length (depending on the complexity of the material taught) and production quality was relatively high with very high engagement by students. More than 75% viewed the videos in their entirety in the first trial and nearly all did so in the second trial (Table 2). This figure dropped off a little when the subject was rolled out to nearly 400 students in Term 5.

Another challenge is that teachers who wish to use authentic learning must learn to think like a coach (Mims, 2003). The notion that teachers might be seen specifically as 'coaches' "upends and rebalances the traditional student teacher relationship [and offers] a relatively new, yet incredibly promising approach" (Olson, 2014). We explored the opportunities presented by this approach and adopted a coaching mind-set throughout the series of videos and guided students on their journey through the capstone. However, authentic instruction requires a different role than traditional teaching, as students are "now in control of their learning and it is important that you not take that power away from them" (Mims, 2003). This coaching mind-set was highly successful and, when asked to evaluate its effectiveness, most respondents suggested they would like even more videos and more than three-quarters said they were at least 'helpful' in completing their Project Report. For instance, one claimed that "the new online portal with videos and a clear breakdown of the subject is fantastic" while others believed that "more videos assist in the learning process" and that "your videos have been truly inspiring!"

Supporting Teaching Materials and Coaching Forum

These instructional and coaching videos were supported with additional teaching materials (e.g. PowerPoint slides, examples of sample submissions, research methods literature, search engine tools, a project planner, etc.) and a general discussion forum was open to students two weeks before the start date so they could post questions well in advance of the 'Project Statement' submission deadline. Students were then assigned to discipline-specific forums (e.g. marketing, finance, human resource management) with a discipline expert, an Online Facilitator (OLF) or, for the purposes of our discussion, 'coach'. In small class sizes, of no more than 25 students, these OLF coaches guided students towards successful completion of the MBA's capstone subject.

Students responded very positively and more than 87 per cent of students viewed the discussion forum posts, while at least half of the students across all three terms actively posted in the forums (Table 2). Students could also message or request a telephone call if they had private or confidential academic issues. Locke and Lathan (1985) believe that goal setting can increase the skill and confidence of athletes and leads to better performance by individuals within an organisation. Consistent with this coaching mind-set, OLFs and students alike were able to track their progress towards key goals in the form of four self-assessed progress reports that highlighted areas for additional 'coaching'. In addition, when the revised capstone was rolled out to nearly 400 students, the commonly asked questions from the two trials were collated and answered in a FAQ forum. This proved very effective and the average student viewed 13 posts. Thus, students successfully gathered knowledge by interacting with the online environment and engaged in a learning community to address their workplace issue.

Table 2: A summary of student engagement in MBA Project

Measurement	Trial 1	Trial 2	Term 5
Number of students enrolled	21	252	386
Percentage of student submission rate (% of subject pass rate)	95% (100%)	96% (98%)	93% (92%)
Percentage of the videos viewed in their entirety by students (proxy for the number of students who watched the entire video)	76%	97%	72%
Number of times, on average, each student watched the videos	2.35x	1.68x	1.38x
Percentage of students who posted at least one class forum post	62%	65%	54%
Percentage of students who viewed at least one class forum post	95%	95%	87%
Percentage of students who found the video content helpful/very helpful in writing the report (from student feedback survey)	93%	75%	N/A*
Percentage of students who found the support in the forums helpful/very helpful to complete report (from student survey)	87%	67%	N/A*

* This question was not on the student evaluation survey given to students from Term 5 onwards.

The Project Statement as a Coaching Tool

Locke et al. (1981) explains that goal setting – in our case, completion of the literature review, analysis of the data, etc. – only works if there is timely feedback showing performance or progress towards that goal. The introduction of weekly progress reports was therefore a critical step in plotting the performance of students as they progressed through a reconceptualised MBA Project. However, one major 'road block' in earlier versions of the capstone was the requirement for students to gain approval for their research proposal before being allowed to collect and analyse data. This often required a lengthy process of submission and re-submission and was frustrating for many students; industry practitioners who could find a research-based subject challenging. Given that the purpose of assessment is to support learning (Black & William 2006, cited in Spector et al., 2016), this approval 'road block' was a source of frustration and highlighted the importance of timely and supportive feedback.

Given the struggles faced by students when faced with a formal research proposal, we re-imagined its role and introduced the 'Project Statement', formative assessment that would help students crystallise their ideas around a suitable workplace-based issue and one they could adequately address within the confines of the teaching period. This short 500-word assessment was due in week two and required students to clearly articulate an appropriate reason for the issue chosen, effectively establish its context in the organisation being considered and outline how they intended to approach their project. Unlike the previous capstone, the project statement was not a 'road block' impeding student progress but rather an opportunity to receive invaluable feedback on their scope of topic, proposed methodology and even viability within the time frame. As such, while this formative assessment was being graded by OLFs, and moderated by the teaching team, students were strongly advised to continue working on their project and to collect background information relevant to their workplace-based issue. Formative assessment, unlike high-stakes summative assessment used to evaluate student learning at the end of a subject, helps educators address problems immediately for those students struggling to understand concepts or tasks and can help students identify weaknesses and target areas that need work (Carnegie Mellon University, 2015). These types of assessments are an integral component of good teaching, student motivation, engagement and higher levels of achievement (Ecclestone, 2010), and are also typically not heavily weighted toward a subject's overall grade. The project statement was therefore designed to engage students early in the subject with the key concepts and learning materials, motivate them to identify an important workplace-based issue that would add value to their organisation and was only weighted at 15 percent of the final grade to incentivise submission, yet with no formal requirement that students pass the assessment item. Its purpose was to support learning and develop the confidence to develop the project while also minimising the stress historically seen when students were required to develop a research proposal.

Consistent with the andragogical literature, this revised Project Statement was supported with 'coaching' and feedback mechanisms to improve learning and give students the guidance to confidently proceed with their chosen project topic. To and Carless (2015) (cited in Spector et al., 2016) stress the importance of feedback mechanisms and the opportunity to use technology to support formative assessment. Feedback is also most effective when it focuses on the purpose of the assessment and is given regularly while still relevant (Collins, 2013). Therefore, we gave students access to several online resources – project statement videos, an exemplar statement with annotated comments suggesting areas of improvement, a discussion forum, FAQs and a dedicated OLF 'coach' – to help students prepare this interim assessment.

Feedback works best when students receive confirmation that they are on the right track and whether improvement is needed. However, any suggestions for improvement should "act as 'scaffolding', i.e. students are given as much help as they need to use their knowledge" (Collins, 2013). The OLF was critical in this scaffolding process and to help them understand their role and best use the project statement as a coaching tool, they were each given a sample of graded project statements from previous trials to benchmark against and develop an understanding of the task. They were then asked to mark three submissions within two days. A member of the teaching team then provided coaching tips and guidance as to how to give supportive and constructive feedback with sufficient clarity and detail to help students use their own knowledge and insights to continue with confidence. As one student explained, "can I express how grateful I am for the project statement feedback … This was excellent and really got me back on track … by far the most useful feedback I have received through the entire course." Hattie (1999) (cited in Collins, 2013) argues that giving feedback involves establishing trust between the teacher and student and time must be made to talk to students and teach them to be reflective about the learning objectives. Thus, after receiving feedback, students were encouraged to continue the discussion in their own class forum and both OLF and student alike had weekly progress reports as an additional feedback mechanism to track progress towards key milestones and provide additional support for any 'at risk' student.

Conclusion

This paper discusses the evolution of the MBA Project, a research-based capstone that sees students apply their newly-acquired knowledge to a workplace-based issue. However, since students often struggled with the research-based nature of the capstone, the decision was made to reconceptualise the subject, to embrace a coaching mind-set and use a range of technological tools to create effective learning activities. While the notion that educators may be coaches upends the traditional student-teacher relationship, it offers promising opportunities to drive student engagement and learning. Adult learners tend to be self-directed, ready to learn and internally motivated yet by adopting a coaching mind-set throughout this re-design and delivery, we successfully connected academic learning with workplace learning. As a result, we have designed a capstone that better mirrors professional practice and facilitated a more 'authentic' educational experience that hopefully delivers graduates with higher levels of overall satisfaction with their MBA journey and sees them 'safely reach port'. Ultimately, perhaps the last word belongs to one of our successful MBA graduates …

> I loved the new format for the Final Project. The step-by-step process starting with your videos were [sic] amazing, and really helped break the process down into bite size chunks. I've ended up with a report I'm really happy with, that has real relevance for the company I work for. The directors of my company have already read a copy of the report and we are immediately putting its recommendations into place. So, thanks so much for re-imagining what this Final Project could be.

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Can an adaptive lesson really make fundamental chemistry interactive & flexible?

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First year undergraduate allied health students commence physiology with an extremely variable understanding of fundamental chemistry principles. Chemistry is also often perceived as difficult, dull and unrelated to daily life, when, in reality nothing is further from the truth. Adaptive learning has been shown to be an effective tool for chemistry homework, but we wanted to assess its value in teaching fundamental chemistry concepts to undergraduate allied health students. An adaptive online chemistry lesson was developed in the Smart Sparrow platform. The lesson was piloted and evaluated using a survey and access to Smart Sparrow learning analytics (n=33). Students reported that the lesson met their needs for flexibility (4.9/6), and that the lesson enhanced motivation to learn chemistry (4.9/6). Importantly all students that completed the survey indicated that they had a better understanding of chemistry after they completed the lesson (4.7 ± 2.3 vs 7.63 ± 1.54, $p<0.00001$). Findings from this pilot study indicate that online adaptive learning resources are an effective, flexible and fun tool for teaching fundamental chemistry.

Keywords: Adaptive learning, Smart Sparrow, Innovative Practice, Chemistry.

Introduction

Undergraduate students frequently perceive introductory chemistry as not only difficult to comprehend, but also rather dull. Students often struggle to gain a full understanding of key chemical concepts and see it as unrelated to daily life, when, in reality nothing is further from the truth (Klara, Hou, Lawman, & Wang, 2013). A basic understanding of chemical concepts is essential to gaining a good understanding of more complex physiological, pathophysiological and pharmacological processes that are essential to nursing and allied health students. For this reason, fundamental chemical concepts are often taught in the first few weeks of a first-year undergraduate physiology course. Students enrol in physiology with an extremely variable understanding of fundamental chemistry principles, some will not know the structure of an atom, while others have a good understanding of advanced stoichiometry. This presents a challenge to the physiology lecturer in terms of which group they should target in class? If the content is taught at a basic level, the students with a good understanding will quickly become disengaged and the lecturer will quickly run out of time to teach all of the material. Vice versa, if some chemistry knowledge is assumed and lectures start at too high of a level, many students will never have the opportunity to learn these key concepts and will be at a disadvantage through much of the science taught later in their course.

Modern students often report that they need to fit their study around other life commitments so flexibility with learning resources that allow students to learn when, where and how they want to is imperative for success. Importantly, time flexibility with learning resources allow students to learn when, where and how they want to, and time flexibility and pace of learning that allow student control have been indicated as two key factors to learning success particularly as they enable learning around other social, family and professional commitments (Collis, Moonen, & Vingerhoets, 1997; Felix, 2001; Valenta, Therriault, Dieter, & Mrtek, 2001).

It is known that active student participation in self-directed study outside of class is linked with student success and is also a requirement for learning (Cuadros, Yaron, & Leinhardt, 2007). Adaptively responsive learning provides response specific feedback, and continuously adapts learning activities to students based on their current mastery of the content (Oxman, 2014; P. Polly, Velan, G, & Hawkins, N., 2015; Wong, 2015). Well-designed adaptive lessons present an opportunity to create a flexible learning environment for students of all levels regardless of prior knowledge. There is also evidence to suggest that adaptive learning lessons that targets students' prior knowledge are an effective tool for chemistry homework (Eichler & Peeples, 2013; Richards-Babb, Curtis, Ratcliff, Roy, & Mikalik, 2018), however it is not yet known if adaptive learning can be used to teach first year allied health students' fundamental chemical concepts. The overall aim of this pilot study was to examine students' perceptions of learning and flexibility using a Smart Sparrow adaptive and interactive online chemistry lesson.

Methods

Thirty-three allied health undergraduate students who were enrolled in an introductory physiology subject in 2017 and 2018 agreed to participate in this study after completing the Smart Sparrow lesson. Ethics approval was received from The Charles Sturt University Human Research Ethics Committee (HREC Protocol No 2015/265).

The adaptive chemistry lesson was developed using Smart Sparrow (http://www.smartsparrow.com). The lesson was divided into a number of parts, and at the beginning of each part students were asked 5-10 questions related to the specific topic. Immediate feedback built into the tutorials was adapted and provided to students based on their individual responses. If students answered the questions correctly they were taken to the next set of questions. If students answered the questions incorrectly they were directed to a combination of explanatory text, images and videos and were then given an opportunity to answer the questions again before moving onto the next topic (Figure 1).

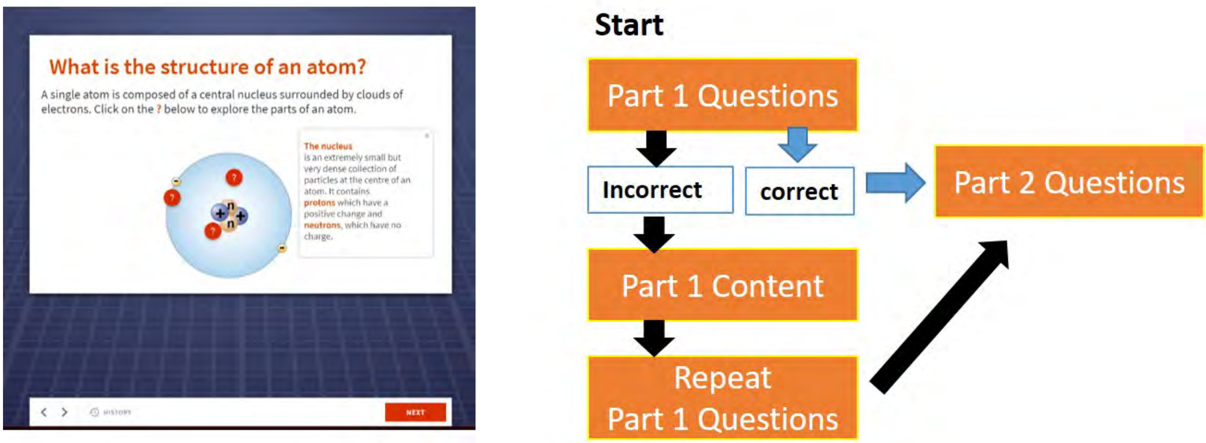

Figure 1. The lesson covered all of the material taught in the chemistry topic and prepared students for similar questions in the final exam. Students were given 3 attempts at each question.

Participants in the study evaluated the effectiveness of the adaptive online lesson for their learning by consenting to an online survey and making Smart Sparrow learning analytics available. A structured online survey using items drawn from existing instruments such as the Course Experience Questionnaire was used to measure perceptions of flexibility and learning. The survey contained 8 questions measured on a 6-point Likert scale to assess the level of (i) flexibility and (ii) student engagement and learning of the lesson. In addition, students were also asked to rate their understanding of the topic before and after the lesson. The remaining 2 questions were open-ended items related to what students liked most about the resources, and what changes they would like to see to further improve the lessons.

Group means were compared using a paired student t-test and were analysed utilising the statistical package GraphPad Prism (version 7.04). The significance level was set at $P<0.05$.

Findings

The survey data in combination with the Smart Sparrow analytics revealed that students found the adaptive chemistry lesson met their needs for flexibility and it also assisted in their learning of the chemistry topic. Recurrent positive themes emerging from student commentary were that the lessons focused on individuality of learning styles, interactivity of the content, and learning. Additionally, students also felt that the lesson met their needs for flexibility (Likert scale [from 1 to 6], 4.9 of 6; Table 1). Students also indicated that the lessons provided an individualised learning environment (4.4 of 6) and that the lesson helped to identify priorities in learning (5 of 6; Table 1).

I like that it covers all areas of the topic and tests you until you have got the questions right. I find this method of repetition works really well for me and it is interactive. (Student 5)

It was simple to use interactively on my iPad. What I liked the most was the change from questions to content knowledge. (Student 31)

Table 1. Compiled Responses to Likert Scale Questions (rated out of 6)

Likert Scale Question	Score (1-6)	n
Flexibility		
It met my needs for flexibility in my learning	4.9	21
It provided an individualised learning environment	4.4	20
It helped me to identify priorities for my learning	5	19
Learning		
It made my learning more efficient (saved time)	4.6	20
It enhanced my motivation to learn about this topic	4.9	19
It provided feedback that enhanced my learning	4.2	22
It made my learning more efficient (saved time)	4.6	20
It improved my understanding of the topic	4.8	19

It has been reported that the flexibility to choose *when to learn* and *how to learn* are key factors for learning success. Not only does adaptive learning offer students flexibility in the way that content is delivered, but there is also true flexibility in regards to the time that students can access resources. Smart Sparrow learning analytics were used to investigate the time of the day, and day of the week that students were accessing the chemistry lesson, and it was interesting to note that the majority of students accessed the lesson during conventional business hours (Figure 2). Further analysis revealed that 27% of students completed the adaptive lesson before the chemistry topic was taught in lectures. A further 48% of students completed the lesson in the weeks after the chemistry lectures and 27% completed the lesson in the week of the end of semester exam.

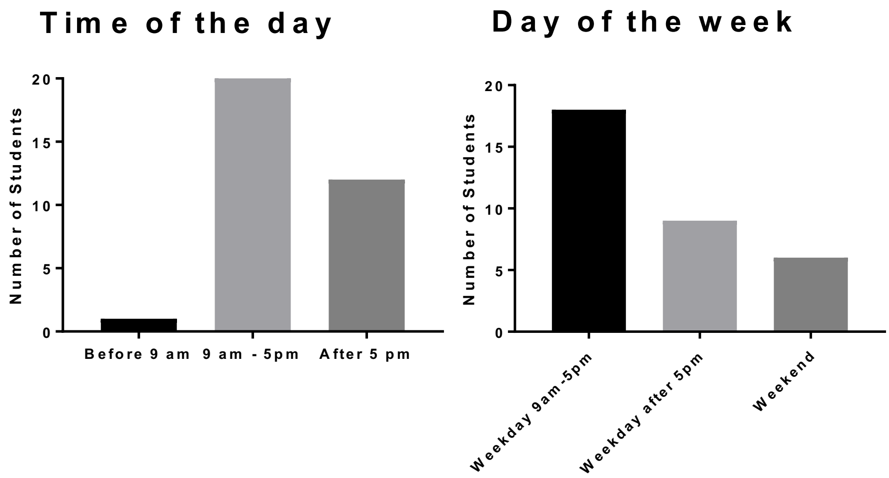

Figure 2. Student access of the adaptive chemistry lesson.

When asked to "*rate your understanding of the topic on a scale of 1 to 10 before you used this lesson*", and to "*rate your understanding of the topic on a scale of 1 to 10 after you used this lesson*", students reported a significantly increased understanding of the chemistry topic 4.6 ± 2.3 vs 7.8 ± 1.5 ($p<0.001$; Figure 3). Importantly, all students indicated that they had a better understanding of the chemistry topic after they completed the lesson.

> The interactive learning was very helpful. The ability to be tested on previous knowledge, then to be given information about the topics and then questioned again. This allowed me to see where my weaknesses were and if I was improving at all. (Student 26)

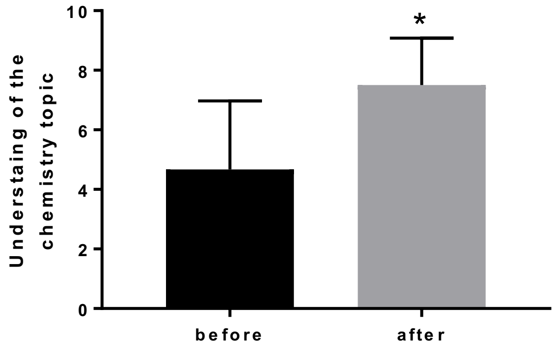

Figure 3. Improvements in students' self-reported understanding of the chemistry topic before and after completing the Smart Sparrow adaptive lesson * $p<0.00001$.

Adaptive learning provides deep and rich engagement with the content, while at the same time assisting students' learning through visualisation and embedded feedback. The success of this lesson was in part due to the fact that students had the opportunity to work through the content at a level adapted to their current level of knowledge. Students were retested if they answered the questions in a section incorrectly, or could progress quickly through the lesson if they were confident with the lesson content. There is an increasing body of literature supporting the effective use of Smart Sparrow adaptive lessons in a range of undergraduate disciplines including radiology, histology, molecular biology and microbiology (Makransky, Thisgaard, & Gadegaard, 2016; P. Polly, Marcus, N, Maguire, D, Belinson, Z, & Velan, G., 2014; Velan, 2015; Wong, 2015). This pilot study provides evidence to suggest that adaptive learning is a useful tool to students in learning a fundamental topic; while at the same time providing the flexibility to engage students with varied levels of prior knowledge.

Conclusion

This pilot study describes the success of an adaptive learning resource, within a first-year level chemistry topic. Our results indicate that students found the resource met their needs for flexibility in their learning. Students also reported that the lesson enhanced their motivation and self-reported improvements in their understanding of this difficult topic area following completion of the adaptive lesson. In conclusion, adaptive learning resources are an effective and flexible tool for teaching fundamental chemistry.

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Can we calm first-year student's "neuroscience anxiety" with adaptive learning resources? A pilot study

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An understanding of neurophysiology is vital for undergraduate allied health students; however, it is often perceived as an intimidating and difficult subject. Adaptive learning presents a novel teaching pedagogy to enhance student learning and engagement in the teaching of neurophysiology to first year students. An adaptive online neurophysiology lesson was developed in the Smart Sparrow platform. The lesson was piloted and evaluated using a survey and focus group. Of the 26 students that completed the survey, 21 students indicated that they had a better understanding of the nervous system topic after they completed the lesson. Students found the lesson was helpful in assisting with their understanding of the nervous system, whilst also being interesting and engaging. Findings from this pilot project revealed adaptive learning technologies show significant promise in enhancing student learning in a difficult first year subject.

Keywords: Adaptive learning, Smart Sparrow, Innovative Practice, Nervous System.

Introduction

An understanding of neurophysiology is vital for undergraduate allied health students. Physiology of the nervous system is often taught at an introductory level in the first semester of study in tertiary allied health courses. It has been well reported that students see the nervous system as an intimidating and difficult topic and indeed the term "neuroscience anxiety" has been penned to describe student anxiety and fear about topics in the field of neuroscience (Birkett & Shelton, 2011; Salomon et al., 2015). It has been suggested that traditional teaching methods, such as lectures and practical classes used to teach the nervous system contribute to the perceived difficulty of the subject. There are however reports of improvements in student outcomes of improved learning and reduced anxiety when traditional methods are replaced with student centred learning and more interactive teaching (Birkett & Shelton, 2011; Salomon et al., 2015; Zwick, 2018). Modern adaptive learning experiences that are designed for high engagement, yet are flexible to the needs of learners present a unique way to address challenges in teaching large, practical based subjects.

Adaptive learning personalises the student experience by adjusting the level of instruction or feedback in response to individual student responses and represents the next generation of educational technologies (Oxman, 2014). Adaptive learning has the potential to offer truly individualised, efficient, flexible and engaging instruction, and offers a novel way to address the perceived difficulty and anxiety associated with the study of neurophysiology. One example of an adaptive learning platform is Smart Sparrow. There is a growing body of literature supporting the use of Smart Sparrow adaptive learning tutorials across a broad range of undergraduate disciplines (Makransky, Thisgaard, & Gadegaard, 2016; Polly, Marcus, Maguire, Belinson & Velan, 2014; Polly, Velan & Hawkins, 2015; Velan, 2015; Wong, 2015). However, there are currently no reports specifically evaluating the use of adaptive learning technologies for neurophysiology. The overall aim of this pilot study was to analyse student feedback on a newly developed Smart Sparrow lesson focused on the nervous system. In particular, we wanted to examine whether;

- completion of the lesson enhanced student engagement for first year allied health students
- completion of the lesson enhanced student learning for first year allied health students

Methods

The participants were 26 allied health undergraduate students enrolled in an introductory physiology subject in 2018. Ethics approval for this study was received from The Charles Sturt University Human Research Ethics Committee (HREC Protocol No H18024).

The Adaptive learning nervous system lesson was developed using Smart Sparrow (http://www.smartsparrow.com). The adaptive lesson, was unique in that students could "choose their own adventure" by selecting whether to navigate through explanatory slides or skip to review questions if they were confident with the material (Figure 1). The questions and content were designed to prepare students for similar questions in the final exam. Immediate feedback was built into the questions and was adapted and provided to students based on their individual responses.

Participants in the pilot study evaluated the effectiveness of the adaptive online lesson by consenting to complete an online survey (n=26). Two of these students also consented and participated in a focus group. A focus group was conducted to further explore the themes arising from the analysis extending the students voice to this evaluation.

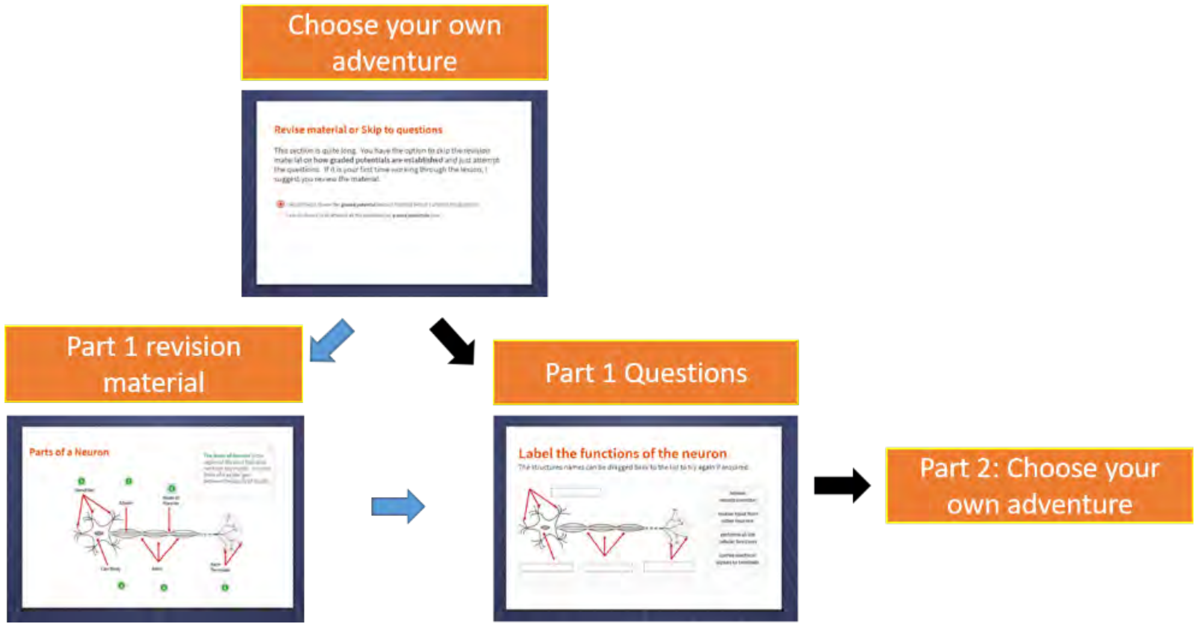

Figure 1. Flow chart indicating lesson structure. Each section of the lesson was designed so that students could select to revise content before attempting the questions, or skip straight to the questions.

A structured online survey was used to measure perceptions of learning and engagement. Some of the survey items were drawn from existing instruments used to measure student motivation, satisfaction and university experience, specifically the Course Experience Questionnaire (CEQ). Other survey items were designed by the research team. The survey contained 8 questions measured on a 5-point Likert scale and the remaining 3 questions were open-ended items asking students what they liked about the resource, did not like about the resource and suggestions for future improvements.

Data are expressed as mean ± standard deviation. Group means were compared using a paired student t-test and were analysed using the statistical package GraphPad Prism (version 7.04). The significance level was set at $p<0.05$.

Findings

Overall, the survey data in combination with the analytics revealed that the Smart Sparrow lesson not only facilitated student learning but did so in a fun, interactive and engaging way where students could progress and consolidate their learning in their own time.

Student engagement

Students reported that the Smart Sparrow lesson was interesting and engaging (4.6 out of 5; Table 1). A total of 7 open text comments mentioned interactivity as one of the most liked components of the tutorial. Students likened this experience with "games", and described the interactive resources as being more useful than conventional teaching methods. Students specifically liked the visual and audio components of the tutorial as an enhancement to their learning. The focus group discussion also highlighted aspects of how the students engaged with the lesson as inspiring confidence to learn.

> Being interactive I found it more useful than lectures or reading texts. (Student 25, 2018)

> Great connection between videos and content. (Student 8, 2018)

> I think because it was interactive as well…it wasn't boring, it wasn't monotonous, it wasn't repetitive in its presentation methods. (Student 8, Focus group)

Table 1: Compiled Responses to Likert Scale Questions (rated out of 5 stars)

Learning and Engagement	/5	SD
How useful was the resource in helping you understand the nervous system?	4.8	0.6
Having more of these resources would help me in my learning.	4.8	0.43
The feedback provided in this resource helped me to understand the topic.	4.2	0.7
I found the resource was interesting and engaging	4.6	0.6
Flexibility		
The resource was personalised or tailored to me	3.9	0.99
I felt in control of the experience of using the resource	4.3	0.84

Student learning

When asked "*How useful was the resource in helping you understand the nervous system?"* 100% of students selected 4 or 5 out of 5 (4.8; Table 1). Likewise, students reported that they would like more of these resources (4.8; Table 1) and that the feedback provided in this resources helped with understanding the nervous system topic (4.2; Table 1). This data was confirmed in the open text comments. A total of 10 open text comments referred to the capabilities of the lesson in regards to enhancing their learning. Students used the tool to test their knowledge, gain understanding, and cement information about the nervous system. Comments included reference to individual learning styles, methods of learning and the different approach the lesson gave them.

> It is a visual and auditory platform of learning. (Student 15, 2018)

> The short quizzes throughout helped cement the information. (Student 10, 2018)

> Can progress at my own pace and review parts that I was uncertain about. (Student 17, 2018)

After completing the lesson, students were asked to *rate your understanding of the topic on a scale of 1 to 5 before you used this lesson*, and to *rate your understanding of the topic on a scale of 1 to 5 after you used this lesson*. Of the 26 students that completed the survey, 21 students indicated that they had a better understanding of the nervous system topic after they completed the lesson (2.8 vs 4.1, $p<0.0001$; Figure 2). This is consistent with other studies that have found that adaptive learning resources improve students learning over more conventional teaching methods (Samulski et al., 2017; Wong, 2015). Indeed, adaptive learning offers students an opportunity to gain comprehension and knowledge with the flexibility of working at their own pace (Booth et al., 2016).

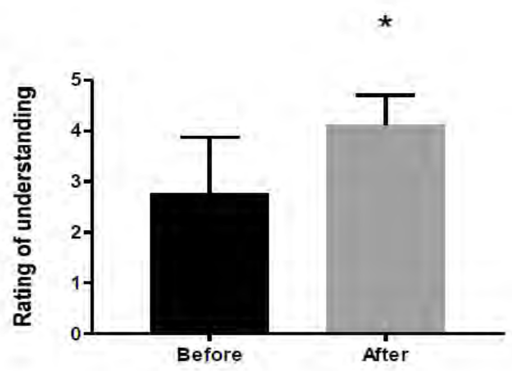

Figure 2. Improvements in students' self-reported understanding of the neurophysiology content before and after completing the Smart Sparrow adaptive lesson * p<0.0001.

Student feedback in the survey and focus group highlighted how students used the tutorial for revision and exam preparation, and also found the lesson helpful for topic management, insight into the subject, and positive reinforcement of learning. The theme of exam preparedness was further explored in a focus group with two students discussing their use of the tool within their own individual learning styles.

> And because the nervous system is just mammoth in its content, even from just participating in the lectures. The volume of content was huge...I sort of invested confidence in the Smart Sparrow, because I thought you are going to be, the creator is going to be focusing on really important stuff. (Student 8, Focus group)

> I would manipulate it [Smart Sparrow], in that I would use it in the areas in which I felt my weaknesses were. Or where my lack of understanding was in that area. (Student 9, Focus group)

Conclusion

This concise paper describes the results from a pilot study of adaptive learning resources in first-year neurophysiology. Our results overwhelmingly indicate that students found the adaptive learning resources engaging and self-reported improvements in their understanding of this difficult topic area following completion of the adaptive lesson. As students can progress through the lesson in their own time, this well-designed, adaptive learning resource can be used to calm "neuroscience anxiety" in first-year undergraduate allied health students! As we now know that these types of interactive learning resources promote learning and engagement, future lessons will contain course specific feedback to demonstrate to students the importance of understanding neuroscience and other physiology topics.

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Reclaiming the field of educational technology: Seeds for discussion

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The purpose of this concise paper is to offer some observations and commentary on the current state of the field of educational technology – with the overarching premise that the field is currently stuck in a "techno-centric habitus" that is limiting the field's evolution. This position is based on research work conducted in Ireland exploring the personal values and beliefs that motivate the staff working in the educational technology space within higher education institutions. In an era where Higher Education is facing many unrelenting issues – educational technologists continue to remain a silent voice in the ongoing debate – "*privately vociferous but publicly mute*". This paper offers a critique of the field that appears as dynamic and innovative largely reflecting the investments in technology – but at its core is harnessed as an instrument that prioritises performance measures over transformative opportunities. This scenario is often compounded by the lived reality of educational technologists who often reside within the fractures of organisational structures – straddling various strategic priority pillars such as Digital Campus, Teaching and Learning and the Student Experience. This work adopted the "thinking tools" of French sociologist Pierre Bourdieu to examine this dilemma. The paper concludes by proposing four key questions for discussion that will contribute to informing and shaping the future direction of the field of educational technology.

Keywords: Values and beliefs, Bourdieu, field, capital, doxa, educational technology

Introduction

This paper will describe a synthesis of relevant findings from a research project designed to explore the habitus of educational technologists in Irish higher education. Innovators who were described in the relevant literature predominately in terms of their technical prowess and achievements, with little scope for any account of who they are and why they do what they do. Among the motivations for this work was a realisation that investments in educational technology have not contributed to any real transformation of educational opportunity in Ireland. In fact, some critics would argue that educational technology has been colonised to support and drive a "new managerial agenda" in higher education (Lynch, 2006). Allied with this is a realisation that there is a lack of public discourse on these issues within the field. However, I have also been encouraged to investigate this area by the unexpected outcome of a request to a group of educational technologists to choose which video clip they would prefer to view. One segment described in detail the underlying architecture of an award-winning educational technology solution, a second video presented a narrative of a student's experience – a student who because of a disability was unable to attend college, but access to the technology allowed her to attend online. The priority amongst the group was clearly to witness the impact on the student – this event still resonates with me to this day. A group that would be labelled as "techno-centric" displayed an emotional response that for me reflected values and beliefs that receive scant attention within the field of educational technology. This added to the view that within the field of educational technology there is amble anecdotal evidence of vociferous private conversations and discussions (McNutt, 2010).

At this time, I was also introduced to the work of Pierre Bourdieu whose concepts of habitus, field and capital resonated with me for reasons which I still struggle to explain. I do know that I had a "gut" instinct that these conceptual tools could explain the inherent contradictions and tensions within the educational technology domain. The concepts of habitus, field and capital provided a "lens" with which to re-evaluate the field and its actors (Maton,2008).

I wanted to "excavate" beneath the surface of the emotional response described above, to illuminate the participant's views, opinions, beliefs and accounts of their practice and present a more accurate picture of the field of educational technology and the habitus of the main players within the field. I was also influenced by the realisation that this required an approach that would encourage self-reflection to counteract the criticism that

Bourdieu (2000) has levied at research activity which tends to take as given the values, questions and categories of the field and the society in which it operates.

> The agent engaged in practice knows the world…too well, without objectifying distance, take it for granted, precisely because he is caught up in it, bound up with it; he inhabits it like a garment…he feels at home in the world because the world is also in him, in the form of the habitus. (p.142)

An important task in this endeavour was to encourage practitioners to reflect on their own beliefs, values and assumptions regarding the field of educational technology and it's dominated neighbour the higher education sector.

The Journey

Amongst the many challenges encountered during this research study was how best to engage in the objective of capturing the values and beliefs of practitioners. An introduction to arts-based research and narrative enquiry offered a methodology that although a challenge to my scientific training, presented an appropriate and authentic approach to give "voice" to the project participants. The intent was to re-position the description of the role of educational technologists from the techno-centric to the personal; to shift the focus to their own values and beliefs and motivations. A methodology had emerged – a methodology that challenged the predominant positivist perspective in educational technology research. There was also an underlying assumption that percolated throughout this study – an assumption that educational technology was indeed a field that co-existed with many competing discourses within Higher Education.

The participants did not share a common view on all aspects of the role of the educational technologist but they did share a common dream – and as with all dreams it was not clearly articulated and visible. But at its core was a belief that technology has a central role to play in higher education and the promotion of a continuing discourse in relation to teaching and learning. This had to be balanced with the operational aspects of their roles which are primarily technology lead – but always trying to ensure that their suggestions are aligned with learning objectives and that the benefits to both students and academic staff are clearly articulated.

One of the conclusions from this study is captured in Figure 1 below a visual representation of the dominant views and beliefs within the field, an instance of the field of educational technology that is comprised only of the participants. If you could imagine that the "green spot" could be adjusted to reflect the common "temperature" of the field regarding a theme, taken at a point in time. The diagram is designed to reflect the constant struggle and interplay that characterises this field (McNutt, 2013).

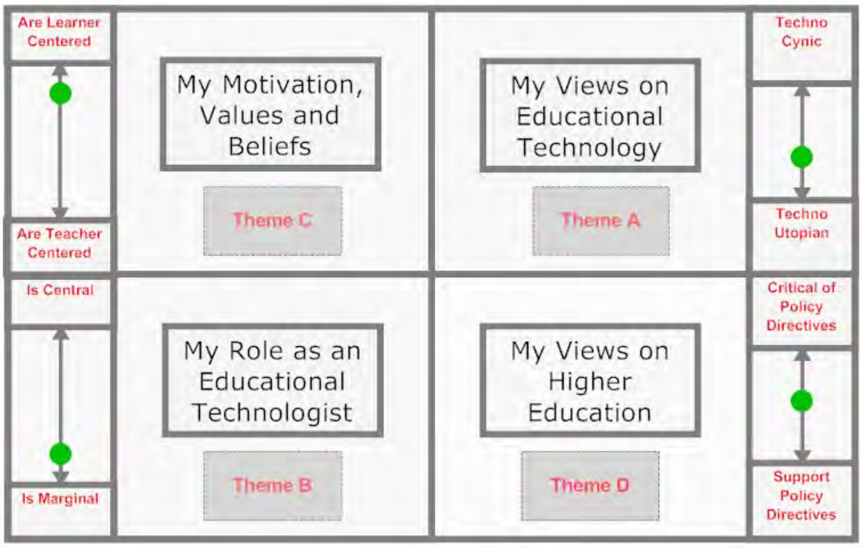

Figure 1: An Instance of the Field of Educational Technology

Reclaiming the Field of Educational Technology

The research work undertaken as part of this study was based on a major assumption that the field of educational technology existed. This assumption was examined and tested when faced with the realisation that the existing body of knowledge, pertaining to educational technology was unable to explain several key questions that emerged.

For example (i) why is the primary agenda within the field techno-centric yet educational technologists fundamentally believe that the needs and requirements of the learner are central? Or (ii) why are the values and beliefs of educational technologists undervalued within the field? (iii) who is dictating the current structures and roles within the field, which is leading to a sense of tension, frustration and isolation?

The adoption of Pierre Bourdieu's constructs of habitus, field and capital allowed an examination and explanation of these issues and provided a platform that allowed the field of educational technology to continue to develop and mature. The questions presented in the previous paragraph could be re-stated as: (i) does the field have a dominant doxa? (ii) what is the capital associated with the field? (iii) and what are there other adjacent fields and/or dominant fields?

Table 1 below presents an expansion of these key assertions as seeds for discussion that would lead to the ongoing cultivation and development of the field of educational technology.

The field of educational technology exists and as such is a legitimate research arena worthy of study. The explorations and explanations afforded by Bourdieu's constructs are the foundations that allow us to theorise about the practice of an educational technologist, and on which a new doxa could be established. A doxa that will redefine the role of an educational technologist by releasing its current identity from the shackles of a techno-centric discourse to allow the field of educational technology and the role of educational technologist to evolve into a recognised professional discipline. **Researchers in the field of educational technology should adopt alternative research methodologies drawn from arts-based and narrative enquiry methods** The methodology adopted in this study was a response to the challenge of exploring the habitus of educational technologists. The influence of arts-based methods encouraged the use of visual media to stimulate and prompt discussion. The narrative that unfolded yielded insights into not only the practices but also to the personal values and beliefs of the participants. This study has illustrated the value and impact of alternative research methodologies that moved the research questions beyond the realm of "how" and "what" and gave pre-eminence to the question "why". **The field of educational technology must encourage and embrace contributions that prioritise the personal narrative of the learner and the innovator.** As an evolving field, educational technologists must be prepared to challenge and question old assumptions and inherited beliefs and discard the debris of three decades of following the mantra that the "next shiny new gadget" will solve all our problems. There is a real need for a new vision of change and equality within higher education underpinned by a realistic and independent critique of educational technology. What this study has shown is that while this vision is already in place, it remains unspoken and buried in the hearts and minds of the participants who contributed to this work. A key to unlock this "buried treasure" is to encourage their stories to be told, not using a narrow technical vocabulary but employing the same richness, variety and humanity demonstrated by the debate and discussion captured by this work. **Professional development programmes within the field of educational technology should include sociological, epistemological and philosophical dimensions.** A critical element in this endeavour will be to ensure that future professional development programmes within the education technology domain (and indeed the adjacent field of teaching and learning) prioritise and make the space for self-reflection. Such a programme would ground the role of an educational technologist as a focal point for an ongoing critique of the political, economic and social cultures that pervade higher education. A programme that seeks to hear their voice and challenges them to raise it in the debates and discussions addressing the core issues facing higher education today.

Table 1: Reclaiming the Field: Seeds of Discussion

Conclusion

This concise paper is presented as a prompt for discussion and debate based on a research study carried out in the Irish higher education sector. The Irish and world landscapes have changed dramatically since the inception of this work in 2008 –it now seems an appropriate juncture for educational technologists to re-visit their role in shaping the future of higher education. It is of significance in an Irish context as we embark on the creation of a new type of university i.e. a Technological University[1]. As I write these final few words I am struck by Bond and Buntings' (2018) recent paper which concludes with an invitation to start a conversation about how AJET can further foster international collaboration, whilst continuing to champion Australasian-centred research. The purpose of the paper is to advocate that the field of educational technology should lead the debate on transforming higher education and foster within its community an alternative critique and assessment based on personal values and beliefs. Alternatively, the field will continue to be colonised and the original motivations and ambitions of the agents within the field will continue to be compromised in a "battle" for existence largely driven by a narrow neo-liberal higher education agenda.

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[1] http://hea.ie/policy/he-reform/technological-universities/
https://www.tu4dublin.ie/

Expectations and engagement: Key touchpoints in online students' experiences of transition

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The first year of study in higher education is a significant time for students, and indeed for institutions. Students are at their most vulnerable in terms of an increased risk of failure, and are at most risk of encountering challenges they have few resources on which to draw in order to overcome. These vulnerabilities, challenges and risks are particularly significant for students who study in the online mode, where a sense of isolation lingers for many students despite the levels of interactivity now available to them. Recent research suggests that institutions have room for improvement in assisting students to navigate their path through this transition. In this paper, we identify five key 'touchpoints' within an online student's transition that play a significant role in positioning them for success. We frame our discussion around two key concepts, expectations and engagement, and explore how institutions might use each touchpoint to position online students for success. Our aim is not to provide solutions, but rather to provoke alternative and out-of-the-box thinking through discussion about how we might better align practices across an institution, and reassess our roles in supporting student transition.

Keywords: Online student experience, transition, student engagement, expectations.

Introduction

There are over 50 years of study into the first-year experience in higher education in Australia (Pittaway & Moss, 2006; Hillman, 2005; McInnis, 2001) and this has shown conclusively that the first year is a significant time for students, and indeed for institutions. This is the year in which students are at greatest risk in terms of academic failure, as well as most vulnerable to a wide range of risk factors, including emotional, financial, and social problems (McInnis, 2001). Further, research highlights that students studying online are particularly vulnerable (Bawa, 2016), with attrition rates 10% to 20% higher than on-campus students (Herbert, 2006).

In this paper, we focus on the online student journey within their first term of study and identify distinct 'touchpoints' that play a key role in influencing a student's chance of success. Student expectations are an important component of their transition experience, and we consider the role of these expectations in positively or negatively influencing their success. Recent literature highlights that engagement is critical for student success and retention (for example Kutieleh & Seidel, 2015), and Pittaway's (2012) Engagement Framework provides the theoretical and practical cornerstone for considering how students can be positioned for success at each 'touchpoint' across the first term. In this paper it is our intention to provoke rather than resolve, to highlight key opportunities for new practices to be developed in order to better support online students' engagement in their first term of study and ultimately their likelihood of staying and succeeding.

The importance of expectations

The need to understand students' expectations, in order to increase the likelihood of their success in transitioning to the university environment, seems almost self-evident. Research highlights that those who commence university with realistic expectations appear less stressed, and adapt more quickly and effectively as a result (Pancer, Hunsberger, Pratt & Alisat, as cited in Scutter et al., 2011). Such expectations are even more important for students studying online, who engage with their studies in environments that 'blur the line' between university and other contexts (i.e. home/workplace), and who often study in relative isolation.

There is a growing body of literature highlighting a 'mismatch' between what students anticipate they will experience at university and the reality that awaits them. This includes expectations regarding how much feedback they will receive, how much access will be provided to teaching staff, how much study they are expected to do, and how much responsibility they will need to take for their engagement and learning (see for example Crisp et al., 2009; Scutter et al., 2011). A recent report (Baik, Naylor, & Arkoudis, 2015) highlighted that almost half of all first-year students reported that the standard of work was higher than they expected (38%); for these students, there is still a 'disconnect' between their expectations and the reality of study. Within the same report (Baik, Naylor, & Arkoudis, 2015), the top reasons for considering withdrawal included that students "thought they might fail" (50%), and the university "wasn't what I expected" (38%). In another national survey of first-year students who withdrew, the most common reason given was that the course was "not what they had wanted" (Hillman, 2005). Given this, it is clear that expectations play a key role in student success.

Student engagement

There is a substantial body of research that highlights the importance of engagement in positioning students for success in their studies. According to Krause (2005) engagement refers to "the time, energy and resources students devote to activities designed to enhance learning at university" (p. 3), thus emphasising the connection between engagement and learning. However, considering student engagement within the online space poses particular challenges, including to pedagogy and to the social constructivist learning models that underpin many contemporary online learning environments (Moss & Pittaway, 2011; Pittaway & Moss, 2014) and thus to engagement and expectations. The sense of isolation many online students feel at the beginning of their studies does not necessarily sit comfortably with social constructivist unit design and thus students may feel a disconnect as they are encouraged to discuss with others, but these others are strangers and more difficult to get to know in the online space.

To better understand student engagement, and address the question of *how* students engage, Pittaway's Engagement Framework (Pittaway, 2012) offers five distinctive, non-hierarchical dimensions of engagement that together, contribute to students' success: personal engagement, academic engagement, intellectual engagement, social engagement, and professional engagement. These dimensions take on different degrees of prominence throughout a student's transition and subsequent study experience, as engagement is understood to play out "in different ways at different points of the educational cycle" (ACER, 2011, p. 1). This might mean that in the early stages of transition for an online student, social engagement is most prominent, whereas later, intellectual engagement might be front-of-mind. Together, these dimensions provide a framework for understanding and planning for students' engagement, within and beyond their first term. It is important to note that attending to these dimensions of engagement is not solely the work of students and their teachers; rather, all within the institution play a role in shaping student engagement. A brief description of each of the five dimensions is provided below.

Personal Engagement

This dimension relates to students' self-efficacy, goal-setting, resilience and persistence. For students to engage and succeed, they must hold a belief that university is valuable and worthwhile, and that they can succeed and have a will to learn (Pittaway & Moss, 2014). Staff must also be personally engaged, and aware of their role in helping students to shape personal aspirations and a positive mindset. This is particularly important for online students, many of whom are 'non-traditional' and must add the identity of 'student' to already-established roles, and must do so without a network of peers in their immediate environments (Moss & Pittaway, 2013).

Academic Engagement

This dimension relates to students' identification and management of the interdisciplinary knowledge and skills that underpin success in communicating in an academic environment. Such knowledge and skills include information and computer literacies, academic writing, reading and note-taking, and time management. Academic engagement underpins engagement more broadly; if students are unable to communicate in academic contexts, they are unlikely to be able to engage intellectually with the ideas of their discipline (Pittaway, 2012).

Intellectual Engagement

Intellectual engagement refers to students' capacity to identify and explore the key concepts and ideas of their chosen discipline, along with an awareness of current debates, a capacity to read widely, and to articulate their own beliefs, values, and attitudes (Pittaway & Moss, 2014). In a sense, this dimension relates to engagement with the 'what' of their university study program, as framed by staff in setting out learning outcomes, weekly tasks, and assessments.

Social Engagement

Social engagement refers to students' interactions with their peers and university staff, with a particular focus on students' capacities to build positive learning relationships. Research highlights the importance of social engagement for online students, with a significant correlation noted between students' interactions online and their levels of satisfaction and learning (Leong, 2011). It is important to note that this dimension of engagement is understood to relate to student interactions both within and beyond the formal learning environment.

Professional Engagement

The final dimension of engagement relates to the ways in which students are engaged in experiences and activities that enable them to "apply, consolidate, and extend their knowledge, beliefs and skills as learners and as developing professionals" (Pittaway & Moss, 2014, p. 143). Specific examples of professional engagement may differ by discipline, but may involve internships and work-integrated learning programs, as well as students' involvement with professional bodies or associations.

Previous literature offers insight into how instructors might account for student engagement across multiple dimensions within the online environment, including, for example, the use of social learning environments to build online communities (see for example Krause, 2005). However, much of this literature focuses specifically on the role of the instructor (Pittaway & Moss, 2014). In the following section of this paper, we seek to broaden this conversation, to consider the role of all parties in enhancing students' engagement and increasing the possibilities for successful transition experiences.

The student journey – key touchpoints

'Touchpoints' are key factors that might influence a students' expectations and subsequent engagement. The term is discussed in marketing research, where as many as 13 touchpoints have been identified across a students' university experience (Khanna, Jacob, & Yadav, 2014). In this paper, we adopt this concept within a wider setting, considering touchpoints as they apply to all staff. We apply the concept of touchpoints to refer to specific *moments* of interaction through which a student progresses. With regard to the first term of study, we propose five touchpoints that offer the most potential for making a positive impact to the expectations and engagement of online students. We developed these specific touchpoints through analysis of relevant literature, as well as through our own experiences as online educators and academics with responsibilities for shaping engagement at local and institutional levels. Our framing of these touchpoints identifies moments that involve key staff members from within an institution that incorporate not only teaching staff, but also marketing, sales and recruitment, 'first contact' teams, and wider support staff. In framing these touchpoints in order to explicitly include a range of stakeholders, we perhaps limit our capacity to encompass those touchpoints that might be specific to a subset of stakeholders (such as those important first moments of online contact between students and their teachers). However, we believe that it is only by aligning the work of all staff that we stand to make improvements to students' experience of transition and retention, as each touchpoint is shaped by many hands. We also invite readers to continue this conversation, to include further touchpoints that are influential for particular groups of stakeholders.

Touchpoint 1: Reading and researching

Opportunities to shape students' expectations and engagement commence prior to their enrolment (Khanna, Jacob, & Yadav, 2014). This first touchpoint occurs as a result of the research a student conducts when they first think about studying. They may spend a considerable amount of time doing this: accessing websites, talking to friends about where they are studying, receiving advice from careers counsellors, and so on.

These initial engagements play a role in whether students choose to continue exploring a particular institution as a study option – is the information they are looking for easily found? Do they get a sense of what it's like to study at a particular site, or in a particular mode? It is relevant to consider how these initial contacts help to confirm or challenge students' expectations, and also how they might appeal to particular dimensions of engagement. For example, if a student encounters messaging that emphasises fitting university around family and/or working commitments, this is likely to establish expectations around social engagement (or lack thereof), and the flexibility of the study experience. On the other hand, if messaging emphasises university as a place where 'great minds' are built, this may establish expectations around the significance of intellectual engagement. A third type of messaging might appeal to professional outcomes, to links to the 'real world', and thus establish expectations about what kind of knowledge, and engagement, is both valued and valuable. It is important for all staff within a university to understand clearly the types of messages and values that students are likely to have encountered within this first touchpoint, and to consider the benefits and risks of these appeals. Interestingly, the most recent large-scale research on students' first year (Baik, Naylor, & Arkoudis, 2015, p. 24) emphasises that intrinsic interest remains the most often-cited reason for choosing to enrol in university (96%), followed by improving job prospects (87%), and developing talents and creative abilities (77%). This would seem to suggest that students are potentially influenced by any or all of the three types of messaging described here.

Touchpoint 2: First contact

The second touchpoint occurs at an unspecified point beyond this initial research, and is when a student lets a particular institution know that they are interested in applying. There are many different ways this might happen – it might be that the student clicks the 'Apply now' button on a website, uses the live chat feature on the institution's website, or attends an Open Day or a webinar session. At this point students will already have expectations about both the courses and the institution more broadly, and also about the kinds of study and social experiences they might have. This first contact will also play a significant role in shaping students' expectations. This will depend on many factors, including who a student speaks to, how knowledgeable that person is, and the role that person plays within the university. If the messages received at this first contact align with the expectations that were established in their researching, students may feel more confident to apply.

As with every other touchpoint, this is both an opportunity and a risk. One particular consideration at this touchpoint is the extent to which studying online is represented as a valid and valuable mode of study: does the institution present a 'traditional' view of what it means to be a student, both in advertising and at events such as Open Days? Are the support structures, course features, and other key aspects of the student experience represented in a manner that applies regardless of mode of study? If applicants intending to study online are presented with a vision of what it means to be a student in these pre-enrolment stages that emphasises campus-based clubs and societies, study facilities that are only available during traditional business hours, and images of study that involve groups of students sitting around desks, this can serve to alienate them and make them feel as though studying online is a 'lesser' choice (Moss & Pittaway, 2013).

Touchpoint 3: Enrolling, orientation, and start of term

The third touchpoint represents the moment when studying at university transitions from being an aspiration, to being a reality: enrolment, orientation, and starting. The experiences a student has at this touchpoint will play a key role in shaping their expectations, and confirming or refuting their initial beliefs about what university will be like and how it will suit them (and them it) that have been foreshadowed through previous touchpoints. Most, if not all, universities offer orientation programs, although these vary in length and mode of delivery. Many of these programs will emphasise raising students' awareness of academic expectations and standards, and the kinds of academic skills needed to succeed (academic engagement). Some will also emphasise the importance of making connections and social engagement, perhaps building on the significant correlation between this and student success (Pittaway & Moss, 2006).

However, recent research suggests that only about 30% of all first year students actively engage with orientation programs, and of these, only 42% believe that the programs helped them get off to a good start (Baik, Naylor, & Arkoudis, 2015). It seems there may be more work to be done here to better align programs with students' reasons for study, and their expectations. Enrolment is also a key aspect of this touchpoint, and it appears that we have room for improvement as a sector, with only 39% of students reporting that they were given helpful advice when choosing subjects (Baik, Naylor, & Arkoudis, 2015). We may also experience tensions here, if online students' expectations of flexibility (shaped through previous touchpoints) do not match the reality of offerings.

Touchpoint 4: First assignment and feedback

The fourth touchpoint occurs in the early stages of term, and is that time when students are reflecting on their experiences so far, and considering whether university is for them, and they for it. Submission and receipt of feedback on an initial assessment task is often a critical moment for students who may be uncertain of their suitability for university study. Ideally, this task needs to reflect assessment 'for transition' (Taylor, 2008), with a focus on providing students with a low-stakes opportunity to apply their skills and knowledge. This initial assessment is important for engagement reasons as well, as it can 'drive' students towards important opportunities to apply their skills and knowledge in appropriate ways and receive feedback. It also allows us to direct students towards particular dimensions of engagement; particularly academic engagement. Finally, this provides an opportunity to really bring expectations to the fore: staff create an opportunity to see what students think constitutes appropriate work, while students can identify what the standard is (and where they sit in relation to it), and can make some decisions as a result of this submission and feedback process.

There is perhaps a tendency to focus on the role of the teacher in this touchpoint, but it is still just as important as in earlier touchpoints to consider this moment broadly. There is a clear role here for Academic Skills Advisors, for example, in both an individual student and an embedded role, and there are opportunities for peer mentors, success coaches, and others as well. The expectations that students bring to this touchpoint are those that have been established at every prior stage, and the dimensions of engagement are at play in this moment may well go beyond the academic, including a key opportunity to reflect on personal engagement.

Touchpoint 5: Major assignments and end of term

The final touchpoint we consider here is what happens next; how students move beyond this initial experience of assessment, make the decision to stay enrolled, and then manage their engagement across the remainder of the term. As the term unfolds, the requirements and expectations staff have of students shift. For example, in terms of assessment, across the term many units will move from assessment for transition into an increasing focus on assessment for achievement (Taylor, 2008), and the emphasis begins to shift from a focus on academic engagement and academic literacies, into an increasing focus on intellectual engagement and often also professional engagement (such as industry-related tasks) and/or social engagement (group assessments).

The student experience across first-term can be an emotional one; essentially it can be an experience of culture shock, and the process of adapting can look like a ‘W curve’ (Gullahorn & Gullahorn, 1963): students often commence in a position of high-interest, high-engagement, and then this dips as they experience the reality of assessment preparation, balancing study commitments, and so on. They then reach a more comfortable place as they adjust to the requirements, and as their expectations are either realised or replaced, before experiencing another ‘dip’ later in the term as workload expectations ramp up, assessment difficulty increases, and so on.

This process of adaptation and the ‘dips’ involved is reflected in research on the first year experience (Baik, Naylor, & Arkoudis, 2015), where one of the major reasons students consider deferring or withdrawing during semester is “emotional health” (which has disturbingly risen from 46% in 1999 to 72% in 2014). Another relevant statistic in this regard relates to ongoing academic engagement – 36% of students reported difficulty in getting motivated to study, less than half (47%) reported working on their studies consistently throughout term, while an increasing number (but still only 37%) report that they regularly seek the advice and assistance of teaching staff.

This suggests that working towards student success across the whole of first term involves attending to students’ academic engagement and importantly their personal engagement: we ought not assume that students will continue and succeed, purely on the basis of submitting their first assessment. For online students, for whom isolation is common and a sense of belonging often lacking (Moss & Pittaway, 2013), these concerns are particularly significant.

Continuing the discussion: Where to from here?

In this paper, we have argued that students’ transition to university is a complex, challenging process, of continually navigating a journey of shifting expectations, managing complex demands and balancing engagement across multiple dimensions. We have suggested that this is particularly the case for students studying online, for whom university is often providing one set of demands and expectations to be balanced among many others. We offer five key touchpoints, from initial research through to completing first term, that might help to sharpen our efforts to engage students and to shape clear and appropriate expectations by focusing on particular moments. We conclude this paper by suggesting some further questions or provocations, that might provide an opportunity to move from imagining a student’s first term journey to improving it, within each touchpoint. Specifically, for each touchpoint, we pose the following questions: *Who is involved in this touchpoint, and who contributes to students’ experience of it? How does each person/role shape students’ expectations? What dimensions of engagement are ‘front of mind’ for students as they engage at this touchpoint? Are these appropriate/sufficient? How do we know the expectations we communicate are appropriate and accurate, and consistent across all parties? What is the student’s role at this touchpoint? What should they be doing, thinking about, valuing? How can/might we use new technologies, in order to monitor this touchpoint and the impact of each contributor? How can/might we use new technologies in order to better* *support students as they move in and through this touchpoint?*

We invite others to enter into this discussion, considering their responses to these questions, and sharing practices as a result.

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Embedding digital literacy: Towards transforming business education

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Equipping business graduates with digital literacy skills can help to enhance their employability and careers. Contextualising digital literacy to the relevant discipline and, aligned with industry expectations can help them navigate through the multiple demands of living, learning and working in a digital 21st century society. This paper draws on a pilot exemplar of the challenges in course design to explicitly embed, develop and assess students on attainment of digital literacy skills in business education. As part of the pilot, and through a cross-functional team, an innovative, media-rich and interactive Digital Literacy Module (DLM) with strong learning design based on authentic activities and scenario-based learning was developed and implemented. Insights presented here will be of value to course leads, curriculum designers, educational technologists and other practitioners to help with embedding digital literacy in higher education.

Keywords: digital literacy, education technology, business education, employability

Introduction

Business education relies heavily on ensuring course design includes digital literacy and remains relevant to industry needs and cognisant of a broad discipline foundation to ensure graduates have a philosophy for decision making that stands the test of time. This paper draws on a pilot exemplar of the challenges in course design to explicitly embed, develop and assess students on attainment of digital literacy skills. Digital literacy (DL) is a core graduate learning outcome for many institutions, including Deakin University. For Deakin's Bachelor of Commerce (B.Com.), it is an assured course and graduate learning outcome with graduates expected to know how to '*use technologies to Identify, locate, evaluate, synthesise and disseminate and communicate information in the field of commerce'* to ensure they develop into life-long learners and to enhance their employability and careers.

Pilot Case Study: Commerce

As part of a major course review, a cross functional team, through innovation and leadership, led the effective design, development and integration of the Digital Literacy Module (DLM) within a large bachelor of commerce degree to provide premium learning experiences underpinned by the use of digital technologies. The DLM, is an online interactive and media-rich learning tool supported by active learning design, authentic activities and scenario-based learning aimed at developing digital literacy skills within undergraduate students first year of study in an Australian higher education institution. The DLM was implemented within a common core first unit. The implementation commenced in trimester 1 of 2016 resulting in great student learning success. For students in their first year of study, the DLM provided a foundation set of digital literacy skills, including knowing how to access information in many different formats and diverse sources, critically analyse and evaluate these sources as well as creating new knowledge and appropriately use technology to communicate information and connect with others, to help them early on in their University study.

The DLM is strategically embedded as a required assessment task assessing Digital Literacy skills. The Library team worked together with the Course team to build the DLM and contextualised the content for the broad business discipline. The DLM covers the three elements of digital literacy: *find*, *use* and *disseminate* and was mapped to the University's Digital Literacy Framework (Deakin University Library, 2014). The University's framework is cited as a best practice exemplar in the NMC Horizon report 2016 (Alexander, Adams Becker, & Cummins, 2016). The DLM is equally accessible to all students, both campus and cloud based, providing an equitable experience and students are able to revisit the learning tool as required through offering it in the Course hub site within the University internal learning environment. The DLM is supported by dedicated discussion forums, a direct email address, in class presentations, video and written instructions.

The team mapped the course learning outcomes for the degree to Deakin University's Digital Literacy Framework (Deakin University Library, 2014). This allowed the library team to identify the level of proficiencies of each digital literacy element required of first year students and produce a list of tangible skills the students would be expected to develop after completing the module. Using a constructive alignment approach, learning outcomes for the module were developed and activities and assessments were aligned to them (Biggs & Tang, 2007).

The DLM Tool

The DLM is an online interactive and media-rich learning resource built on the *Tumult Hype* platform, an innovative web-based and multi-media creation tool. The DLM is designed with interactive and media-rich (see Fig 1) elements guided by Mayer's (2014) multimedia principles to help guide the use of clear and multimedia instruction through appropriate use of words and graphics to foster learning. The learning design is based on authentic activities and scenario-based learning (SBL). Authentic activities have the potential to foster meaningful intellectual accomplishment and learning, since authentic learning activities are directly related to students' real-life experiences (Herrington, Reeves, Oliver, & Woo, 2004). An authentic industry aligned workplace scenario was used whereby students work for a consulting firm whose team have been asked to work with a company that offers accommodation in QLD. Coupled with SBL, the DLM supports active learning strategies that simulates a workplace industry scenario (Clark & Mayer, 2012; Dahl, 2004).

Using a scenario-based approach, a threaded narrative guides students through the module's content and activities, connecting each section together in a logical way. The use of scenarios has been shown to generate authentic learning experiences in higher education (Agostinho, Meek, & Herrington, 2005; Diekema, Holliday, & Leary, 2011). Using a scenario allowed us to develop an experiential learning environment via virtual workplace learning enabling students to understand how digital literacy is relevant in a real-life work environment. The scenario also aligns with the University's focus on work integrated learning and employability. The scenario was contextualised to an authentic work-based setting where the student takes on the role of an employee in a small consulting firm. A fictional manager appears regularly throughout the module to provide context for the scenario and assign tasks that the student has to complete.

Being delivered wholly online the library embedded activities to encourage active learning and participation from students (Dowell & Small, 2011) and to help increase engagement and motivation (Diekema et al., 2011). Students are required to actively engage with the scenario, to learn by doing tasks that replicate something they would do in a real-world setting. This has a two-pronged effect, assisting in developing their digital literacy skills for employability, as well as the required skills for studying.

The DLM is integrated with MMK101's assessment allowing a focus on scaffolding of learning. The DLM has three sections based on the current Deakin Digital Literacy definition of 'using technologies to find, use and disseminate information' (Deakin University, 2018). 1. Find: How to find information and use *databases in the library; 2. Use: How and when to use different information types and assess their quality; and 3. Share (Disseminate) – ethical use of information and tools for sharing*. Initially, to open the first section of the DLM, students are required to self-assess their digital literacy skills through a short survey. Students then progress through each section where they are directed through different activities designed to teach them first year level skills in DL. Each section is concluded by students completing a short multiple-choice quiz where they are required to achieve a result of at least 80%. The next section is locked and inaccessible until students achieve the 80% passing grade. The DLM is finalised when students complete a post-DLM survey reflecting on what they have learnt and what they believe their digital literacy skills are following all the activities. Further, the DLM is a hurdle requirement that must be completed in the first three weeks of the trimester. Completion of the DLM is required to unlock their first assignment submission dropbox, without which students would forfeit 20% of their final grade in the unit. Each section is set with conditional release in CloudDeakin to ensure students progress and complete each section in order. Upon successful completion students are issued with a certificate of completion which they can download as a pdf for their records and the dropbox for their first assignment opens.

Scaffolded support is provided to students undertaking the DLM with instructions available in different formats. Written instructions are embedded into the assessment documents and in the unit site along with a captioned video. Librarians present to students on multiple campuses and answer questions in live-streamed classes which are also recorded and housed on the unit CloudDeakin site, and monitor a dedicated email address and discussion forum for the DLM which contains a set of frequently answered questions. The DLM also provides students with a pdf that captures their answers to activities they have completed that can be saved for future reference in addition to the certificate of completion, both of which can be added to their ePortfolio.

Figure 1: Sample screengrabs of the Commerce DLM

Outcomes

The integration of the DLM in the core unit of the BCom involved a comprehensive scaffolding of learning and support by a multi-disciplinary team across the university working successfully to deliver premium learning, resources and experiences. The success of knowledge skill building across the whole course improved eVALUate results as demonstrated by the MMK101 eVALUate results (student evaluation of the unit, its resources, experiences and the teaching within it) since the DLM’s inception in T1 2016 (over 5,000 students, from T1 2016 to T3 2017, see Table 1). All eVALUate measures in the unit have improved *markedly* over time. This is evident in key indicators such as Q2, which asks students whether the learning experiences provided helped them achieve the learning outcomes. This measure improved from 78% agreement in T1 2016 to the most recent results in T3 2017 of 93%. When asked whether the learning resources in the unit helped them achieve the learning outcomes (Q3), student agreement increased from 79% in T1 2016 to 91% in T3 2017. Further, students’ overall satisfaction in the unit (Q11) has dramatically improved from 66% in T1 2016 to 91% in T3 2107. This coincides with the implementation of the DLM in T1 2016, which provided students with the resources to develop skills and knowledge in the area of digital literacy, skills and knowledge they then use in future assessment tasks in this and all other units of study.

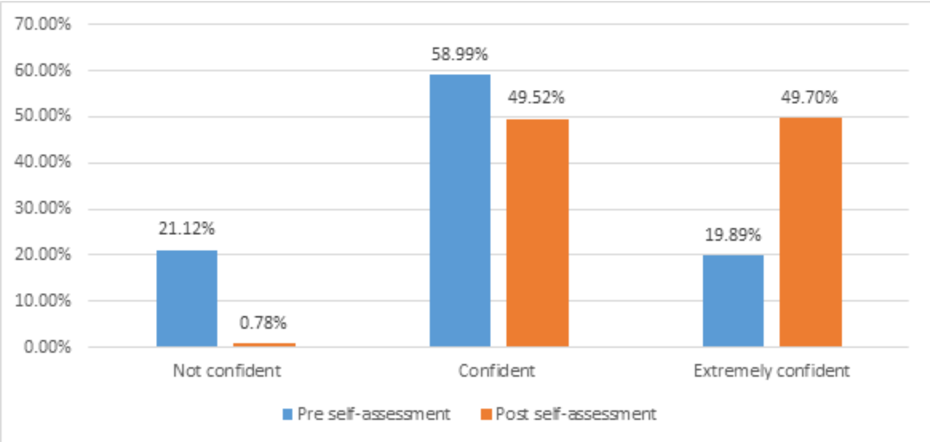
Table 1: Student satisfaction results from MMK101 T1 2016 to T3 2017

TEACHING PERIOD	ENROLL-MENTS	Q1 LEARNING OUTCOMES	Q2 LEARNING EXPERIENCE	Q3 LEARNING RESOURCES	Q4 ASSESSMENT TASKS	Q5 FEEDBACK	Q6 WORK-LOAD	Q7 TEACHING QUALITY	Q11 OVERALL SATIS-FACTION
2017 T3	452	93	93	91	91	89	89	93	91
2017 T2	708	97	97	94	97	92	92	94	97
2017 T1	1549	91	86	87	86	82	89	82	84
2016 T3	498	99	95	91	91	91	93	95	95
2016 T2	962	87	82	86	80	77	79	82	81
2016 T1	1533	84	78	79	71	74	74	76	66

Feedback in teaching and learning experiences is a vital tool that recognises, corrects, encourages and challenges student performance. Through the DLM the team utilised feed-forward feedback through the modules contained within the DLM, and the quizzes at the end. The due date for completion of the DLM is set two weeks before students' first written research-based assessment task is due, encouraging their new skills be applied in completing this task. This then feeds forward and can be utilised to demonstrate knowledge in all areas of digital literacy to support their learning in MMK101.Students can use the feedback provided within the DLM to improve their future assessment work and demonstrate the skills and knowledge they have developed, to a much higher standard than they could without the DLM. Further, feedback from students to improve the DLM each trimester was also used to better facilitate quality student learning experience via student feedback through the DLM, a designated MMK101 CloudDeakin DLM discussion thread, unsolicited emails from students and eVALUate data are collated, reviewed and analysed to ensure the DLM is aligned with students' needs. This process focusses on a continuous improvement model where the team focused on learning outcomes, skill development and student needs. By the end of T3 2017 a total of 5,379 students had completed the DLM.

Overall, DLM statistics show a significant overall increase in student confidence moving from 21% of students not being confident in their digital literacy skills before completing the DLM, reducing to less than 1% of students not being confident in their digital literacy skills post completion (Figure 2). Students’ mid-level of confidence in their digital literacy skills decreased from 58.99% prior to completing the DLM to 49.52% after completion, but this was compensated by the students' level of extreme confidence in their digital literacy skills increasing from 19.89% before completing the DLM to 49.70% after completing the module.

Figure 2: Overall percentage student confidence levels in digital skills



Confidence in individual digital literacy skill areas, including use of advanced searching techniques, finding peer-reviewed journal articles, critically evaluating quality information, finding scholarly overviews without using Wikipedia or Google, and checking copyright permissions, all increased dramatically (Table 2).

Table 2. Percentage student confidence levels in digital skills

	Pre-Module Self-Assessment			Post-Module Self-Assessment		
	Not Confident	Confident	Extremely Confident	Not Confident	Confident	Extremely Confident
Overall student confidence levels	21.12	58.99	19.89	0.78	49.52	49.70
I am confident in using advanced search techniques to find specific information	13.93	66.91	19.17	0.43	47.61	51.96
I am confident in finding peer reviewed journal articles for my assignments	21.16	57.32	21.52	0.87	45.43	53.70
I can critically evaluate quality information for my assignments	12.30	65.64	22.06	0.65	49.57	49.78
I am confident I can find a scholarly overview on a topic, using library resources (not Wikipedia or Google)	20.61	58.59	20.80	0.43	52.39	47.17
I know how to check the copyright permissions to share and reuse an image	37.61	46.47	15.91	1.52	52.61	45.87

As part of the post-completion self-evaluation contained within the DLM, students were asked about the perceived benefits they received from the DLM. Two key themes identified – the value of the skills students developed, and the benefits gleaned from the design of the module itself. Students clearly valued the skills they were able to develop and the knowledge they gained in digital literacy. Students clearly perceived that they learned key information about the Library and Library resources available to them. As one student explained succinctly, "*overall, I learned there was a lot I didn't know about the Deakin library*". The ability to search for relevant information more efficiently and effectively was identified as a skill set developed by students: "*I also improved the awareness of the way I should search*" and "*this module has really expanded my understanding of the proper use of data and information*". The DLM also highlighted that students had little prior knowledge of copyright and copyright permissions – "*copyright of images was something I was unaware of previously*".

Beyond the knowledge and skills developed, the design of the DLM was identified as a key benefit. Students perceived "*the module was interactive, easy to follow and has great information*", and that there was a "*massive* *amount of information provided*". Students reported that the benefits of the DLM enabled them to develop further, as self-directed learners, as "*more than informative, I believe it has mostly built up my confidence*" and that they will "*use the knowledge gained for my studies and career*".

The scaffolded learning and support model taken to integrate the DLM in the BCom course and unit incorporating feed forward and feedback and a continuous improvement has improved the student learning experience. Due to the innovative DLM, student success and retention has increased markedly as a further demonstrated measure indicating the enhancement provided in teaching and learning and the student experience. The increases in student success and retention has clearly had a positive impact on our equity-based students as shown below. It can be clearly demonstrated that from T2 2015, when the DLM did not exist (Table 3), through to T3 2017, when the DLM had been embedded in MMK101 every Trimester for two academic years, success, retention and, most interestingly, success of equity-based student cohorts have all increased (Table 3).

Table 3: Percentage student success and retention before (2015) and after (2016) DLM implementation

Student cohorts	**Percentage**		**Unit success rate**		**Mean mark for unit**		**Percentage not completing unit**	
	2015	**2016**	**2015**	**2016**	**2015**	**2016**	**2015**	**2016**
All students			**68.2%**	**82.6%**	**56.2**	**55.0**	**4.0%**	**2.0%**
International students	6.6%	42.1%	84.6%	88.1%	54.8	54.0	0.0%	0.9%
Domestic students	**93.4%**	**57.9%**	**67.0%**	**78.4%**	**56.3**	**55.8**	**4.3%**	**2.8%**
Low SES students	10.8%	12.4%	70.0%	82.4%	54.0	55.3	0.0%	0.0%
Regional and remote students	19.5%	18.6%	61.1%	81.1%	52.3	57.4	2.8%	2.8%
Students with disability	5.9%	6.6%	54.5%	88.9%	49.2	63.1	0.0%	10.5%

The student success rate has increased by almost 15%, attrition rate has halved, while amongst equity-based student cohorts the success rate has increased even further to between 10-30%, as well as their mean final mark in MMK101 also increasing.

Across all students in the unit, the success of the DLM was reflected in their achievement of the learning outcomes in the unit. In the assurance of learning of digital literacy demonstrated by students in the unit summative assessment, results have improved dramatically. This clearly demonstrates the value and impact of the DLM in teaching and learning.

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Swimming in unchartered waters: A case for developing lecturers of English in Vietnam higher education

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The changing landscape of global higher education, due to the increasing use of educational technology, has become 'unchartered waters' for many university lecturers. Continuing professional development (CPD) that aims to support lecturers to 'swim in the unchartered waters' has become a priority in many countries. However, CPD tends to be competency-based with little attention given to lecturers' motivations. This paper presents a conceptual framework that helps to explore CPD for lecturers teaching English as a Foreign Language (EFL) with technology in the Asian context of Vietnam higher education. It unpacks the important elements of CPD for the 21st century EFL lecturer through the lens of Self-Determination Theory (Deci & Ryan, 1985) and the Technological Pedagogical Content Knowledge Framework (TPACK) (Mishra & Koehler, 2006). Accordingly, three psychological needs for competence, autonomy, and relatedness are identified as being essential elements for CPD, with TPACK specifying lecturers' competence. This new CPD approach can guide EFL teaching practice and CPD policy in Vietnam and other similar contexts.

Introduction

The 21st century has been a time of dramatic change in higher education in part due to the increasing use of educational technology. Several decades ago, good teaching required sound pedagogical content knowledge (Shulman, 1985), that is, teachers' knowledge of using appropriate methods to teach a particular subject. With the increasing use of educational technology, the question of how technology can be used to support the teaching and learning of a particular subject has become a focus for many university teachers. Consequently, how these teachers can best be supported in their endeavours to integrate technology is a critical area for researchers to explore. Mishra and Koehler (2006) introduced the Technological Pedagogical Content Knowledge (TPACK) framework that describes the capabilities required of teachers to integrate technology into teaching with seven constructs: Content Knowledge, Pedagogical Knowledge, Technological Knowledge, Technological Content Knowledge, Technological Pedagogical Knowledge, and Technological Pedagogical Content Knowledge. TPACK has since been widely used for both pre-service teacher education and in-service teacher professional development. TPACK helps guide continuing professional development (CPD) approaches to support in-service educators in teaching with technology in the 21st century. However, TPACK only focuses on teachers' competence, or the core knowledge that teachers require to teach a subject with technology. TPACK does not address other needs of teachers, such as beliefs and motivations, which are important for their professional becoming (Friedman & Phillips, 2004; Kennedy, 2014; Scanlon, 2011).

This paper will present an ongoing doctoral research study on continuing professional development (CPD) for lecturers teaching English as a foreign language (EFL) with technology at Vietnamese universities. In particular, the paper focuses on the development of a conceptual framework for "Becoming a 21st century EFL lecturer in Vietnam", which combines two Western theories to examine CPD in an Asian context. The paper begins by describing the context where the study is situated, the research problem and research questions, the research design and especially the conceptual framework that guides the investigation. It then discusses preliminary findings from a focus group used to validate the conceptual framework. The paper concludes by outlining the future directions of the study.

Background of the study: Vietnam

Learning and teaching in the 21st century have been significantly influenced by the integration of technology in educational settings. The Vietnamese government has responded to this trend by investing in ICT to improve the quality of higher education broadly, and English language education in particular.

The aim is to enhance graduates' language competence to enable better global integration (Dinh, 2015). Most noticeably, in 2008 the government launched the National Foreign Language Project 2020 worth millions of US dollars to promote foreign language learning and teaching (English in particular) via the use of communicative language teaching approaches integrating technology (Project 2020, 2016). The project also prioritises professional development as one of the important tasks to improve the quality of teaching and learning. However, the results remain limited. The problems include (1) the traditional view of professional development as a deficit model with the main purpose of updating teachers' knowledge and skills, as reflected in important documents issued by the Vietnamese government (i.e., HERA 2005; Tertiary Education Law 2012; Strategic plan for educational development 2011-2020); (2) limited opportunities for EFL lecturers' CPD (Dang, Nicholas, & Lewis, 2012b; Dinh, 2015); and (3) irrelevant CPD which is not needs-based (Tran, 2016). Therefore, CPD in Vietnam remains an under-researched area (Harbon et al., 2014; Nguyen, 2016; Tran, 2016; Vietnamese Prime Minister, 2012), lacking both a theoretical background and practical directions to support the challenging work of the 21st century EFL lecturer.

Kennedy (2014) discusses a transition in CPD approaches, from the traditional view focusing on technical knowledge and skills and teachers' passive role in their learning, to a constructivist view valuing lecturers' needs and motivations in their professional becoming, with individuals taking an active role in their development. This constructivist view of CPD has been shown to be relevant to the Vietnamese context (Nguyen, 2016; Nguyen & Sunggingwati, 2008; Tran, 2016). However, to date there has been no large-scale study that examines a CPD framework for becoming a 21st century EFL lecturer in Vietnam, which takes into consideration the complexities of lecturers' professions when they have to teach English in a communicative approach with technology. The research study, therefore, aims to explore such a CPD framework by addressing the following overarching research question: What are the key elements of a CPD framework for the 21st century EFL lecturers in Vietnam?

The research design

The study adopts mixed methods in an exploratory sequential design with "qualitative data collection and analysis in Phase 1 followed by quantitative data collection and analysis in Phase 2, which builds on Phase 1" (Creswell and Clark, 2011, p. 73).

The study began with a review of the literature to inform the development of a conceptual framework for "Becoming a 21st century EFL lecturer in Vietnam" (described below). In Phase 1 of the current study, a focus group was conducted with nine Vietnamese EFL experts to validate the conceptual framework. The experts were studying and working in Melbourne with various experiences in EFL teaching in different universities across Vietnam. Specifically, the focus group helped to unpack EFL experts' perceptions of the importance of competence, autonomy, and relatedness in their teaching practice and professional development. The focus group data will guide the design of an online practitioner survey in Phase 2. The survey will be administered to EFL lecturers in Vietnam to continue the validation of the framework with broader data about lecturers' perceptions of what is important for their practice, their career development, and CPD expectations. The mixed data analysis will provide a comprehensive understanding of the current EFL teaching practice in Vietnam Higher Education to inform relevant CPD of the 21st century EFL lecturer in Vietnam.

The conceptual framework for "Becoming a 21st century EFL lecturer in Vietnam"

The conceptual framework has been developed from the literature on teacher professional development, focused on CPD in higher education for in-service and pre-service teachers, on a global scale and taking into consideration the Vietnamese context.

Firstly, the study attempted to conceptualise CPD in the Vietnam Higher Education context as professional becoming (Scalon, 2011) that requires not only the development of competence but also teachers' values and beliefs (Friedman & Phillips, 2004; Kennedy, 2014). The study adopts a constructivist ontology that views lecturers as active learners, social learners, and creative learners in the process of learning as becoming (Perkins, 1999). Accordingly, learning is actively achieved through discussion, debate, hypothesis formation, investigation, reflection, and taking viewpoints. Learning is also socially constructed via dialogue with others, or through collaboration. Finally, as creative learners, learning takes place as knowledge and understanding are created and recreated. The constructivist ontology, therefore, underscores the importance of teacher autonomy and relatedness in the construction of teacher knowledge and competence.

Secondly, the review of the literature centred on studies describing CPD approaches that support the use of educational technology in teaching practice such as those published in the most recent TPACK book by Mishra, Koehler & Herring (2016). In the chapter on in-service TPACK professional development, the authors summarize the most effective approaches to CPD, and these approaches share a similarity with Kennedy (2014) in their aims to meet the teacher needs for competence (TPACK), autonomy (by providing opportunities for individual free choices of preference), and relatedness (collaboration in CPD). Though there has been rare research using the lens of Self-Determination Theory to explore CPD concerning TPACK, this lens is helpful for the current study in Vietnam.

The conceptual framework that has been developed from the literature review is outlined below in Figure 1. The framework is grounded in Self-determination theory (Deci & Ryan, 1985, 2000). The competence element of the conceptual framework is focused on technological competence and is informed by Mishra & Koehler's (2006, 2009) Technological Pedagogical Content Knowledge (TPACK) framework.

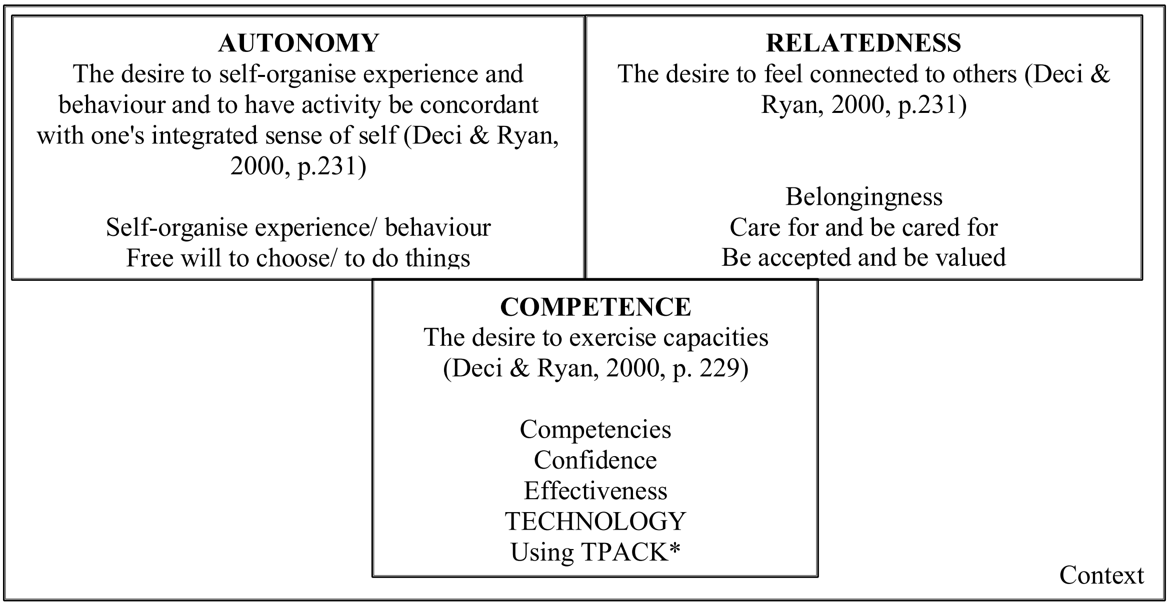

Figure 1: The Conceptual Framework for "Becoming a 21st century EFL lecturer in Vietnam"

Self-determination theory

Self-Determination Theory is a theory of motivation that emphasises the satisfaction of three psychological needs - competence, autonomy, and relatedness - to achieve motivation and well-being in professional life. This theory is well aligned with the constructivist ontology and provides a lens for the exploration of EFL lecturers' experience of competence, autonomy, and relatedness in becoming a 21st century professional in Vietnam. Autonomy refers to "the desire to self-organise experience and behaviour and to have activity be concordant with one's integrated sense of self" (Deci & Ryan, 2000, p.231), or the desire to have free will to choose and do things. Relatedness refers to "the desire to feel connected to others" (Deci & Ryan, 2000, p.231), or it can be understood as the feeling of belongingness, care for and being cared for, being accepted and valued. Competence is "the desire to exercise capacities" (Deci & Ryan, 2000, p.229), or the feeling of being competent, confident and competent in doing things.

Technological Pedagogical Content Knowledge (TPACK) framework

TPACK attempts to identify the nature of knowledge required by lecturers for technology integration in their teaching while addressing the complex, multifaceted and situated nature of lecturer knowledge. Hence, TPACK fits well with the competence element of the Self-determination theory and can be used to clarify seven types of knowledge EFL lecturers need to effectively teach with communicative language teaching approaches and technology. Koehler & Mishra (2009) define these knowledge as: teachers' knowledge about the subject matter to be learned or taught (CK); teachers' deep knowledge about the processes and practices or methods of teaching and learning (PK); teachers' knowledge about working with technology, tools and resources; and adapting to changes in information technology (TK); teachers' knowledge of pedagogy that is applicable to the teaching of specific content (PCK); teachers' understanding of the manner in which technology and content influence and constraint on another (TCK); teachers' understanding of how teaching and learning can change when particular technologies are used in particular ways (TPK); and the basis of effective teaching with technology, teachers' understanding of the interactions among content, pedagogy, and technology knowledge (TPACK).

There are three contributions that the study can make with the development of the conceptual framework to explore CPD approaches for Vietnamese EFL lecturers. Firstly, from the practical aspect, the framework can guide CPD policy to address the problem of limited CPD theoretical foundation and directions. Secondly, regarding conceptual contribution, the study will contribute to the understanding of Self-Determination Theory and TPACK in a cultural setting other than Western culture. The researchers will investigate how each construct, such as competence, autonomy, relatedness, and the seven types of TPACK knowledge are conceptualised in an Eastern collectivist culture such as Vietnam. Thirdly, this is the first study that the researchers are aware of that combines Self-Determination Theory with TPACK to explore CPD for the 21st century EFL lecturer. TPACK only focuses on the core competencies of teachers but neglects their other needs for autonomy and relatedness. Self-determination theory can, therefore, broadens the TPACK framework to include these constructs.

Discussion and future directions

Preliminary findings from the focus group with Vietnamese EFL experts validated the importance of competence, autonomy and relatedness as essential elements of CPD for the 21st century EFL lecturer. The experts reported that to them competence means meeting the government's competence standard for EFL teachers. Regarding TPACK competencies, they found it difficult to distinguish between the seven TPACK constructs since they did not have significant experience in teaching with technology. Similar to the findings of Dinh (2015), the experts could only distinguish between Technological Knowledge (working with technology) and non-Technological Knowledge, such as CK, PK, PCK, because they were not trained to teach with technology. This suggests that TPACK-based CPD is vital for EFL lecturers in Vietnam.

The EFL experts perceived their autonomy as free choice in making their own decisions in their teaching practice and CPD, but reported the need for support from institutions and leaders and to have opportunities and resources to make their own choices. This is referred to as "autonomous interdependence" where autonomy is the product of interdependence rather than independence (Ryan, 1991, p. 227, cited in Littlewood, 1999, p. 74). According to Littlewood (1999, p. 74), in the collectivist culture, autonomy is exercised with relatedness, that people "need to feel not only autonomous but also part of a social network". As a result, autonomy develops most effectively in an interpersonal environment which supports it. However, the experts in the focus group argued that autonomy could be a drawback if it was not accompanied by competence. This is because incompetent lecturers may make a choice that is not good for students and thus impacts the quality of teaching. Accordingly, they supported the idea of a certain level of control in relation to autonomy. This suggests that to exercise autonomy, EFL lecturers need to experience relatedness and competence.

Regarding relatedness, most participants felt connected with others in their work and their CPD. However, they mentioned a feeling of "split belongingness", both to their institution, and to other parties given the fact that they also worked for businesses, and taught extra or private classes to earn their living. Participants also emphasised connectedness not only inside but also outside of the institution, with various stakeholders such as colleagues, mentors, parents, and students.

Responses from the focus group suggested including the context in the conceptual framework since teacher CPD is “bounded within a dynamic social, cultural, and political context of lecturers’ learning” (Tran, 2016, p. 249) and influenced by the politics and policies (e.g. individual versus collective culture, educational reform, and institutional policy) (Day& Sachs, 2004).

In conclusion, this paper presents a doctoral research study on CPD approaches with a focus on the development of a conceptual framework to support the becoming of the 21st century EFL lecturer in Vietnam. This conceptual framework provides a new way of viewing CPD regarding TPACK for Vietnamese higher education and other similar settings. The next step of this study is to develop and administer the practitioner survey to EFL lecturers working in Vietnam to collect further data on lecturers’ perceptions of what is important for their practice, their career development, and CPD expectations to further refine the framework. The study reflects a message that in order to empower teachers to ‘swim in unchartered waters’, CPD approaches should meet their needs for competence in teaching with technology, autonomy and relatedness.

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Changing technologies and assessment redesign: factors impacting implementation and participation

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This project reviewed current assessment practice across a School at a large University in Melbourne through analysis of student Course Experience Surveys (CES), desktop analysis of course guides, teacher interviews and student focus groups. Based on the findings, targeted resources were designed and professional development activities delivered to teachers to improve assessment and feedback processes in an environment of changing educational technology contexts. Analysis of qualitative CES data identified the most significant issues with assessment design and implementation, and this was used as a reference point and in communication with teachers to promote an understanding that assessment design impacts student learning and achievement.

The development of resources and delivery of professional development activities to improve assessment design were undertaken during a period of significant technological change at the University. A new Learning Management System (LMS) was implemented and all courses were required to have an online presence and comply with a set of guidelines. The impact of this significant change on academics and students was examined to determine whether institutional technology implementation facilitates or hinders efforts to improve assessment and feedback processes in the context of learning and teaching practice.

Keywords: Assessment design, LMS, educational technology, course experience survey, change management

Introduction

The project's aim was to enhance the practice of assessment that supports learning by reviewing and challenging existing understandings of assessment and feedback practice, and supporting academics to embed improvements in their courses (Sadler & Reimann, 2018). With the introduction of a new LMS there was an opportunity to rethink assessment and feedback practices through technology change and increase staff awareness and capability for assessment for learning through aligned and innovative curriculum design. The professional learning activities being undertaken attempted to shift assessment practices to position them as central to the curriculum and align teaching, learning, assessment and feedback as interdependent activity (Boud et al., 2018). The project data has been collected after only one semester of implementation of the new LMS. This paper aims to generate discussion around how educational technology change is best undertaken at Universities to maximise the beneficial impact on assessment practice and student learning.

The introduction of new technologies can be destabilising for academics and effective adoption for assessment design is often inconsistent (Bennett, Dawson, Bearman, Molloy, & Boud, 2017). In a sector that rewards discovery, promotes the generation of new ideas and practice, and celebrates innovation, it is anomalous that the introduction of new teaching technologies is unsettling for academics. This research asks why such change is unsettling to teachers and whether support strategies can be implemented to equip teachers with the capabilities to embrace and exploit this disruption in order to enhance their teaching practice and assessment design.

Presentation of CES data in the context of the professional learning activity for teachers aimed to connect teachers with the decisions they were making about assessment design and the impact on student's interpretation of the assessment tasks. Although this scrutiny can be challenging for teachers, the focus on the personal and social aspects of learning can shift teachers' assessment strategies from the didactical to a more social constructivist approach. Fraser, Kennedy, Reid, and Mckinney (2007) propose that such a focus will provide opportunities for greater ownership and control of the process and are more likely to result in transformational professional learning for teachers.

Ownership and control are critical factors in the successful implementation of learning management systems and impacts the engagement of students and teachers on their application and use. Engagement in educational environments has been characterised by collaboration; project-based delivery; and an authentic real-world focus (Kearsley & Shneiderman, 1998). If we were to extend this to teacher engagement in the use of the LMS for enhancing assessment design, this would include being involved with peers in using the technology, ensuring the implementation project aligns with their academic practice, and a connection with their discipline within a societal context. The data in this project is analysed through this lens and investigates whether teacher identity and the community they operate in are factors impacting on successful assessment enhancement in the context of this technology change.

Methods

This project adopts multiple data collection methods including: desktop analysis of course guides; teacher interviews; student focus groups; CES data; and online questionnaires. Data was collected from students in order to get their appraisal on task related efficacy and engagement and identify issues of clarity and alignment. This enables student voice to be an integral component of the improvement for assessment and feedback design by providing insight into students' learning experiences (Campbell, Beasley, Eland, & Rumpus, 2007). In addition, course guide data is reviewed to understand student's experience of assessment tasks and implications for their engagement and performance (Lizzio & Wilson, 2013) and provides a basis for interpreting CES data.

The iterative collection and analysis of data will continue over the coming semesters to evaluate the continuous learning of academics in the improvement of assessment and feedback processes. The research examines this learning within the context of the shift to a new LMS, however we also need to consider the contexts in which the change is situated. This includes the physical and digital spaces that academics work in, and institutional, social and interactional elements (Ang, Zaphiris, & Wilson, 2010). These elements involve cooperative partnerships with a variety of professions, each of whom have their own professional cultures, management protocols, and understandings. The research adopts an Activity Theoretical framework (Engestrom, 1987) as an approach for understanding the differing objectives that participants bring to any activity, and to reveal the contradictions in practices that are generated as a result.

Activity theory describes contradictions that drive transformation (Kaptelinin & Nardi, 2012). In the context of implementing new educational technologies there are contradictions between achievement of institutional strategic initiatives and the impact that the priorities of teacher's professional identities have on progressing the institutional goals. Sharples, Taylor, and Vavoula (2010) describes the technological layer of Activity theory as being concerned with human engagement with technology, whereby the technological tools function as interactive agents in communication, mediation and reflection. In this project the LMS serves as this technological tool for teaching and learning.

Discussion

What students are saying about their assessments

Qualitative CES data was collated over two semesters across 343 courses (see Figure 1). Keywords about assessment were searched for in student comments and then each result was reviewed and using NVivo, themes were generated based on this review. Analysis of the CES data revealed student perceptions of ambiguity in assessment and feedback, with the top five issues identified in order of priority as:

- confusing criteria
- inadequate assignment resources
- lack of alignment between assessment task and course learning content
- inadequate feedback
- inconsistent assessment task information

The issues with assessment design and communication (see Figure 1) are represented by the number of times a specific issue is raised by students in their comments on the CES. This data was supported by comments from students in focus groups and an online questionnaire. The CES data was used to frame professional development activity in assessment design, and workshops that were conducted targeted the top issues raised in the data. The connection between what students were saying and improving task design to address this feedback ensured traction in the activities. These activities focused on clarity of assessment task writing; writing rubric criteria that provided developmental feedback to students; discussion of appropriate resources to supplement assessment tasks such as graded assignment examples; and aligning learning outcomes with authentic assessment tasks.

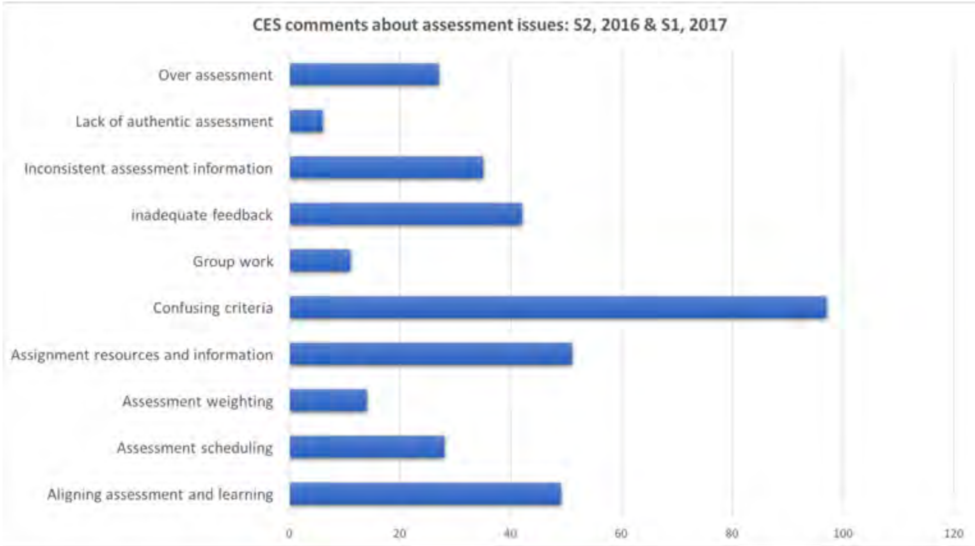

Figure 1: CES data

All activities were conducted using the new LMS to ensure alignment with teachers' practice, however in these sessions observations indicated tensions in teachers between the learning of strategies to improve assessment design and the learning of new tools in the LMS. Learning the procedural steps to understand the functionality and operations of the LMS provided significant cognitive challenge to teachers. Attempts to contextualise this in the workshops by considering ways of improving assessment design using the LMS proved difficult. However, providing examples of best practice or contextualising within a pedagogical framework has been shown to ensure a more successful implementation experience (Ryan, Toye, Charron, & Park, 2012).

Possible factors that caused tension in staff undertaking the professional development could have been the lack of opportunity to contextualise the training, and not enough time allocated within discipline settings. This is supported by research that indicated teachers were genuinely concerned about the time and effort needed to make a successful transition to a new LMS in their courses, and the impact on students (Smart & Meyer, 2005). In order to learn the LMS effectively consultation and training is required, as well as a strategy that engages teachers along with their peers, in discipline focused activity (Ge, Lubin, & Zhang, 2010).

Approaches for improving assessment design

In order to build teachers' capacity in appraising their assessments and improving design, an interactive resource was developed by academic developers from the Institution. The resource provided definitions, links and activities. The aim of the resource was to:

- develop teachers' understanding of assessment concepts and good practice
- enhance teacher understanding of alternative assessment strategies
- align with the LMS implementation project

The interactive resource was referred to in professional learning activities and provided as a stand-alone resource on an institutional Learning and Teaching blog. The resource, referred to as the Assessment Map (see Figure 2) was designed around the concept of a path or map that provided a combination of non-linear just-in-time access to resources, as well as an adaptive sequential approach to activities (Adachi & O'Rourke, 2015) that contextualised assessment design within the LMS. The Assessment Map provided an engaging graphical metaphor, aligned with institutional strategic goals and policy, linked to institutional services and processes, and served as an adaptable living resource.

Figure 2: The Assessment Map

Measuring success

The research project will continue to interview teachers over the coming semesters to measure whether the development of resources, professional development and training activities have had a systemic effect on improving assessment design. We have developed a baseline with two semesters of CES data, course guides and some interviews and focus groups. Further analysis of how the LMS is being used with regards to assessment design will be undertaken. Student survey results and comments from the staff interviewed indicate that the new LMS has had a positive impact on assessment design. In one course 86% of students strongly agreed or agreed that the new LMS provided clarity of assessment tasks, however this data cannot be treated as significant or compared to the CES data which surveyed multiple cohorts across many courses. Teachers' comments provide evidence that the new LMS has positively impacted on assessment design and delivery, but once again due to the small numbers interviewed this is not necessarily representative of the whole teacher cohort.

Anecdotal evidence suggests that many teachers are not engaging with the uptake of new technologies, in particular the shift to the new LMS. It is useful to ask why this is. Statements from academics to explain the frustrations with meeting institutional targets focused on the amount of time allocated to training or the level of individual support. However, often when this individual support was provided the result was that the learning designers or support staff ended up configuring the learning content for the academics in the LMS to achieve University targets. Many online education providers implement a model where learning designers configure content and discipline experts deliver the subjects. However, in the context of this project, we are examining capacity building of academics to review their assessments and utilise online tools to manage and improve this process.

Some of the interviews undertaken provide evidence that the tensions between successfully introducing new educational technologies, and teachers maintaining and developing their professional expertise have actually driven the transformation of the Activity system and progressed institutional goals. This is observed in teachers who participated in the pilot LMS implementation who used this opportunity to innovate and enhance their professional skills. However, there were more resources and support for teachers participating in the pilot stage and subsequently this may not be representative of whole of institution transformation.

Concluding remarks

The project has involved developing resources and providing professional development opportunities for academic staff to build their capacity to reflect on their practice in designing assessments. The aims have been for teachers to use new educational technologies to improve assessment design and feedback. Conflicts between institutional strategic goals and development of academic staff's ongoing professional practice has in some instances created tensions and prevented teachers from focusing on the goal of improving assessment design through the activities, and not meeting strategic requirements for implementing the LMS. In other cases, teachers have capitalised on the technology change and used the opportunity to reflect on their assessment design and explore new uses of tools within the LMS to improve student outcomes. The research will continue to explore the tensions and contradictions in progressing teacher professional development activity in the context of the introduction of new educational technologies at an institutional level.

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Group work in IT: Investigating the student learning experience

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It is well known that students dislike working in groups. However, preparing students for the workplace is important and part of the graduate attributes for each university. As such, group work can be seen as an integral part of university assignments for many students. This paper reports on the group work experiences of IT students who complete a team work assessment as part of one of their subjects. Most students in the cohort study online which can add some complexity to the team work process. Most students felt that all members of the team were given an equal opportunity to contribute, with students reporting they generally worked at least adequately well together. One of the obstacles to working together was reported as working together online due to not being able to meet face to face. Overall, with scaffolding, working as a team does not have to be a negative experience for students and can provide deep learning.

Keywords: online learning; teamwork; group work; project-based learning

Introduction

It is well known anecdotally that ‘group work’ in an educational setting is disliked by students and staff. This is often due to the belief that less capable students do not fully participate or contribute, relying on more capable students to complete the required work (Sofroniou & Poutos, 2016). The capable students therefore spend time resenting other group members and less capable students are possibly being rewarded for work they did not do. Poor design of learning activities significantly increase the likelihood of such problems arising (Weimer, 2016). Thus, in this study it was therefore the aim of the lecturer to design a series of learning tasks that reduced the likelihood of these problems occurring. This paper shows the results of the study in which students reflect on their team work experiences and how it assisted them to complete the team assignments.

With this in mind, two subjects taught by the School of Computing and Mathematics ITC218 ICT Project Management and its paired subject ITC505 ICT Project Management have been identified within their subjects as suitable for addressing team work so that it may further foster deep learning. Based on constructive alignment and using a learning design approach, the subject assessments have been modified to incorporate team work and peer to peer interaction. A backward design approach was used to develop assessment items, resulting in the constructive alignment of learning outcomes (Biggs & Tang 2011), while the use of scenarios and team work has enabled authentic learning.

This project investigated student perception of team work before engaging in the team work activities and after they have completed the learning activities including an assessment item, were designed using a learning design approach. Specifically, the project investigated whether students report:

- learning from their peers and teaching or sharing knowledge with their peers;
- learning more or differently through gaining different perspectives from team members, than they would have working on their own;
- the re-designed learning tasks have overcome, some or all of the known problems experienced while participating in team work in an educational setting.

One of the key concepts of learning design is the ability to re-use frameworks or templates. This is so that innovation and best practice can be shared, whilst conserving resources. It is envisaged that if the re-design of the learning tasks are deemed successful, that the framework, or learning design may be re-used in other subjects and disciplines to enable successful peer to peer learning.

It is the intention of the researcher when designing the assessment tasks for students to not only gain knowledge of project management theory, but to experience project management through team work. The aim was also for students to be able to reflect on the theory they learned in the subject and compare the reality of their team work experience (both positive and negative) and learn how they could improve their practice in future project and team work situations.

Literature review

Constructive alignment is not a new paradigm, however it has only recently gained traction in higher education (Biggs & Tang, 2011). Unlike traditional subject design that focuses on what topics are to be taught, constructive alignment uses an outcomes-based approach that focuses on which learning outcomes students are to achieve and to what level (Biggs & Tang, 2014, Biggs & Tang 2011). When using a constructive alignment approach, teaching activities and assessments are then designed to achieve those outcomes and assess the standard to which they have been achieved (Biggs & Tang, 2014).

Authentic activities can be defined as the kinds of activities "that people do in the real world that are completed over a sustained period of time, rather than a series of shorter disconnected examples" (Herrington & Kervin, 2007, p. 223). Using constructive alignment to design authentic learning tasks can provide students with real world relevance. Through collaboration and reflection, students can be given the opportunity to examine learning tasks from a number of perspectives, using a range of resources (Herrington, Reeves & Oliver, 2006). While poor design of learning activities significantly increases the likelihood of problems arising in collaborative activities (Weimer, 2016), there are a number of benefits to students when engaging in such activities. These benefits of students engaging in collaborative learning activities, include, but are not limited to:

- Engaging in subject specific discussions with peers
- Learning how to work cooperatively and support each other
- Developing effective team work and communication (including interpersonal and cross-cultural awareness) skills
- Assimilating multiple views to deepen knowledge and promote critical thinking
- Fostering individual accountability to the team
- Developing independent learning strategies
- Structuring out-of-class learning
- Mitigating learner isolation (Curtin University, 2015).

In addition, in an online space, collaboration has additional benefits for both teacher and student, such as flexibility, managing student participation and behaviour, trackability and student autonomy (Curtin University, 2015). It is widely known, that over the past 15 years, that technology-supported teaching, learning (*e-learning*), and assessment has been increasingly used in open, distance, and flexible learning. As a result, there has been significant investment in the development of learning technologies, systems, and resources (Donald, Blake, Girault, Datt & Ramsey, 2009). Although researchers have developed several definitions for the term learning design, one definition refers to the variety of ways that student learning experiences can be designed, specifically online learning experiences. It is also worthwhile noting, learning design can be described as a 'framework' to make explicit the conceptual and practical underpinnings that form a sequence of educational type activities in an online environment (Dalziel 2008). Learning Design has also been described as "the act of devising new practices, plans of activity, resources and tools aimed at achieving particular educational aims in a given situation" (Mor & Craft, 2012, p.86). It should be informed by:

- subject knowledge;
- pedagogical theory;
- technological know-how; and
- practical experience

Additionally, learning design should also encourage innovation within these areas while supporting learner efforts and aims (Mor & Craft, 2012).

Learning design as a framework supports student learning experiences ("Learning Design: The Learning Design Construct," 2003), including those online, with Oliver (1999) suggesting a learning design can be comprised of three key elements. These are: the tasks the learner is required to do, the resources that support learners to complete the task and the support mechanisms that exist from the teacher implementing it. It is learning design as a framework that provides a means of sharing innovation and best practice of successful learning activities and tasks (Campbell & Cameron, 2009). By removing subject content from successful learning activity and then breaking it down to its integral pedagogical tasks, a 'generic template' or 'learning design pattern' can be re-used. Adding content and resources to this underlying structure allows the template to be customised and therefore shared in other contexts (Cameron & Campbell, 2010).

From the literature review the following research question was developed:

1. Were the students in the subjects able to overcome common team work obstacles to work effectively as a team?

Methodology

This project uses design-based research for the methodology as it provides a "systematic, but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation" (Wang & Hannafin, 2005, p. 6). This iterative process allows for the design, redesign and development of both the teaching and data collection methods for the subjects. Thus, this paper reports on just the first iteration with the one subject with the second iteration currently being conducted.

A pre and post survey was conducted with the students. The pre-survey was conducted at the beginning of Session 2, 2017 and contained seven questions, with 19 participants responding. Background questions were asked of the students such as what year of study, age range and if post graduate or undergraduate or if studying online. They were then asked seven Likert scale questions on how they think they learn and work as a team member from their previous experience in completing group work.

The post-survey, asked at the end of the semester, contained 14 questions with 24 participants responding. Background questions were again asked as well as Likert scale questions on various aspects of team work. Students were also asked open ended questions about working in a team and about what they learned in their group and what knowledge they shared.

Results

From the 19 students who completed the pre-survey 58% (n=11) students were male and 37% (n=7) students were female and one student identified as other. Student ages ranged with only 5% or one student 21-24, 21% of students being 25-29, 16% were 30-39 and there were 37% identifying in the 40-49 age group. This suggests a very mature age cohort which is perhaps dissimilar from many other student cohorts for similar types of subjects. The students were asked to identify if they were undergraduate or postgraduate as the assessment was delivered in both of the paired subjects with 84% (n=16) checking they were post graduate students, which may in part suggest why the cohort is older than other cohorts. All of the students who completed the pre-survey were studying online.

In this survey students were asked, based on their previous experiences, whether they thought team work was a good idea. Of the 18 respondents 10 agreed, while one strongly agreed and two disagreed. The other five respondents neither agreed, nor disagreed. Students were also asked whether based on previous experience if they think they will learn more about the subject matter working in a team than they would if they worked by themselves. The results were mixed, with four who agreed or strongly agreed, and six disagreed or strongly disagreed, while nine were undecided. When asked whether they enjoyed taking part in team work, eight agreed or strongly agreed, four disagreed or strongly disagreed and seven were undecided.

At the completion of the subject students were surveyed again, and 24 students responded to the survey. All students who completed the survey studied online with only two students indicating they were undergraduate with 22 students being post graduate. The age distribution was mature with 25% of students in each of the 30-39, 40-49 and 50-59 age group with the others less than 29 years of age.

Students were asked whether they felt they learned from working as a team during the subject with eight students agreeing or strongly agreeing while 10 disagreed or strongly disagreed and another six were undecided. Students were also asked whether they learned more in a group than on their own, of which eight agreed or strongly agreed, 14 disagreed or strongly disagreed and two were undecided. Of the five respondents who strongly disagreed when asked what team members learned from them, two of the students commented *"I fed them a lot of information about the course [subject] readings, terminologies, assignment, etc."* and *"possibly just general knowledge about how the business processes in the case study would work in practice and how to work out reasonable estimates for various metrics (from experience)".* Indicating while they thought they hadn't learned anything from their peers, other participants had learnt from them. This was supported by statements from those that somewhat disagreed who indicated that their peers learned from them both skills and subject specific content, for example *"what the assignment was actually about", "various project management knowledge from my past experience"* and *"how to use Slack."* These students who 'somewhat disagreed' that they learned more in a group, indicated that they had in fact gained new knowledge and skills from their peers such as *"learned [a] good way to present learnings in table [sic]"* and *"how other people think about setting up a project and what it would look like, so a different perspective."*

Students who strongly agreed that they learned more in a group indicated that their peers also learned subject specific knowledge and team work skills from them, regardless of their background with quotes from students including *"software development guidance, as I'm a software developer. So was able to actually discuss the processes involved as if it were a real project"* and *"I had some knowledge of team values and organisation that come from my teaching background."*

Other students who strongly agreed indicated that they took on a leadership rather than peer to peer role with one student commenting *"making sure all members know what we are all working toward. Example first meeting one member was missing, it was up to me to bring him to speed about what have been discussed during meeting."* While other students were more unsure of their contribution to peer learning with one student suggesting at length *"unsure - all the team members were very capable and gave the impression of being able to think through problems and issues without panic or giving up. I really do think that they would have done a great job even if they were just working by themselves".* These students indicated that they had a positive experience and learned from their peers team work, skills and subject specific knowledge including *"how willing people can be to help each other in a, as a team"* and *"how to properly write up a code of ethics."* and *"time management, since we were all working on* [the] *same assignment it was critical that each individual submits parts on time before next task. Also you could share different ideas and learn somethings concept that you didn't know before"* [sic].

Survey participants generally felt that all members of the team were given an equal opportunity to contribute with 62.50% (n=15) strongly agreeing and 21% (n=5) somewhat agreeing. Interestingly, from the 19 participants who completed this question in the pre-survey only 26.3% (n=5) strongly agreed and 31.5 (n=6) agreed to this same question. This suggests the way the group work was set up for members of the team to have an equal opportunity improved greatly within this subject. Finally, students generally felt they worked together on the project adequately with 37.5% (n=9) stating this and 25% (n=6) stating they did this well and then 16.9% (n=4) stating they did this extremely well.

Some members of the group mentioned overcoming obstacles during the group work in order to learn more about group work with one student commenting *"team collaboration with unfamiliar faces and different geography present unique challenges, in that, it is much more challenging to collaborate in a team where each member has prior personal engagements with work/family. This in turn reflected on the time and commitment we invested as a team to fully understand and agree on the final outcome of the project document"*, while another student commented they learnt *"how you can have a functional group work assignment by everyone taking turns to lead, and work on different parts cooperatively".* This suggests lessons learned were important to the students, particularly in overcoming some of the challenges.

Discussion and conclusion

Ensuring the learning activities and assessment were constructively aligned (Biggs & Tang, 2011) allowed students to know what they needed to do in order to succeed in the subject and achieve relevant graduate attributes. Results indicate that all team members were given an equal opportunity to participate and they worked together on the project suggesting that they knew what was expected of them in order to do this.

Based on prior experiences only 60% of the students thought team work was a good idea, while after the team work had concluded students generally felt they had worked well together and had an equal opportunity to contribute. Student comments suggest that authentic learning occurred through the team work assessment and activities they completed. They also reported overcoming obstacles in their team work, suggesting the students they engaged in the project collaboratively as reported above (Curtin University, 2015). Their new skills in working collaboratively may assist them in the workforce in the future. This suggests that some of the university graduate attributes were achieved for the subject.

Only some of the students felt they had learned from working in a team at the conclusion of the group work. Interestingly those who thought they had learned from being in a team also thought their peers had learned from being in the group. It may be beneficial to directly teach team work benefits in the future so that all team members are more able to articulate what they learnt. Future research in this area may also be beneficial.

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Lessons learnt from a university LMS transformation: the good, the bad and the ugly

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In a changing Higher Education landscape, universities are increasingly under pressure to implement transformative learning experiences, leveraging advances in technology and increasing flexibility in the curriculum. This paper discusses the process by which our University transitioned from one Learning Management System to another, and the impact of this transformation. This impact is viewed across the College of Science, Engineering & Health learning and teaching strategies and the student experience, our planning and staff capability development. The complexities and lessons learnt from this process are identified in an attempt to reflect on the LMS transformation as a broader catalyst for change.

The Higher Education landscape is undergoing dramatic changes in recent decades. In an increasingly competitive market, there is a greater need to deliver high quality learning experiences, which are cognizant of the various demands on students. Online and blended learning have become popular modes to fulfil the need to deliver flexible learning experiences. When considering these modes, the experiences of students in various learning spaces becomes a focus of study. Amongst the many learning spaces, in face to face and online contexts, our focus for this paper is on the Learning Management System as the key driver for content design, development and delivery to 21st century learners. In particular, this paper discusses our University's replacement and transition of our existing Learning Management System (LMS) with a new LMS, Canvas.

Aligned with RMIT University's Strategic Plan, the implementation of Canvas provided opportunities to create student centric learning and teaching experiences. It also created the need for extensive training and a deep dive into institutional strategies for staff capability development. The complexities that arose from this transition are discussed here, with a view to understanding the lessons learnt and reflecting on the process as a catalyst for broader change across our College (Science, Engineering & Health) and university.

LMS transition

Preliminary work for the LMS transfer began in 2017, with the target of all existing courses transferred to Canvas in time for appropriate delivery in Semester 1 2018. Details of the number of courses involved in the rollout, early adopters and semester live courses breakdowns are provided in Figure 1.

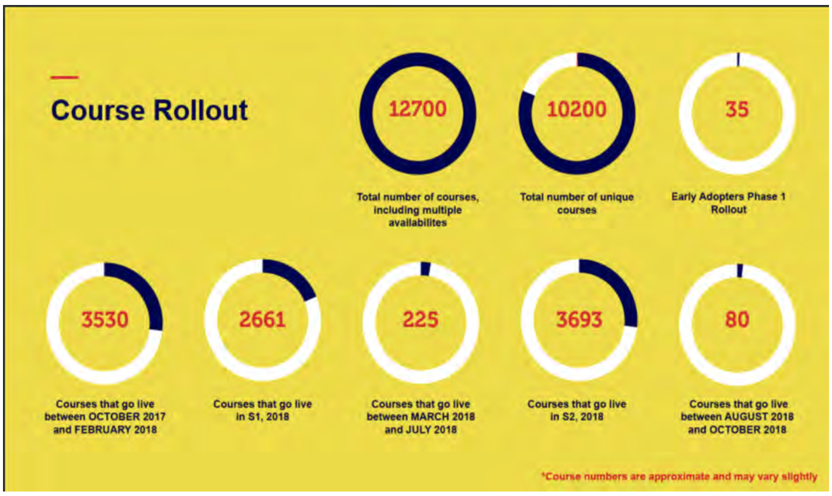


Figure 1: Course rollout across the university.

Key stages and tasks were identified from the central Project team in the early stages, to ensure a smooth transition across the Colleges in the university. In our College, this process began with the identification of all courses being delivered in 2018, both onshore and offshore. 4 LMS Project Officers were allocated and inducted into each School (Science, Engineering, Health and Vocational Education) in the College to monitor staff engagement, apply templates and setups for staff to commence work on the quality assurance requirements.

Quality assurance

All courses in Canvas were required to meet the quality assurance standards before going live. These "14 Elements to Canvas Success" were built using components of the Digital Learning and Teaching Framework Threshold Standards (2017) that are based on the principles of connected, clear, aligned, inclusive, and consistent learning experiences in our courses. These Standards were translated into the "look and feel" in Canvas, which allowed the LMS Project Officers, course coordinators and lecturers to create courses that met the university aspirations. These Elements included: providing consistent information and banners, introductory course announcements and welcome messages (video), teaching team details, Canvas functionality and identifying the course as fully online, blended or largely face to face, course schedule, navigation panes, copyright and active links, assessment information and submission requirements and finally, university branding. This use of consistent formatting, banners, naming conventions and placeholders ensures that students are encased in a "web of consistency" (Biggs, 1999).

Capability development

An essential aspect of this LMS transition was to identify, plan and deliver professional development workshops along with online resources to build staff capability, an essential aspect in the development of skills and confidence. An allocation of hours in work plans for teaching staff to meet the 14 Elements was provided. The central Project team training was supplemented by the work of our College Learning Enhancement team, who designed and facilitated Canvas self-help resources and workshops, designed College templates and banners, Program shells and provided video assistance for recording welcome videos. The Professional Development Plan provided by the central Project team to support staff in meeting the 14 Elements included:

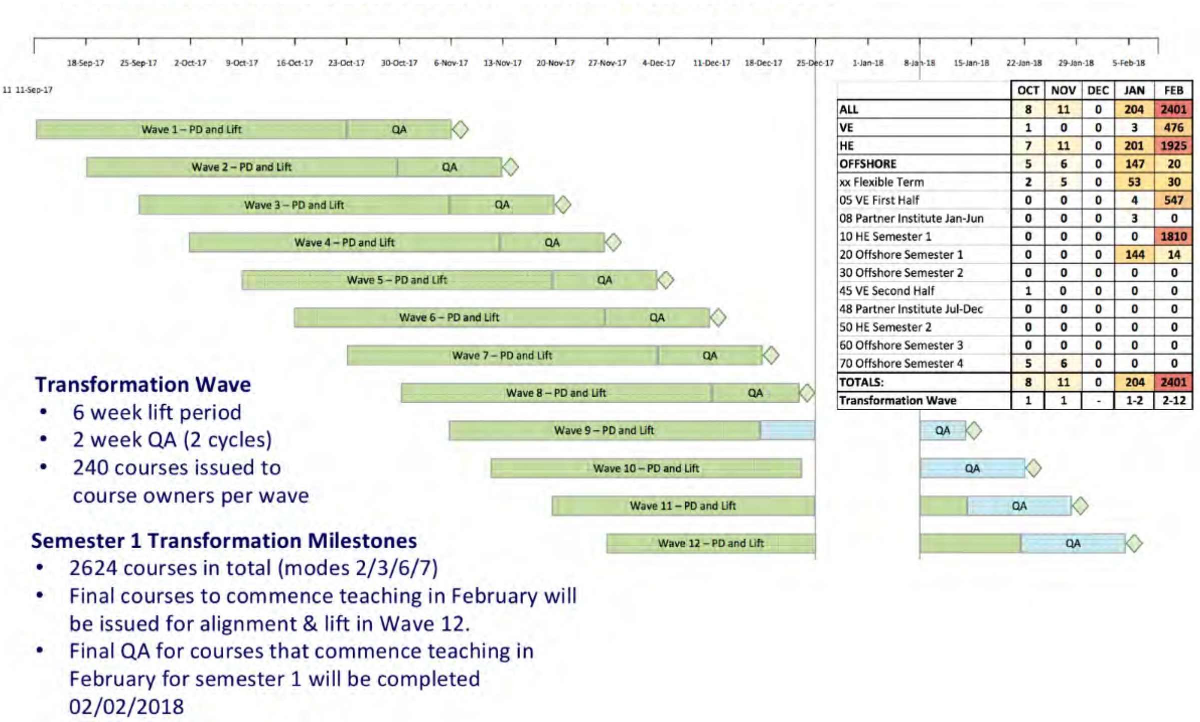
- F2F workshops for course coordinators (Canvas for Course Coordinators)
- F2F workshops for all teaching staff (Canvas Essentials)
- Drop In Support - at elbow support to answer queries and solve issues.

Critical to this work was the support provided to the course coordinators for courses that the central Project team identified as not meeting the 14 Elements to ensure courses go live for semester delivery.

Complexities and lesson learnt

The initial aspiration of the university central Project team was not to just "move and dump" content from the old LMS into Canvas. The aim was to align courses to the university Digital Learning and Teaching Framework, with academics working closely with the LMS Project Officers to ensure their courses aligned with the Framework. A pilot of early adopters trialled this model for delivery of their courses in Semester 2 2017. The detailed alignment to the Framework proved very time consuming and it became evident that it would be difficult to deliver all courses via this model in the scope of a 12-month project. The central Project team then focussed on the 14 Elements which aimed for a consistent student experience across all Canvas sites.

The LMS Project Officers initially moved the content from the old LMS to Canvas for staff and applied the template to their courses. This also proved extremely time consuming for the volume of work required in a short period of time. This process was eventually outsourced to an overseas third-party provider. The central Project team then developed a staged process of "waves". Staff were randomly allocated to a wave, unless a request was made for early access to a course (Figure 2).



	OCT	NOV	DEC	JAN	FEB
ALL	8	11	0	204	2401
VE	1	0	0	3	476
HE	7	11	0	201	1925
OFFSHORE	5	6	0	147	20
xx Flexible Term	2	5	0	53	30
05 VE First Half	0	0	0	4	547
08 Partner Institute Jan-Jun	0	0	0	3	0
10 HE Semester 1	0	0	0	0	1810
20 Offshore Semester 1	0	0	0	144	14
30 Offshore Semester 2	0	0	0	0	0
45 VE Second Half	1	0	0	0	0
48 Partner Institute Jul-Dec	0	0	0	0	0
50 HE Semester 2	0	0	0	0	0
60 Offshore Semester 3	0	0	0	0	0
70 Offshore Semester 4	5	6	0	0	0
TOTALS:	8	11	0	204	2401
Transformation Wave	1	1	-	1-2	2-12

Figure 2: Semester 1 Transformation Plan - 12 transformation waves

Once a course was released to a staff member they were allocated six weeks to work on the course and meet the 14 Elements, the course would then be QA'd by an LMS Project Officer and the course coordinator would be notified whether it passed or not. This allocation of courses to waves did not take into account staff on leave, staffing changes (including change of course coordinator), busy academic periods such as assessments and exams. In addition, a high proportion of sessional teachers were course coordinators and their contracts finished at the end of their teaching period, thereby not being available until the week prior to the start of semester to work on their course sites. These compounding issues eventually led to little or no staff engagement with the "wave" process. In our College there was mounting concern that we would not have any courses ready for Semester 1 to pass QA and go live. To counter this our Learning Enhancement team ran a number of workshops and drop-in sessions at our Schools to support staff through the QA process. These ran in conjunction with the central Project team Professional Development and QA sessions.

30 drop-in sessions were held across the two College campuses (City campus and Bundoora campus) in January and February 2018 to ensure 1200+ courses were ready for delivery by Semester 1. For staff unable to attend a drop-in session, a Google form was created enabling staff to complete a self-check, with links to quick guides to assist staff in meeting the 14 elements, and then submit for QA offline. Over 350 QAs were achieved during these sessions and by the use of the self-check form. This validated the role of local educational developers as vital to the uptake and creative use of educational technologies in multiple learning contexts (Oliver, 2005; Woodley, Funk & Curran, 2013).

The College Learning Enhancement team also developed and delivered workshops that focussed on the pedagogical use of Canvas. The College of Science, Engineering & Health instructional site for teaching and educational resources (our blog) provided staff with resources for this. Monthly updates were provided to each School (within our College) Learning & Teaching committee. However due to the tight timeframes and deadlines, this work became secondary to the completion of course transfer in time for semester delivery. However, in conversations with staff, we found that their main focus was their content, rather than the Project requirement of meeting the 14 Elements. This tension often points to a conflation between the pedagogical use of technology (Willis & Bowles 2009) and the use of technology for technology's sake, an "upside-down" (Gibbs & Gosper, 2006) approach, with the tools rather than curriculum innovation driving change. Upon reflection, this tension can be eased with staff development on the potential for enhanced learning and teaching (Mishra & Koehler 2006), away from traditional transmission models (Toohey 1999) by creating targeted activities, focused on blending face to face teaching and learning with one or more types of technology.

Garrison and Vaughan (2008) refer to this combination as a “thoughtful infusion”, and Torrisi-Steele (2011) calls it “harmonious integration”. Perhaps this thoughtful infusion can occur once the initial process of content transfer takes place and staff can begin the work of quality uplift of resources created in Canvas. Certainly, there is much more work to be completed in this area, a consideration that has been taken into account by the release of the University’s next “6 Elements” of Canvas Uplift which focus on quality uplift of resources.

On a positive note, the use of LMS Project officers embedded in the Schools has largely proved to be advantageous in alleviating staff anxiety around the transition and encouraging engagement thorough localised support. This support, supplemented by our Learning Enhancement team, has provided dual levels of access to training and resources. This has ranged from support provided for the creation of welcome videos to accessing new LTIs for Canvas and building engagement with third-party web tools to enhance interactivity. Driving this change and support at the localised and diverse context of our College, has allowed the central Project work to be contextualised.

An interesting consequence of this LMS transition has been the creation of communities of practice (Wenger, 1999) to share resources and collaborate on problem solving and improving the current state of our online environments. Supporting this articulation of pedagogical strategies and providing avenues for meaningful connections became part of our work in the College. For example, specialised staff in one of our Schools formed their own community of practice, supporting and assisting each other to solve issues in Canvas and write backend code and scripts to extend functionality. Staff then share this with our College Learning Enhancement team who in turn publish on our Learning & Teaching blog. “Spotlight on Canvas” workshop sessions were also held, which provided staff with an opportunity to view peer examples and exemplars of practice. This driving of continuous improvements from the staff has provided us with insights into the transformation process itself.

Ultimately, the success of any such large-scale transformation process depends on the institution’s appetite for change. In the case of our university, the bold LMS transition has provided us with opportunities to shift embedded practice, address staff capacity and reflect on the overall cultural shift that such a process can begin. Only time will tell how this change is sustained and transformative.

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Smooth sailing - designing effective online learning spaces

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In response to the issue of a wide variability and structure in the Learning Management System (LMS) design across subjects at the school level in an Australian university, the researchers of the study developed a research-informed LMS template. The template drew on the critical factors identified in the literature that could contribute to students' positive learning experience in online learning spaces. The study aimed to evaluate the usability and continued use intentions of the template by trialling it in four Business subjects and applied a mixed method approach to explore lecturers' and students' perceptions. Results showed that both students and lecturers responded to the new template positively in terms of its usability and suggested strong intentions to use it in the future.

Keywords: Online learning spaces, LMS template design, usability, use intentions, evaluation.

Background

With higher education moving towards blended and online learning (The New Media Consortium, 2017), there is increasing discussion around creating effective and efficient online learning spaces. Part of this discussion centres around the quality of student learning experience in the Learning Management System (LMS) which is widely used in universities to manage and support student learning (Coates, James, & Baldwin, 2005). It is noticed in the research literature a variability of the structure and quality of LMS design (Lonn & Teasley, 2009; Mestan, 2019; Rankine, Stevenson, Malfroy, & Ashford-Rowe, 2009). This is partly related to lack of support and resources for individual staff, for instance, guidance for LMS design and design exemplars (Ellis & Calvo, 2007).

In the university where this study was conducted, a wide spectrum of quality in LMS design was noted across subjects, from poorly structured to interactive use of the learning platform (i.e., Moodle). The LMS layout and format adopted across subjects also varied largely and therefore lacked consistency. This issue caused students' negative learning experience. Students often had to spend extra time familiarising themselves with the different designs and layouts in order to locate information needed or to fulfil task requirements. On various occasions, staff expressed strong desire for effective LMS usage with the faculty teaching and learning team.

Researchers of the study attempted to address this constant issue by designing a research-informed, evidence-based LMS template. First of all, the development of the template drew on the four perspectives on the design of learning environments proposed by Bransford, Brown, and Cocking (2000). These include 1) a student-centred perspective, focusing on learners' use of current knowledge to construct new knowledge; 2) a knowledge-centred perspective, highlighting the achievement of interconnected understanding of discipline knowledge; 3) an assessment-centred perspective that aims to create feedback opportunities; and 4) a community-centred perspective to promote interaction between students, teachers, and the wider community. Alignment among the four perspectives were taken into consideration in the development of the template, as suggested by Bransford and colleagues. The layout of the template also aimed to create a user interface that was clear, concise, familiar, responsive, consistent, aesthetic and efficient (Garton, 2012). The template also allowed opportunities for active learning, self-reflection, assessment understanding, formative feedback as well as community learning.

Figure 1 shows a screen shot of the main page of the new LMS template as trialled in one of the subjects involved in the study. Moodle's built-in 'grid' format was adopted for the page layout design. Subject coordinators' photo and contact details were provided on the top right corner (photo removed due to privacy concerns). Specially designed icons were used to represent individual sections (i.e., Subject Overview, Learning Resources, Assessments, Interaction and Subject Feedback).

Figure 1: A screenshot of the subject main page

Figure 2 shows screen captures of the individual sections. The Learning Resources section contained learning materials and activities, organised by weekly topics. All materials and activities were presented in the form of an ‘e-book’ for easy access and navigation. The Assessment section comprised of assessment help resources, detailed task descriptions, rubrics, submission guidelines and links. The Interaction section included subject announcements and discussion forums for asynchronous interactions and general discussions. The Subject Feedback section provided spaces for students to express their opinions on any critical issues related to the subject early in the semester as well as at the end of teaching period. The Subject Overview section is not shown in the figure below, however, it contained the subject learning guide and links to various help resources such as student support, library and relevant policies and procedures.

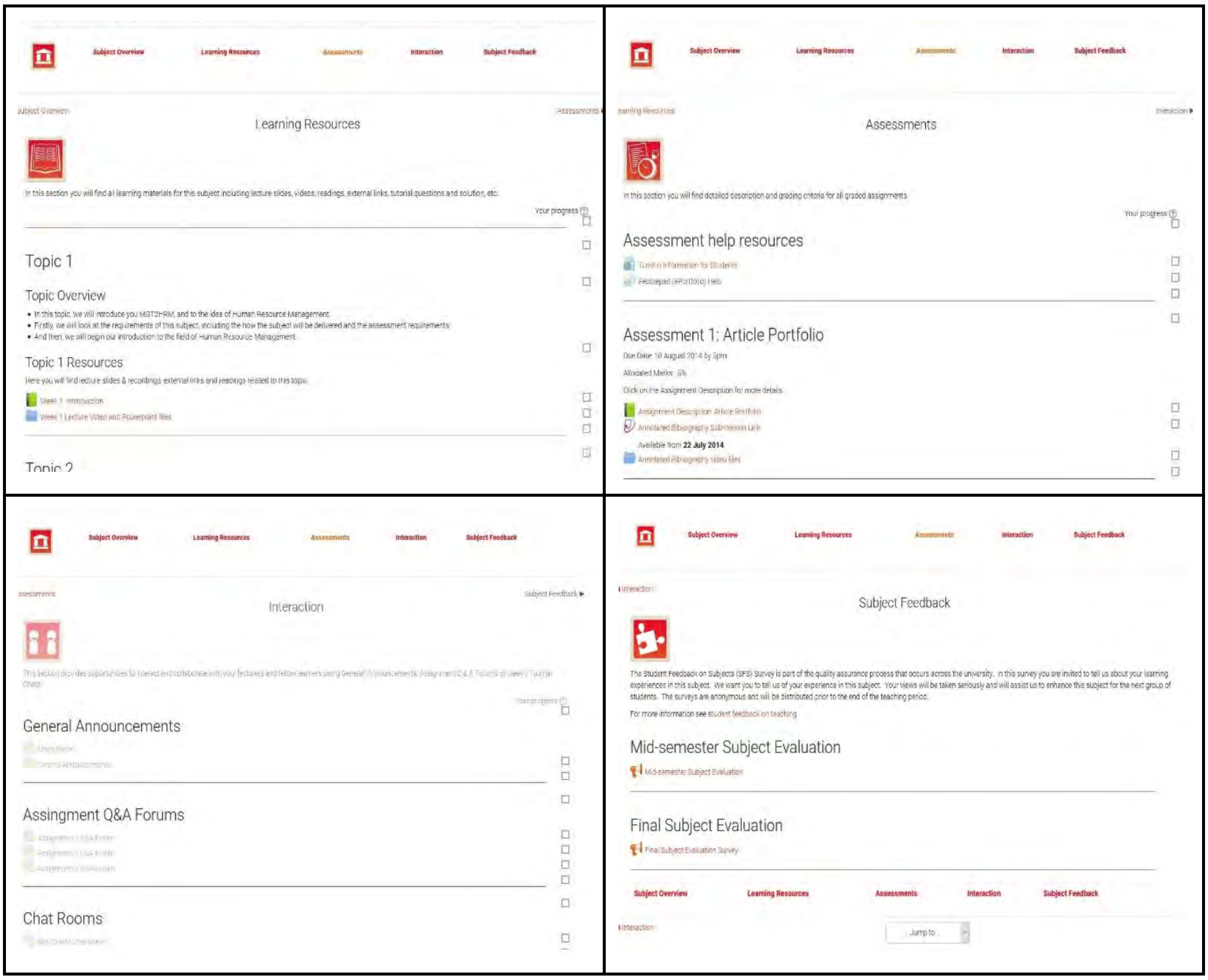

Figure 2: Screenshots of the individual sections

The LMS template was trialled in four Business subjects during semester 2, 2016. A user study was conducted at the end of trial period to evaluate the usability and continued use intentions of the proposed LMS template. Usability evaluation focused on how well students could learn and used the LMS to achieve their learning goals. It also looked at students’ satisfaction with the use process (Pangestu & Karsen, 2016).

Methodology

In order to gain a thorough understanding of the perceived effectiveness of the template among lecturers and students, the study applied mixed methods approach drawing on both quantitative and qualitative methods in data collection and analysis (Burke & Onwuegbuzie, 2004).

An ethics approval was granted to conduct the user study. The students in the subjects were invited to take part in an online survey via email with clear explanation that participation in the survey was purely voluntary and would have no bearing on their performance or grades. Out of 240 students enrolled in the four subjects, only 18 responded to the survey.

The USE questionnaire (Lund, 2001) was adopted to evaluate the usability through the constructs of usefulness, ease of use, ease of learning and satisfaction. The construct of continued use intentions adopted from Venkatesh et al. (2003) was also included in the questionnaire. All items were measured on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). (The questionnaire is not included in the paper due to space limitations but is available upon request.) The survey also included open-ended questions seeking students' opinions of what they liked and disliked about the trialled template, their suggestions for further improvement, as well as their comparison of the template with those of the other subjects that they enrolled in.

The collection of survey data was followed by a short interview with selected students and the subject coordinators involved, at the end of teaching period. The interview questions aimed at investigating in depth both the students' and the teachers' experience with the trialled template and triangulating with the findings from the survey data. Each interview lasted between 10-15 minutes and conducted by the researchers who were not involved in the teaching of any of the trialled subjects.

Results

Student Survey

Table 1 provides descriptive statistics of the survey constructs. The mean scores demonstrate that majority of the students tended to strongly agree that the trialled template was useful, easy to use, easy to learn and they were satisfied with its usage, thus indicating their positive attitudes towards the usability of the trialled design. The students also seemed to prefer to use it in the future.

Table 1: Descriptive statistics

Variable	Mean	Standard Deviation
Usefulness (Use1-8)	4.26	0.68
Ease of Use (EoU1-11)	4.28	0.65
Ease of Learning (EoL1-4)	4.36	0.64
Satisfaction (Sat1-7)	4.11	0.86
Intention to Use (Int1-3)	4.26	0.55

In order to analyse the most influential element(s) that could support students continued use intentions, Davis' technology acceptance model (TAM) (Davis, 1989) was adopted. TAM is widely used in Information Systems research to explain or predict individuals' acceptance of computer-based systems in various scenarios and organisational contexts (Chakraborty, Hu, & Cui, 2008). TAM posits that user perceptions of usefulness and ease-of-use determine attitudes towards using a system or technology. In order to measure the overall effect of usability on continued use intentions, we extended the original TAM by including satisfaction and ease-of-learning constructs in addition to basic TAM constructs of usefulness and ease-of-use. The PLS (Partial Least Squares) analyses of the structural model revealed ease-of-use as the most significant predictor of continued usage followed by usefulness. However, satisfaction and ease-of-learning only indirectly impacted usage intentions via usefulness and ease-of-use constructs. (The details of PLS analyses are not included in the paper due to space limitations but are available upon request.)

When asked to compare the proposed LMS template with those of the other subjects on a scale of 1 (Much Worse) to 5 (Much Better), 66% of the students reported that the trialled template was 'better' or 'much better' than any template they have used in the past (1=0%; 2=0%; 3=33%; 4=44%; 5=22%).

As reported in the open-ended questions, the features that the students liked the most, of the new template, included clear format, informative design, ease-of-use, ease-of-access and the logical arrangement of materials. No issue was reported, nor any further improvement needed according to the students' responses to the open-ended questions.

Student Interviews

The interview findings indicated the students' very positive attitudes towards the trialled template. The students' overall experience of the LMS was reported as unique. Simplicity and ease of navigation were the most frequent comments that the students made about the new layout. Most students encountered no challenges in navigating through the LMS except one who reported some difficulty in finding the needed documents. In fact, simplicity and ease of navigation were the two distinctive advantages of the trialled LMS as compared to those of the other subjects the students enrolled in. These qualities of the LMS, as the students pointed out, contributed to their learning in that they were able to focus on learning rather than waste time looking for information they needed, as they normally did in the LMS of the other subjects. Below is an example of the students' comments:

> The reason I did really so well in this subject I would say because of this design layout and because it was lot easier to find what I was looking for. Whereas in my other subject it took longer to find what I was looking for. I was wasting time.

Unanimously the students strongly agreed that the new template was their preferred design and suggested it should be implemented across their future subjects. One constructive feedback from the students in terms of further improvement was to provide subheadings or brief descriptions to the audio/visual recordings to facilitate search for relevant information.

Staff Interviews

The subject coordinators of the four subjects involved in the trial were interviewed at the end of study period with the aim to get their perspective on the new LMS template. Overall, the subject coordinators reported very positive experience with the new template. The clear and simple interface made it easy to set up, use and navigate. They considered the 'e-book' feature in the LMS particularly helpful in terms of presenting and sequencing materials as well as learning activities. For example, one lecturer commented:

> …because I think the subject was blended and we have a lot of online stuff and if you put a lot of stuff on the LMS the student won't be able to find it easily and they tend not to search for things. So, I thought the design was quite intuitive so those kind of boxes (sections/grids) were clearly marked and students were able to find things relatively easy, so I think the design is as good as we are going to get.

Other useful features in the template, as they reported, included a dedicated section for communication and the use of icons. The lecturers also mentioned that they received very positive feedback from their students about the LMS design.

Interestingly, when comparing the LMS templates with those they had used previously, the lecturers pointed out a strong pedagogical thinking underpinning the new template with an emphasis on content, communication, assessment and feedback, which was missing in the other templates. These are in fact the key elements of an effective learning environment identified in the research literature. Overall, they found it much better as compared to other templates they had used before, as evident from the following comment:

> I think, it's a million times better!

All the subject coordinators expressed strong intention to continue to use the new template in their future offerings. They even suggested that the template should be rolled over across all subjects in the school for consistency reason to avoid students getting confused with different templates used in the school.

With regards to further improvement of the template, it was suggested to set up a separate section for lecture materials to save students from scrolling through all the other materials to locate what they needed.

Discussion and Conclusion

The survey results suggest that the proposed template scored high on all aspects of usability measurements namely efficiency, effectiveness and satisfaction. This means that the new design could help in achieving the intended learning goals. This aspect is also echoed in the interview data as the majority of students suggested that it saved time, provided easy access to learning materials and activities and was visually pleasing. This is a significant finding when compared to similar studies of usability evaluation of online learning (Pangestu & Karsen, 2016) where only some aspects of usability appeared significant. The results also showed the participant's strong intentions to use the trialled template in the future. Further, the empirical evaluation of an extended TAM revealed ease-of-use as the strongest predictor of use intentions, followed by usefulness. This is in line with several TAM studies (Halawi & McCarthy, 2007; Lee, Cheung, & Chen, 2005) and suggests that the more students find online learning spaces easy to use, the more likely they will use it in the future and ultimately get engaged with them. The results also suggest that teachers need to motivate their students about the usefulness of online learning spaces if they wish to enhance the usage. The strong continued use intentions are also confirmed in the student interviews.

The results of staff interviews are also in line with the student survey and interview results. All subject coordinators agreed that the new template helped in their teaching as it was easy to use, easy to navigate and was hassle free. These findings are very encouraging in that innovative teaching practices may be facilitated, and student learning enhanced through the design of effective and efficient online learning spaces where students have easy access to relevant content, clear guidelines on assessments and opportunities for feedback and communication.

This study has made several useful contributions. First, it attempts to design a research-informed evidence-based LMS template and to validate its usability with the key stakeholders. Second, it will help provide a consistent online learning experience to students across various subjects and courses. Third, the study findings may help validate the usability of similar online learning spaces in varied contexts. Finally, it helps understand students' continued intentions to use the LMS or other similar online learning platforms.

Admittedly one limitation of our study is the small sample size, as it was a trial study conducted on a small scale where participants voluntarily chose to take part in the online survey and the interview. Also, as the study was conducted using a particular LMS (Moodle), the findings may not be generalised to other learning management systems. The next steps would be to roll out the trialled LMS template across a larger number of subjects and conduct a similar usability evaluation with a larger sample to validate our findings.

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Reducing the confusion and clicks and its impact on learning

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With the increased importance placed on first-year university units to transition, retain and engage new students, there is a need to carefully design the navigation within a unit of study. The importance of reducing confusion for new students and the cognitive load placed on them during their first experience of university learning may assist with retention.

This paper presents a collaborative project between a first-year Unit Coordinator and Senior Learning Designer to redesign the navigation of a core communications unit in a Bachelor of Science (Nursing) degree. The purpose was to reduce the confusion over what was required of the students each week and to reduce the number of clicks and scrolls through the weekly content, allowing students to focus on the content itself.

Keywords: usability, design principles, retention, learning design, first-year experience

Introduction

Globally, there is an increased pressure on universities to improve student outcomes and retain students. By providing first-year students with the support to facilitate a positive university experience and guiding them through the process of transitioning from high school into tertiary education, some improvements can be made in retention numbers (Kift, 2014).

However, increasing student numbers and the diversity of student groups in age and cultural background, has made student retention a challenge for both academic and non-academic staff. First-year students can vary greatly in both social and academic skills. Making students feel comfortable in these first experiences of university study can be challenging but it is a crucial element towards student success (Kift, 2014).

The aim of this project was to lessen the confusion for first-year students, allowing them to concentrate on their learning rather than spending valuable time deciphering course content and finding resources.
The first-year unit in this project introduces professional nursing communication and conduct skills. It teaches oral and written communication skills needed to become a successful health care professional, equipping students with the skills to handle and manage difficult nursing situations. Academic writing and literacy are introduced at a foundation level in the unit and are consolidated as the students move forward in the course. For many students, it is the first time they have encountered academic writing and researching.

The number of students enrolled in the unit can range from 500-700 students, depending upon the semester, including both on-campus and online students. The unit is taught across two campuses, to metropolitan and rural students. A typical nursing student enrolled in this unit is a mature age, female returning to study, often raising a family and working part-time. There are a large number of international students in the unit. Many students in the cohort are first-in-family to study at university. Many have never used a Learning Management System (LMS) before, therefore their first experience navigating through the Information and Communication Technology (ICT) systems used by the university and encountering the LMS can be a confusing one.

Based upon previous student feedback, the Learning Designer and Unit Coordinator worked to design a way to reduce the confusion and streamline the navigation of the content and weekly learning activities. In the development of the new navigation, usability and design principles such as simplicity, consistency and efficiency were applied (User Experience Professionals Association, 2014). The new navigation model was implemented at the start of the semester and student feedback was collected after four weeks of teaching. The feedback was then used to improve the design for the remainder of the semester.

Time for a change

A Learning Management System is a software platform used to deliver online learning content and manage the student learning (Bradford et al, 2007). The LMS used by the university to deliver the learning content for this unit is Blackboard Learn. This LMS has a navigation structure which cannot easily be modified. There are pedagogical restrictions in the design options within the content sections, the most common way of presenting the content is item by item, cascading down the length of a screen. Bates (2018) stated an LMS does an adequate job for managing content but does not allow for a transmission model of teaching where instructors can have control over the content development and management. Bates states that the LMS is a convenience for institutions, providing them with a secure environment for storing a course, but does not allow for innovation in teaching (Bates, 2018).

Data collected from student feedback and anecdotal feedback provided to the Unit Coordinator and sessional teaching staff over previous years revealed that students felt confused about what was required of them each week. This feedback was mirrored in other first-year units in the course. Finding the weekly content and then determining what was required and in which order, proved to be a stumbling block for many students. The number of clicks required to get to the content was an obstacle and students reported their frustration at having to scroll down on each module page to find the content they needed. This is one of the legacies of the LMS, as over years it has become a “digital filing cabinet” of learning materials (Bates, 2018). Each content item is displayed on a page or within a folder, making levels of information that can be hard for students to navigate through.

The weekly image maps

The Learning Designer and Unit Coordinator began by mapping what was required from the students for each week of the semester. There were a large number of tasks and learning activities to be completed each week before attending a weekly tutorial class. The learning tasks included watching a number of short interactive lectures; completing a worksheet to bring to the tutorial; reading journal articles; and completing a formative quiz. Online students were required to complete all the tasks and work through an online tutorial activity. Optional “homework” activities are available but not formally assessed. Students are encouraged to complete all activities in order to ensure success in their assessments. As there is no face-to-face lecture content delivered, the information of what is required each week needs to be made explicit within the content area of the LMS. Previously this information had been delivered via the announcements area of the LMS, but students remained confused as the information was not linked directly to the weekly learning materials.

Dawley (2007) states the organisation of the content in a course can prove the difference between the success and frustration for the student. A well-organised unit design can provide students with the visual clues for thinking about the organisation of the content and this can carry through to their retention of the content. The time a student spends in a course should be used for learning, rather than navigating and deciphering how the course works and where the content is stored (Dawley, 2007). A novice online learner can be prone to cognitive overload where content does not follow a linear or logical sequence (Clark and Mayer, 2016).

The Unit Coordinator requested a design that included everything needed for the weekly materials to be located in the one place, with no scrolling or clicking into subfolders to locate the materials. The Learning Designer investigated a way to display a diagram which would step students through the requirements for the weekly learning activities. A visual course map can be useful to students allowing them to view a hierarchy of the course materials, providing an orientation to the course content (Dawley, 2007). A visual representation was required, that would enable users to easily navigate the materials, giving obvious signposts and visual clues, allowing users to get where they needed to go without becoming frustrated. After researching different infographic and timeline designs, a “weekly image map” was developed, which used a timeline sequence, stepping students through the requirements for the week.

In the design of the timeline white space was used to lessen the confusion and draw the viewer directly to the information along the central timeline (Golombisky and Hagan, 2010). Icons were selected and used to represent each weekly activity. The icons were chosen to give a visual clue as to what each activity involved. Based on the principles of usable design, using the same icons consistently in the weekly maps allows the student to become familiar with what is required each week at a quick glance (User Experience Professionals Association, 2014). Originally, the design for the timeline and icons was to make the icon itself a clickable hyperlink leading to a resource. However, the variation in the number of resources for each activity did not allow this in the design. A text hyperlink was added next to each icon to describe the resource. By adding a text link for each resource, the image map became a one-click map, which was part of the original specifications. The text on the map was underlined to act as a visual clue to students, indicating the text elements are hyperlinks.

The Unit Coordinator requested that each weekly image map be made a different colour to allow students to differentiate between the weekly maps. Colour can be used as an organisational tool, indicating what goes together (Golombisky and Hagenm, 2010). In this case, it was used to differentiate between the weekly image map. It also is used to draw the user's attention to a focal point and help the user follow the colour through the design.

To create an image map that could be easily edited by the Unit Coordinator, the map was developed as a clickable Portable Document Format (PDF) file. Ideally, to display a graphic online, a Cascading Style Sheet (CSS) and Hypertext Markup Language (HTML) would be used. The LMS was able to display an image within the unit but did not allow for the interactivity of hyperlinks within the image. Developing a graphic using CSS and HTML code was not achievable in the project timeframe. The Unit Coordinator was also unfamiliar with HTML coding therefore any future updates and maintenance of the maps would not be sustainable. A PDF image map however could be displayed in the LMS and easily edited using PDF software, which was available and familiar to the Unit Coordinator.

In order for the design to become sustainable for future semesters, the hyperlinks were added as permanent links, rather than direct links within the version of the unit. This drove the decision to store the materials outside the LMS. The weekly learning resources, were stored outside of the LMS in a cloud-based storage area and permanent public links were used within the map to access the resources. Figure 1 shows the first iteration of the weekly map which was implemented in weeks one to four in the unit.

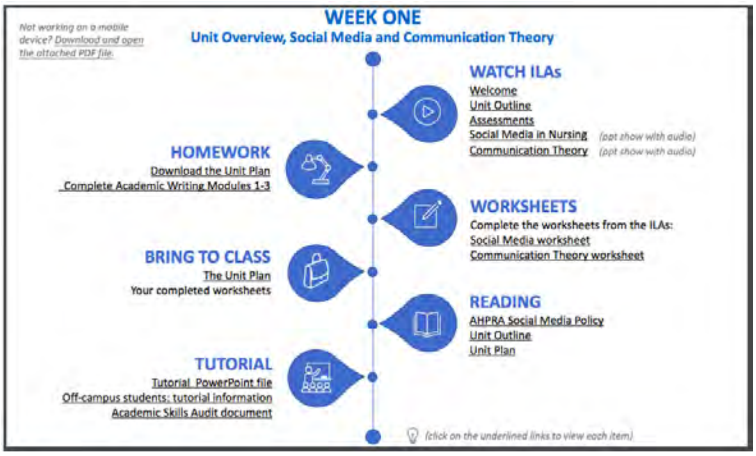

Figure 1: Week one image map

Once the design of the image map was complete, the map was replicated in other areas of the unit. The assessment and revision sections of the unit site were displayed in an image map to ensure the information for students appeared in a consistent manner throughout the site (see Figure 2).

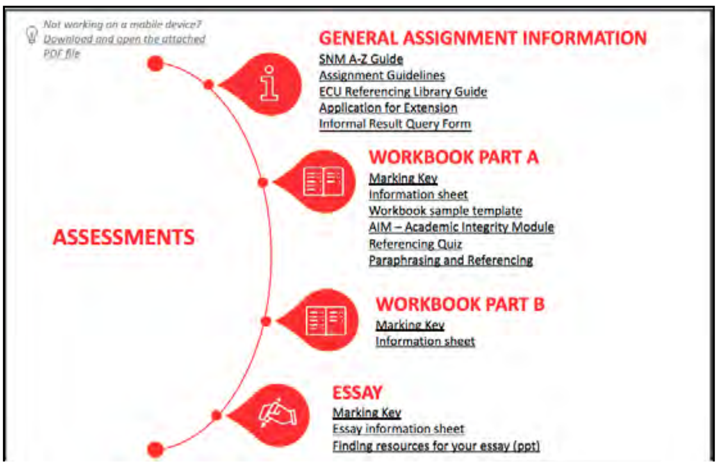

Figure 2: Assessment image map

Student Feedback

A survey distributed in week four of the semester gathered feedback on the weekly image map design. Approximately 250 surveys were completed, and the majority of the student feedback was extremely positive with many commenting that they were finding the unit the easiest to navigate compared to their other units. The students liked having everything in the one place and found it very clear and easy to access the materials. Some students commented that they liked to print out the weekly map and use it as a visual checklist of what needed to be completed, ticking off the elements as they completed them. Some examples of positive comments included, "User friendly compare (sic) to other units. Two thumbs up!", and, "everything is perfect and I can say that it's the best amongst the blackboards I've encountered". Comments relating to the image map itself included, "So good because everything is in one place and it's easy to tell what task you're up to!", and, "it works for me, a lot easier to understand than it was before". Some students repeating the unit had experienced the previous version of navigation, before the image maps were implemented. Sessional teaching staff also provided feedback on the differences between the two version of the unit. These students and staff both commented that they found the unit much easier to navigate after the changes were made and were very happy with the improvements.

The initial feedback from students via email and posted to the online discussion board showed there were some issues the Learning Designer had not foreseen. Testing the image map in various browsers had not revealed these issues. Students were able to feedback more details about the internet browser application and version they had used to access the map, and via which hardware device and operating system also. Some combinations of browser software and hardware device did not display the image map as it had been intended. One Macintosh browser application displayed the learning materials within the same frame as the map, rather than opening them fully within the browser window. As computer platform or browser issues arose, students were given the instructions to resolve them. Often updating their browser software or using the alternative link to download the PDF version of the image map, solved these issues. The weekly image map did not function as intended when students accessed it using the LMS mobile application software. The image map displayed in the application, however the hyperlinks were not clickable by the user. To inform students of this issue, a note was added to the image map with instructions for opening the attached PDF version of the map.

One issue that occurred across all browser applications was there seemed no way of forcing the hyperlinks to the learning materials to open in new or separate tabs from the image map itself. There are varying opinions amongst web designers as to whether external links should be displayed in a new browser tab or window, with some preferring to keep users within a site and others preferring external links opening in new browser tabs (UX Movement, 2012). The PDF image hyperlinks did not allow the option of opening the link in a new window or tab. Many software browser applications allow users to set their own preferences for opening external links in new tabs. The students were informed that they would need to use the back button in their browser to return to the image map. This issue did not hinder the students and was not mentioned in the feedback.

Improvements made based on feedback

At the end of the survey, students were asked, "does the flow of the weekly map work for you or can you suggest another format?". From this open-ended question, the Unit Coordinator and Learning Designer determined if any improvements to the image map could be made. In response to the feedback, quality improvements were made to the maps from week five to the end of the semester.

A change requested by students was to add the time required to complete the short interactive lectures and learning activities. This aligns with research in the area of time management for online students, with online students not understanding how much time to allocate to different learning tasks and preferring to have clear guidance about how to manage their time (Bach, 2007). The design of the map was altered after week five to include the approximate time required to complete the learning activities (see Figure 3, point 1).

Another request from students was to provide a copy of the recording in the multimedia file format MP4. This feature was included in the improved design, giving the option of downloading and viewing the original file or the multimedia file format MP4 version. An issue associated with the MP4 version was that the hyperlinks included within the presentation did not work on playback within the cloud storage platform. To inform students of this issue a note was added to the image maps and students were informed of the issue by the Unit Coordinator (see Figure 3, point 2).

Another suggestion was to change the ordering of the items in the timeline. The order in which the Unit Coordinator and Learning Designer had placed the activities was based on their perception of what needed to be done weekly but this was not congruent with the logical order according to the students. Students requested a slight change, wanting the quiz and homework activities moved to the final positions in the timeline (see Figure 3, point 3).

There were a number of queries regarding the quiz activity asking whether the marks for the activity would be recorded. The Unit Coordinator requested the title of the quiz activity change to include the word "ungraded", to clarify that the quiz activity was ungraded and was an optional learning activity for students to test their knowledge at the end of the weekly module. The quiz instructions included this information and were displayed once the quiz was opened. Adding it also to the image map seemed to reassure students, before they opened the quiz itself.

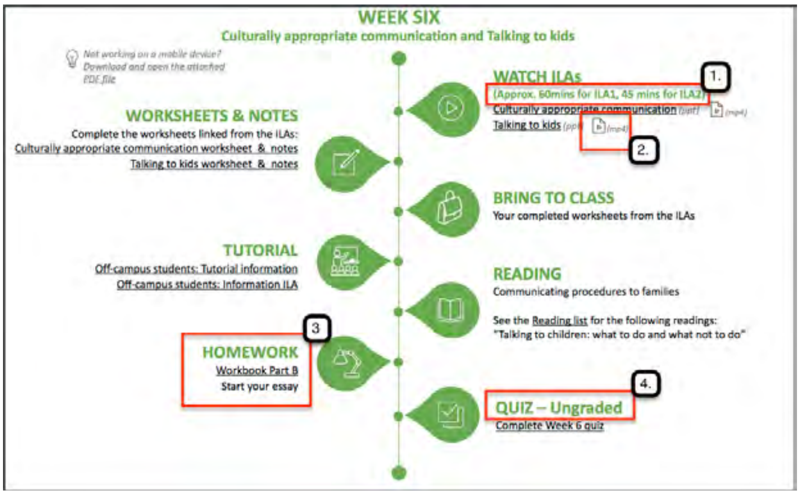

Figure 3: Changes made to the weekly image map

Conclusion and future directions

This paper highlights the development of an alternative way of displaying weekly learning materials to first-year students. An image map was designed to overcome the confusion felt by students when using a learning management system for the first time, and to minimise the number of clicks and scrolls required to access the information which is normally displayed in a long page design dictated by the learning management system. The basic principles of design and usability, as well as online navigation were used to design the image map. Initial feedback from teaching staff and students has been very positive. Quality improvements were made based on student feedback. Future directions include the fine tuning of the map to eliminate the need for updates after each teaching period and to explore different ways of displaying the map in the LMS, to overcome issues encountered surrounding different display depending on browser software and hardware platform used.

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Don't Just Stay in Your Lane: Developing Digital Literacies Freestyle

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Digital literacies are no longer optional for higher education staff - they are a necessity. However, comprehensive solutions on how to develop digital literacies in the workforce remain elusive. While many institutions implement clear definitions and frameworks in policies at the macro-level, rigid application of these tools is ineffective at a micro-level wherein personalized approach is needed. This paper describes the approach of a pilot professional development program at a regional university library that scopes and evolves to meet the needs of the workforce. The program is guided by design principles focusing on personalization and flexibility. In the future, the program will be evaluated to determine its impact on the workforce's development of digital literacies to provide guidance for other higher education institutions.

Keywords: digital literacies, professional learning, higher education, adult learning

Introduction

Developing the digital literacies of higher education staff is a necessity, but comprehensive solutions at the micro-level can be elusive. Scholarly literature that describes the implementation of digital literacy development initiatives for higher education staff is scant. This paper describes a work-in-progress professional development program occurring at the University of Wollongong (UOW) Library to proactively develop the digital literacy of its workforce. The program addresses the complexity of digital literacy by focusing on organizational and workforce needs, rather than applying a rigid framework for development. The program regularly scopes and adapts to the unique needs of the workforce and is administered primarily through a custom-built website containing online learning resources. The purpose of this paper is to share this approach with the academic community given the lack of scholarly literature in this area.

Background and context

The current state of the Australian higher education sector demands that staff are digitally literate. Academic and professional staff need to meet the challenges of an increasingly technology-focused industry, and to facilitate the digital literacy development of students (Adams Becker et al., 2017). While higher education organizations hurtle towards technological change, the digital literacy divide, defined as "a lack of knowledge of how to effectively use digital technologies for valued social economic and political practices", in academia is deepening (McIntyre, 2014, p.92). UOW Library, for example, has integrated advanced technology such as 3D printers into its learning spaces, contributed to the institution's shift into wholly online education and worked to increase the development of digital literacies for both students and staff through various learning initiatives. The Library recognized that reducing the digital literacy divide in its workforce was imperative for meeting the challenges of its institutional context, and chose to proactively act through the implementation of a rich professional development program that focused on cultivating a culture of self-directed learners.

Digital literacy is messy and complex. While the 2017 NMC Horizon Report for Higher Education lists digital literacy as a challenge that is understood and solvable, lack of a single accepted definition and framework prove otherwise (Adams Becker et al., 2017). Definitions of digital literacy used by higher education institutions in Australia vary. La Trobe University (2017), for instance, has adapted the JISC definition of digital literacy to guide their institutional framework. Deakin University (2018), on the other hand has created a custom definition that is implemented in their graduate qualities. At UOW, there is no consensus on a definition. Brown (2017), in his critique of digital literacy frameworks drives the messiness of digital literacies home by pointing to several frameworks of varying purpose. Complicating this issue further is the use of different terms such as digital capability and digital dexterity that on the surface seem equivalent to digital literacy. Consensus on a single term, definition and framework at an organizational level can provide clarity to a complex concept on the macro-level. However, this clarity is ineffective on a micro-level in disciplines, units and teams wherein it becomes too prescriptive. As Beetham (2017) writes about digital capability "… [it] is a whole-organisation agenda, but how it gets taken up depends on local factors such as departmental cultures, management styles, and how innovators are supported. It is important to find common ground between diverse stakeholders." (p. 2).

A framework approach had previously been used at UOW Library to introduce the concept of digital literacy to its workforce. Staff participated in a mandatory series of self-paced modules provided by an external vendor that were mapped to Belshaw's (2014) '*Essential Elements of Digital Literacy*' framework. Staff formed small groups of 5-8 individuals and worked through each learning module together as a small community of practice. Each group was led and mentored by a peer who self-reported higher levels of digital literacies. The phase was an effective first step to integrate digital literacy development as a core business in the organization. The value of the program lay in its consolidated model, which clearly defined digital literacies and set a benchmark for staff development. However, anecdotally, staff felt that the program was too prescriptive and that the content in the modules was too far removed from their own work and personal contexts. The rigidity of the program design and implementation did not cater to the diverse skillsets found in the organization. Those with low levels of digital literacies were lifted, but those who had mid- to high-levels found the program rudimentary. A personalized program that met the unique needs of the UOW Library workforce was needed.

Program design

Due to the messy nature of digital literacies and given that a rigid, framework-focused model had already been implement, a program was built in-house to meet the unique needs of the library workforce. The program does not use a framework to anchor its content and instead focuses on addressing the Library's workforce and organizational needs through continuous scoping and adaptation. In lieu of an institutional definition of digital literacy, the program used the definition crafted by JISC (2014) to guide its development. The JISC (2014) definition is as follows: "Digital literacies are those capabilities which fit an individual for living, learning and working in a digital society." It is this definition that guides the topics covered in the program. In addition to aiming to aid staff in the development of their digital literacies, the program also seeks to develop the workforce into a community of self-directed learners.

The program is guided by four key design elements – personalization, flexibility, learning agency and self-directed learning. These elements were identified based on workforce and organizational needs. Table 1 demonstrates how the design elements map back to workforce and organizational needs and were put into practice. It should be noted that these elements were key at the time of writing, but are anticipated to evolve as the program unfolds.

Table 1: Elements of program design mapped back to workforce and organizational needs.

Elements of Program Design	Need	Application
Personalization. The program can adapt to individual staff context and learning preferences.	• Content that is relevant at the individual level, either in work or personal context. • Variety of options to learn (i.e., in a group or alone, online or in face-to-face sessions) • Program that isn't prescriptive and can respond to individual needs on an ongoing basis	• All learning content is custom built based on staff requests and context. • Staff given freedom to choose how they learn, and are offered custom online resources and face-to-face group sessions, and as well as assistance in finding external learning resources (i.e., Lynda.com courses) to suit their learning goal. • Content topics are determined on an ad hoc basis.
Flexibility. Multiple entry points are offered to allow for asynchronous learning.	• Program that can be accessed just-in-time or when individual is ready.	• Custom online learning resources available at any time through a website.
Learner agency. Staff can determine their own learning goals and can co-construct program and	• Staff members given the freedom to choose what they would like to learn	• Staff set their own learning goals. It does not have to be related to their work. • Staff do not have to engage with

learning content.	● Staff members given the opportunity to provide input in program design and evolution.	custom learning resources. ● Staff included in conversations around program design.
Self-directed learning. Program equips staff with skills for ongoing learning.	● Program equips staff with capabilities to develop digital literacies on their own in the future. ● Program offers encourages knowledge-sharing amongst workforce to create a decentralised knowledge network.	● Learning content is not instructive. ● Learning content encourages staff to use external learning resources (i.e., YouTube videos, Lynda.courses). ● Learning content encourages staff to share their knowledge with others (i.e., through learning resource creation, running sessions, online discussion forums).

Personalization is at the heart of the program, and is enabled through commitment to flexibility and learner agency. The program does not focus on a prescriptive framework, instead allowing staff to determine their learning goals and path. All custom-built learning content flows on from their goals. Staff are given the freedom to request content topics and provided with a variety of learning methods to achieve their goals, including online learning resources, an online discussion forum for knowledge sharing, face-to-face sessions, and one-on-one consultations with program designers to help them identify goals, seek assistance and build their confidence as self-directed learners. A similar approach at Bond University proved effective in catering to the diverse skillsets (Kinash & Kordyban, 2012). Flexibility in the program is demonstrated by determining content topics for learning resources and face-to-face sessions occurring on an ad hoc basis, often at the suggestion of staff.

The main entry point to the program is a custom website built on WordPress. The website is segmented into the 5 content themes, broken down further into concepts and technologies (see Fig. 1). Each theme contains webpage-based learning resources that aim to facilitate self-directed learning and knowledge sharing amongst staff. The aim of the resources is to define, rather than instruct, and to encourage staff to use external learning support (i.e., official support forums, YouTube videos, online tutorials and courses). The intention of this design is to facilitate self-directed learning, and equip staff with the knowledge and tools to develop their digital literacies after the program formally ceases. Each resource adheres loosely to the following structure:

- Define the topic and its potential utility in work or personal contexts
- Provide a brief list of places to find help (i.e., support forums)
- Provide a learning benchmark in the form of a checklist
- Encourage staff to implement and/or share their new knowledge.

Each learning resource is developed by either a program designer or any staff member who feels confident enough to describe the topic to their peers. The intention of this is to develop a decentralized knowledge network and undo the workforce's perception that only a few "tech-savvy" staff can provide assistance. In addition to the learning resources, staff can also request help or share knowledge through comment sections and a discussion board, stay in the loop with current technology affairs through informal blog posts and view an event schedule of any scheduled external events.

The secondary entry-point to the program are ad hoc face-to-face sessions. These sessions take a variety of forms. To date, they have taken the form of structured 'how-to' sessions covering specific tools like Feedly, informal discussions on broader topics such as social media and open conversations about staff experiences of developing their digital literacies. In a similar fashion to the learning resources, the sessions are led by any staff member who feels confident to do so.

Figure 1: Content themes used to structure website content.

Substantial effort was put into generating engagement and commitment from staff through ongoing conversation, rather than mandatory participation in predetermined activities. Staff are invited to provide feedback on an ongoing basis and played an active role in co-constructing the final design. The dissemination of the design preceded the setting of staff performance goals, and all staff were guided to elect at least one digital literacy-oriented goal of their choosing. Recording their goals formally was the only restriction placed on staff in the program. Tying a digital literacy initiative to a formal professional learning initiative proved successful for Newland and Handley (2016) as it added a personal value for academics. The use of performance goals in the context of UOW Library was not intended to force mandatory participation, but rather to show the strategic value to the initiative and thus generating commitment from staff.

Challenges

The degree of personalization available in the program creates a heavy workload for the program designers currently developing the website and online learning resources. While the intention is to have all staff contributing the development of online learning resources, time is needed for the workforce to develop confidence in this area and a few key staff have been developing a large portion of the learning content.

Further, the program is difficult to evaluate due to its lack of structure, degree of personalization and the fundamental fact that the development of digital literacies is a messy process. It is difficult to clearly see how staff are progressing due to the breadth learning goals. Ongoing qualitative feedback mechanisms have been implemented, including surveys and informal forum groups but this is a time-intensive process.

Conclusion and next steps

A total of 76 staff are participating in the program. At the time of writing, the program is approaching the end of its first quarter in a year-long timeline. Over 25 learning resources and blog posts have been shared on the website. The orchestration provided by the program designers will be pared back at the program's mid-point as it is hoped that more staff will begin developing their own resources and running their own sessions proactively as a result of this initiative.

Evaluation methods to gauge how the program's effectiveness in assisting staff to develop their digital literacies are have been identified and will be implemented throughout the program. Conclusions drawn from the evaluation process will be shared with the academic community to assist other higher education institutions seeking to develop the digital literacies of their workforce.

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From digital natives to digital literacy: Anchoring digital practices through learning design

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While the academic community and the general public often refer to learners today as inherently tech-savvy digital natives, those in the educational technology community have long advocated for a move away from digital native stereotypes in favour of fostering digital literacy. As such, the educational technology community can play a vital role in shifting from popular conceptions of digital natives and toward developing digital literacy for the benefit of all learners. In this paper, we provide a comparative analysis of search data from Google Trends showing continued use of the term digital natives and the rising interest in digital literacy. In order to help educators move away from popularized concepts of digital natives by instead developing digital literacy in three domains, we propose a conceptual framework for anchoring digital practices within a Learning Design model.

Keywords: digital natives, digital literacy, learning design, educational technology.

Introduction

Amongst the general population and within academia, there is a continued fascination with *digital natives*, a term coined at the turn of the twenty-first century. As many within the educational technology community know, conceptions of digital natives position students within the Millennial or Net generation as being inherently tech-savvy and ubiquitous consumers and producers of technologies, especially social media. Prensky's work (2001) popularizing the concept of the digital native is widely referenced, evidenced by his over 21,000 citations within Google Scholar as of October 2018. While the overall academic community shows continued interest in digital natives, there is a notable decline in the use of the terms "digital natives," "Millennials," and "Net generation" within educational technology journals, indicating that the educational technology community appears to be moving away from these stereotypes (Judd, 2018). At the same time, across communities there is growing interest in the concept of digital literacies, which focus on the ways in which technology uses and preferences are learned.

In light of these disparate trends, we argue that those in the educational technology community can play a vital role in fostering meaningful change by addressing calls to move away from stereotypical ideas of digital natives (e.g., Brown & Czeriewicz, 2010; Kennedy, Judd, Dalgarno, & Waycott, 2010) through the development of digital literacy (Smith, 2017). Through an analysis of search data from Google Trends, we illustrate continued use of the term *digital natives* and, comparatively, the rising interest in *digital literacy*. In order to move away from concepts of digital natives and toward fostering digital literacy in all students, we propose a conceptual Learning Design framework for developing a robust set of knowledge and skills within three domains of digital literacy.

Defining digital natives and digital literacy

While continued popularity of the terms "digital natives," "Net generation," and "Millennials" is well established (Judd 2018), little research has compared the sometimes-conflated yet decidedly distinct terms of "digital natives" and "digital literacy." Both terms originated around the turn of the twenty-first century, but while the term digital natives often implies inherent or innate abilities to use and understand technologies, the term digital literacy emphasizes the process of *learning* to effectively use technologies.

Digital native proponents argue that students in the Net generation, also known as Millennials, are unique in contrast to their digital immigrant elders because young people born in this era have always known a world with digital technologies and the Internet. An extensive literature analysis of foundational, recurring digital native claims shows eight dominant themes defining Net generation students as those who 1) possess new ways of knowing and being; 2) drive a digital revolution transforming society; 3) are innately or inherently tech-savvy; 4) are multitaskers, team-oriented, and collaborative; 5) are native speakers of the language of technologies; 6) embrace gaming, interaction, and simulation; 7) demand immediate gratification; and, 8) reflect and respond to the knowledge economy (Smith, 2012, pp. 6-7). Nevertheless, evidence from leading researchers and practitioners within the educational technology community has largely shown the digital native to be an unevidenced stereotype, and as such, it is not a particularly accurate or useful portrayal of students' technology needs or abilities (e.g., Bennett & Maton, 2010; Hargittai, 2010).

Contrary to ideas of digital natives, the original definition of digital literacy highlighted a developmental process whereby people build mastery of ideas, not just keystrokes (Gilster, 1997, p. 15). Digital literacy is often defined as "the ability to use information and communication technologies [ICTs] to find, evaluate, create, and communicate information, requiring both cognitive and technical skills" (ALA Digital Literacy Taskforce, 2012, para. 2). In this way, definitions of digital literacy often incorporate complimentary aspects of the *information literacies* needed to effectively locate, evaluate, and use information. Additionally, digital literacy reflects aspects of *multiliteracies* or *new literacies* (Baker, 2010) focusing on new ways of studying and understanding literacy in the twenty-first century as closely associated with ICTs (Lankshear & Knobel, 2003) and, relatedly, notions of digital natives (Ng, 2012). Recognizing these overarching concepts, we argue that digital literacy requires mastery of knowledge and skills within three domains: the **procedural and technical** domain for those *operational, procedural, or technical skills required* for functional aspects of the technology; the **sociocultural** domain encompassing the ways in which technologies are *shaped by and reflect the sociocultural contexts* within which they are created and used; and, the **cognitive** domain for those *cognitive aspects required for effective technology use* including the need to process information, form schemas for information retrieval, and make metacognitive connections.

A comparative analysis of search trends

A comparative examination of the usage of these search terms (see Figure 1) allows us to consider, within a snapshot of the last decade, trends reflecting the level of popularity and interest for these topics.

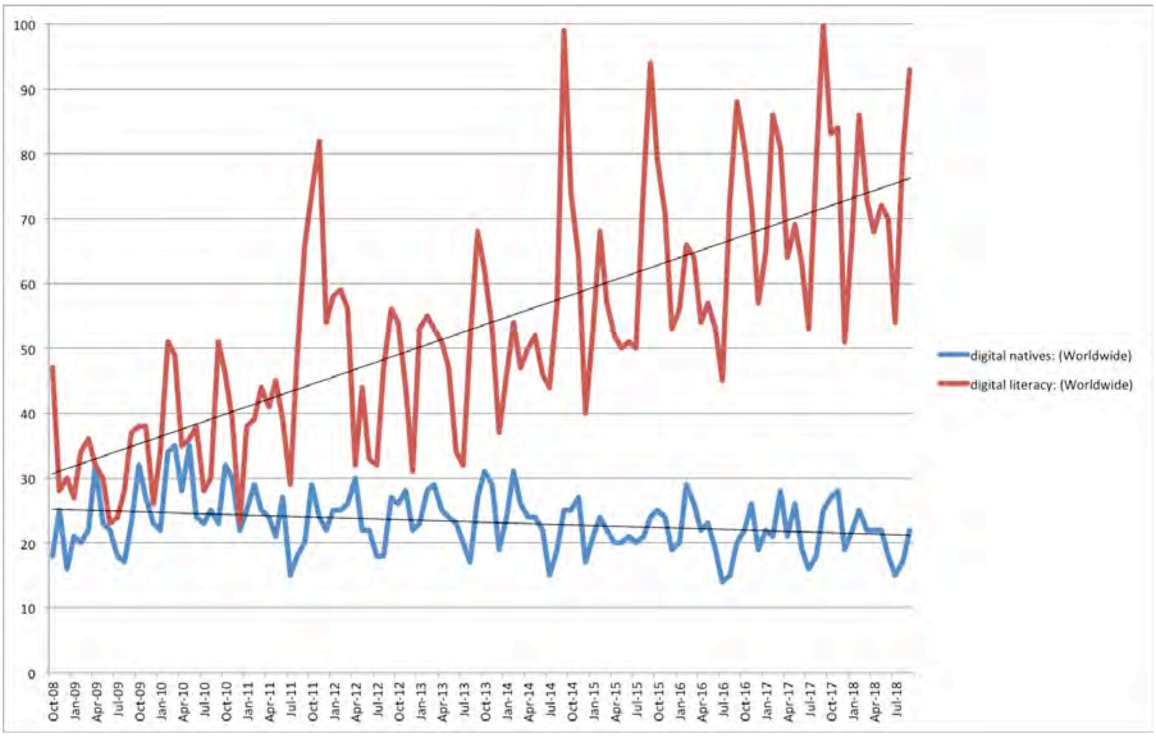

Figure 1: ***Graph of Google Trends search data over the past 10 years (worldwide).*** This graph shows interest related to the search terms "digital natives" (blue) and "digital literacy" (red) since October 2008. According to Google, these "numbers represent search interest relative to the highest point on the chart for the given region and time," with 100 for peak popularity and 50 indicating a search term is half as popular.

As can be seen in Figure 1, overall search interest in "digital natives" remains relatively constant over the past decade. Comparatively, Google Trends data reveals growing interest in "digital literacy," with peak popularity for this term occurring in October 2017. While such trends can vary geographically, potentially due to language differences and other regional variations (Stocking & Matsa, 2017), when examining additional Google Trends data according to geographical area during this time, researchers found similar trends for these search terms in the UK, US, Canada, and Australia.

The Google Trends search data illustrates that while the term "digital natives" persists, growing interest in the topic of "digital literacy" presents an opportunity to move toward evidence-informed dialogue about learning and technologies across generations.

Anchoring digital literacy through learning design

Digital native stereotypes remain popular, suggesting that educators are looking for ways to connect with their students and foster meaningful use of technology. However, our analysis of the literature suggests that when such efforts rest on digital native stereotypes, they are misguided at best. At worst, they may be harmful because young learners don't necessarily come with all of the knowledge and skills they need, and when educators assume that they do, valuable learning opportunities are likely missed. Thus, the educational technology community can support a movement toward the more useful construct of digital literacy by providing a clear Learning Design (LD) framework in order to guide educators toward meaningful and robust technology integration.

To help shift discussions from a focus on digital natives to the development digital literacy, those in the educational technology community can play an important role in helping educators to facilitate effective digital practices through effective designs for learning. Mor and Craft (2012) define Learning Design as "the deliberate shaping of form in response to function. LD is the act of devising new practices, plans of activity, resources and tools aimed at achieving particular educational aims in a given situation" (p. 86). *The Larnaca Declaration on Learning Design* (Dalziel et al., 2016) articulates a clear connection between LD and digital literacy. Walker and Kerrigan (2015) advocate for further work connecting these two areas: "The challenge for Learning Design theory and the further development of the Larnaca Declaration is not only to embed critical digital literacy into the development of learning practices, but also to contextualize this as part of successful Learning Design" (p. 99). Mor, Craft, and Main (2015) emphasize the importance of conceptualizing a model prior to design of particular learning activities. To address this challenge of embedding digital literacy in LD while at the same time recognizing the importance of first conceptualizing an overarching model to guide this process, in the following section we propose a model for embedding the three domains of digital literacy within a Learning Design framework that aims to provide a foundation for fostering effective digital practices.

To inform this model, we consulted the design literature for recurring elements of designs for learning that can anchor an overarching pedagogical approach to digital literacy. Fink's (2003) work engages with strategies for designing significant learning experiences, and emphasizes the importance of *situational factors*, such as learner characteristics and disciplinary context, that inform the key components of integrated course design: teaching and learning activities, learning goals, and feedback and assessment (p. 62). These inform the essential foundations of Learning Design for digital literacy represented at the top of Figure 2. Likewise, Herrington and Oliver (2000) demonstrate that for authentic learning to occur, particularly in online environments, elements of *situated learning* can foster application of knowledge and skills within real-life contexts. They define the critical elements of situated learning environments as providing authentic contexts, activities, and assessments through design strategies, including: coaching and scaffolding (i.e., by the teacher); modeling of processes/practices; engagement with multiple perspectives/roles; collaboration for knowledge construction; and reflection and articulation (e.g., making tacit knowledge explicit) (Herrington & Oliver, 2000, pp. 25-26). Additionally, when teaching or learning about and through technologies, alignment between learning outcomes and technological affordances
(i.e., the types of interaction that a technology facilitates or prevents) becomes key (Willcockson & Phelps, 2010). We have distilled and integrated all of these considerations into five pedagogical elements of Learning Design framing the development of digital literacies outlined in Figure 2.

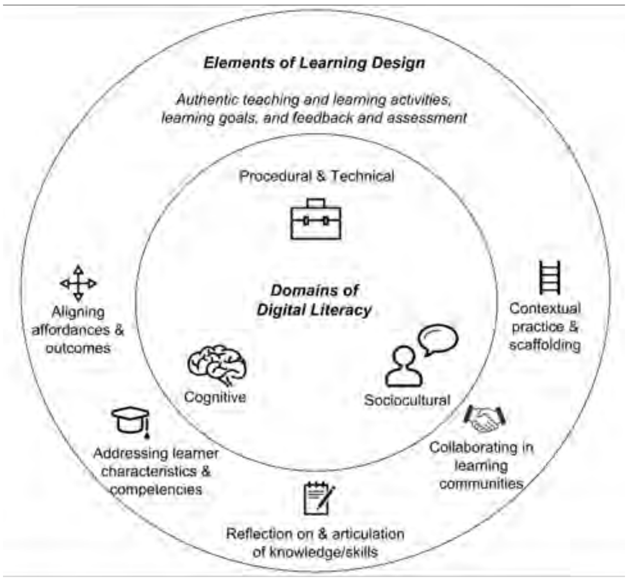

Figure 2: Learning Design elements supporting development of three domains of digital literacy. We propose five key LD elements to support digital literacies in the procedural and technical, sociocultural, and cognitive domains.

Drawing upon the design literature and characteristics of situated learning, these five key LD elements can help to bolster authentic development and application of digital literacies in each of the interconnected areas of procedural and technical (e.g., technically manipulating account settings), sociocultural (e.g., creating and exchanging digital artifacts in socially/culturally relevant ways), and cognitive (e.g., metacognitive abilities for learning how to learn about and with technologies). Educators may look to this model when considering the steps involved in building digital literacy in each domain:

1) *Aligning technological affordances and learning outcomes*. For example, mapping disciplinary or professional competencies onto the most appropriate digital tools or technology-mediated interactions.
2) *Addressing learner competencies and characteristics*. For example, determining the prior knowledge and skills learners bring in each domain, and where existing competencies need to be further developed.
3) *Enabling learner reflection on and articulation of their knowledge and skills*. For example, supporting learners in moving from being tacit about digital knowledge and skills to being explicit about each domain.
4) *Facilitating collaborative knowledge construction and exchanges in (online) learning communities*. For example, where appropriate, engaging in student-student and student-educator interactions via in-person or online learning communities that help in acquiring and apply digital literacies within all the domains.
5) *Creating opportunities for contextual practice and scaffolding*. For example, modeling or coaching within contextual practice opportunities that reflect the domains.

These LD elements are neither prescriptive nor sequential, but rather should be seen as a part of an iterative design process. When linked to clear learning outcomes in each of the domains, they can offer a robust approach to digital literacy development.

Conclusion

The rising interest in digital literacy, as evidenced by Google Trends search data, provides the educational technology community with a timely opportunity to facilitate a move away from stereotypical ideas of digital natives. In this paper, we argue that this move must be supported by intentional design for learning digital literacy, which fosters knowledge and skills in three interconnected domains: procedural and technical, sociocultural, and cognitive. Educators may look to the proposed conceptual framework for strategies to anchor digital practices through a model that articulates five key situated LD elements.

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Evaluative judgement and peer assessment: promoting a beneficial reciprocal relationship

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There are many pedagogical benefits of peer assessment: it can develop content knowledge, students' feedback skills, and afford additional sources of feedback for students. Furthermore, peer assessment can contribute to the development of students' evaluative judgement, a core capability for independent practice and lifelong learning. However, peer assessment is frequently seen as problematic, due to logistical issues, and concern from both staff and students around the ability of peers to contribute meaningfully to learning. Somewhat paradoxically, students' evaluative judgement is likely to contribute to successful peer assessment. Technological solutions for peer assessment can have a significant role in improving uptake of peer assessment practices. If such implementations also focus on the core requirements/principles of evaluative judgement development, this may be one way to improve the success of peer assessment. This paper provides a rationale for the inclusion of peer assessment within curricula. It introduces the concept of evaluative judgement; highlights the benefits and challenges currently faced within peer assessment, and identifies desired functionalities for peer assessment and evaluative judgement that could be implemented through technological means.

Keywords: evaluative judgement; peer assessment, assessment for learning

Introduction

Peer assessment encompasses a wide range of activities that students can do with each other. This might be viewing and providing marks on an oral presentation; marking up and providing feedback on a written piece of work; students marking each other on clinical skills; a team of students assessing each other on their teamwork skills; or even students correcting their peers' short answer questions according to an answer key. Essentially, these are all activities where "students judge and make decisions about the work of their peers against particular criteria" (Adachi, Tai, & Dawson, 2018b, p. 454). However, how do students come to be able to judge and make decisions of work against criteria? The notion of developing students' evaluative judgement can help to explain how this can be facilitated within educational settings. However, peer assessment may also contribute to the development of evaluative judgement (Tai, Ajjawi, Boud, Dawson, & Panadero, 2017). This conceptual paper aims to explore how developing students' peer assessment abilities, and developing students' evaluative judgement, interact and contribute to each other. Peer assessment very frequently also involves the use of technology: given the reciprocal nature of peer assessment and evaluative judgement, this paper will then consider how technology might contribute to the development of evaluative judgement through implementations of peer assessment.

Evaluative judgement: what is it, and why is it important?

Evaluative judgement is an emerging concept within higher education. It has been defined as "the capability to make decisions about the quality of work of self and others" (Tai, Ajjawi, et al., 2017, p. 5). At first glance, it may seem just like a more complicated way of referring to self and peer assessment, however it entails more than just participating in assessments. Evaluative judgement also requires an understanding of quality, and the ability to apply understandings of quality. Evaluative judgement is therefore crucial for independent practice, which may feed into self-regulated and lifelong learning practices. Quality, here, is a holistic concept that cannot be devolved, broken up, or otherwise itemised to exist as a checklist or other basic instrument which anyone could use.

The need for students to have a workable understanding of quality has been raised in a range of interconnected fields. When Sadler (2010) discussed the student's role in feedback, he identified that students must be able to process information and see the gap between their actual performance, and the expected performance. Boud (2000) approached students' understandings of quality from the concept of sustainable assessment: that students needed to partake in in assessments which prepared them for the future, rather than undermining their independence. Here, Boud suggested that assessments should function so that students might be able to judge the quality of their performance in future instances where no formal assessment existed. Boud & Falchikov (2006) also argued that learners must *become* the assessor to foster long-term learning. Concepts such as phronesis, or “know-how” (Hager, 2000), connoisseurship (Eisner, 1985) and tacit knowledge (Eraut, 2000) also involve expertise of the individual. All these ideas touch on aspects of developing expertise, understanding quality, and in some cases, being able to judge quality. Evaluative judgement draws these ideas together, and provides a more articulate justification for a range of commonly used pedagogies, heretofore used to ‘improve learning’ but without an underlying conceptual rationale (Tai, Ajjawi, et al., 2017).

Evaluative judgement itself is discipline and context dependent (Bearman, 2018). Evaluative judgement therefore is not a generic skill that exists within all students in exactly the same way: we aim therefore to develop their evaluative judgement in a particular area. For instance, a civil engineer might be very good at identifying quality in concrete composition and pouring, but have little understanding of what constitutes quality for poems. A surgeon observing the use of laparoscopic equipment by a fellow surgeon will be able to comment on the skill of their peer in a qualitative manner, but may be unable to judge how well a consultant psychiatrist treats a patient with a mental illness. Returning to learner in higher education, an English literature major may be able to describe and execute a well-written persuasive essay, but be less able to write a policy advisory document. For a particular discipline, specific content knowledge, skills, attitudes, dispositions, and/or other qualities are required for evaluative judgement to be properly exercised. Indeed, students’ ability to self-assess accurately is also somewhat context and task dependent (Boud, Lawson, & Thompson, 2015). Thus, there is an argument for implementing activities in all courses, and all units of study that develop students’ evaluative judgement.

Ways of developing students’ evaluative judgement

Developing evaluative judgement, on the other hand, may be a transferrable skill: the types of learning activities and processes that develop evaluative judgement are likely to be similar across professions and disciplines, even if they are not exactly the same. Several ways of developing evaluative judgement have been proposed. This includes the use of exemplars, the use and co-creation of rubrics, self-assessment, peer assessment, and feedback (Ajjawi, Boud, Dawson, & Tai, 2018). All of these activities are proposed to be helpful in helping students gain a more holistic understanding of quality. While rubrics might be seen as a way to break up a holistic understanding into various criteria, there are still elements of quality that are unlikely to be able to be captured within the standard range of rubrics, some of which can even be single descriptor rubrics (Dawson, 2015). Many of these activities are assessment related. Other common assessment activities that might develop complex and holistic understandings of quality include critical reflection, and the use of an annotated portfolio of work.

Evidence for these ways of developing students’ evaluative judgement is scarce to date. This is likely due to the relative novelty of the term, rather than a lack of investigation into how students develop understandings of quality that they are able to employ in their own judgements of work. The work that does exist is in the field of exemplar use, and peer assessment and feedback. To & Carless (2015) found that in-class use of written essay exemplars, including peer and teacher discussion, helped students to be able to identify and judge quality. Similarly, Nicol (2014) found that peer assessment and feedback helped students to identify quality within essay work. Tai, Canny, Haines & Molloy (2016) also identified that peer feedback and discussion regarding performance of clinical skills contributed to students’ evaluative judgement. Peer assessment may be particularly powerful in developing evaluative judgement, as when acting as an assessor of peers, students must exercise their evaluative judgement, thereby providing opportunities to practice and refine their judgement skills.

Peer assessment functions, benefits, and limitations

Peer assessments has multiple beneficial functions, including the development of transferable skills, providing an authentic form of assessment (when viewed in terms of future work and life-long learning skills), promote students’ learning, including the development of evaluative judgement, the provision of feedback to students in a timely fashion, and developing students’ feedback skills. It may also alter the nature of educators’ time and input required for a particular learning activity (Adachi et al., 2018b; Rust, Price, Donovan, & Brookes, 2010).

Which benefits arise depend on how the peer assessment is constructed: there are several choices to be made concerning the use of peer assessment. Adachi, Tai and Dawson (2018a) identified a total of 19 design elements which contribute to the overall make-up of a peer assessment, including one cluster of decisions concerning the use of peer assessment. This included the subject area, intended learning outcomes, whether it is a process (e.g.

team work, communication skills) or a product (e.g. essay, presentation) that is being assessed, and whether that assessment counts towards grades (and how much it contributes towards that grade). For example, where students are asked to formatively assess each other on their participation in a group project to provide feedback to team members, students will gain feedback on their performance, and it may be seen as an authentic form of assessment, as a form of 360º performance appraisal. Asking students to mark peers' lab reports against a rubric may foster the marker's learning of criteria and standards of work, and also mimics the peer review process which academics undertake for publishing, lending to its authenticity.

The limitations of peer learning, and particularly peer assessment, have been explored extensively. Where peer assessment is used for summative purposes, there may be significant backwash effects on students, and students may act differently as a result (Boud, Cohen, & Sampson, 1999). This may include preferential grading of friends or the deliberate down-grading of competitors: as Falchikov (2007) points out, "we cannot escape the tension between co-operation and competition that permeates education" (p. 139). These issues may be reduced through the formative use of peer assessment, reducing the incentive for deliberately inaccurate peer assessments. General concerns around the accuracy of peer assessment also persist, which feed into the more general idea that peers are unable to contribute to feedback and assessment, i.e. that students are the "blind leading the blind" (Carless, 2013; Tai, Haines, Canny, & Molloy, 2014). However, peer assessment has been found to become more accurate (when compared to educator assessments) when an understanding of criteria and standards is established (Falchikov & Goldfinch, 2000; Kulkarni et al., 2015). It is likely, therefore, that evaluative judgement is important for peer assessment to be done well, in the understanding of quality work, and the application of standards to judgements.

Peer assessment design for developing evaluative judgement

Given this reciprocity between peer assessment and evaluative judgement, what features of peer assessment therefore contribute to the development of evaluative judgement? Falchikov (2007) argues strongly for the use of scaffolding in peer learning, and then, once learners have developed their skills, for the gradual fading of support to allow students to become independent practitioners. Peer assessments should therefore commence with strong scaffolding: the articulation and discussion of standards, and quality of work, should be a starting point. Establishing a shared understanding is important for academics in the marking and moderation of work (Bloxham, 2009; Sadler, 2013); the same applies here. By participating in peer assessments, students may also come to understand the complexity and subjectivity within assessment processes (Bloxham, Den-Outer, Hudson, & Price, 2016). To develop students' skills in peer assessment, there should then be many opportunities to practice and undertake peer assessments, to help in understanding quality in particular areas – either in terms of the topic or content knowledge, or in terms of the format of assessment. To combat concerns around the legitimacy of peer assessments, the subject of the peer assessment should be something that students could reasonably expected to already have a level of knowledge about. Furthermore, students should be given explicit guidance around what that subject is, to indicate the boundaries and acknowledge the limits of their expertise (Tai, Canny, Haines, & Molloy, 2017). All of this contributes to a learning environment and culture where peer assessment is frequent, normalised, appropriate, and therefore expected. Using peer assessment in this manner, however, also implies that it occurs largely in addition to educator assessment and feedback, especially in the earlier years. This may represent a significant workload for educators, and so the role of technology in peer assessment will be important in promoting its uptake.

How can technology facilitate peer assessment and the development of evaluative judgement?

Technology is omnipresent in higher education. In one way or another, technology has a role in facilitating learning, and this is especially the case for distance learners. Practically, technology can help in the running of peer assessment activities. Allocation of pairs or groups can usually be done through the Learning Management System and with this comes the ability to exchange or share work to be assessed, and discuss tasks with each other. Beyond this, specific peer assessment software can also afford functionalities around providing grades, marks, or feedback to peers, and provide in-built mark-up tools for commenting on work. However, the implementation of these functionalities can be time consuming, requiring the support of educational developers and institutional information technology services (Adachi, Tai, & Dawson, 2016). This is likely to have an impact on who implements peer assessment, and how it is implemented.

Beyond the logistics of peer assessment, we should also consider what might be done to foster evaluative judgement, both in the immediate peer assessment, and across time. The key components of evaluative judgement should be supported: students should have easy access to standards, criteria, and representations of these things. This might be as simple as providing annotated exemplars and rubrics. Given the promising research on video feedback, audio or video explanation of standards may provide a different media which helps with student processing of information (Mahoney, Macfarlane, & Ajjawi, 2018). Real-time discussion opportunities with peers and educators may also assist in developing understandings of quality prior to the act of peer assessment, and these might be facilitated online where a record of conversation is easily made for others to consult. Students are also likely to benefit from multiple opportunities to conduct peer assessments and practice their evaluative judgement capabilities: this might be automated through an adaptive system that provides peer work of varying quality, to provide a wider range of experiences.

Evaluative judgement is a continually developing capability. We should therefore also develop systems that allow for the longitudinal evidencing of evaluative judgement development. Though the judgement itself is complex and qualitative, students might gain feedback on the relative accuracy of their judgements. This could include visualisation of progress over time, and opportunities for students to reflect on their developing understandings of quality, and how they have applied them to their own work, and work of others. Such a repository would remain accessible across units and even courses of study.

Implications for practice and research

Practice and research which involves the term 'evaluative judgement' is relatively novel, though similar ideas have been discussed for many years. Therefore, the first goal for practice and research in this area could be seen as the explicit use and employment of evaluative judgement as a concept. Within the bounds of peer assessment, this may be especially helpful in providing a rationale for peer assessment, and a new way of communicating the desired outcomes of peer assessment.

Research which explores the development of evaluative judgement so far has occurred in face-to-face settings. The use of technology in these settings has been limited, as many activities are based around in-class discussion. Therefore, exploring how evaluative judgement is and can be developed while learning at a distance, and/or learning online is a key next step. The types of peer assessments undertaken in such learning environments are also likely to be designed differently, and so describing these accurately, and exploring their connection to evaluative judgement, will also be crucial.

Overall, evaluative judgement represents an exciting conceptual advance that draws together assessment and pedagogy in higher education. Peer assessment is likely to contribute to the development of evaluative judgement, and evaluative judgement to successful peer assessment. Within the context of the present higher education environment, the creative use of technology will be key in promoting both practice and research in this field.

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Thinking out-of-the-box: Slow as a panacea for creating democratic education in Australian schools

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The uptake of digital technologies in education is a significant issue for governments and organisations across the world as concerns are expressed about students' lack of progress in these areas. As a result, the inclusion of digital technologies is often unquestioned and caught up in a largely aspirational discourse of inevitability, where the belief is that using digital technologies will lead to curriculum reform. The case study of Slow, presented here, aims to enlighten the conversation with examples from research in different education jurisdictions in Australia. Slow is a national vision for digitally rich education through a different lens. This new theoretical framework of *Slow* comprises four convergent themes: state of mind, time, process and connectedness. These themes are offered through interdisciplinary, technology-rich secondary school examples that highlight the potential of *Slow* to re-imagine the way we think about education. Important critique offered throughout the concise paper signposts diverse interpretations of the digital technologies agenda that is often missing from 'click-bait' media snapshots and in recent government reports. Examinations of understandings and practices in some Australian education contexts offer universal and readily transferable treasures that suggest powerful options and ripostes for policy, education leaders, teachers and young people.

Keywords: digital technologies, education, schools, Slow

Introduction

Australia's prosperity as a global competitor and its economic future has permeated education in the last decade, through the national vision for Information and Communication Technology (ICT) and Science, Technology, Engineering and Maths (STEM) education. Policies and reports such as *The National STEM Strategy* (Office of the Chief Scientist, 2013), *National STEM School Strategy* (Office of the Chief Scientist, 2013), the *Digital Education Revolution* (Rudd, Swan & Conroy, 2007), *Review of Australian Higher Education* (Bradley, Noonan, Nugent & Scales, 2008) and the *Melbourne Declaration on Educational Goals for Young Australians* (Barr, Gillard, Firth, Scrymgour, Welford, Lomax-Smith & Constable, 2008) are set against the backdrop of the effects of the heightened issues of international competitiveness, productivity and economic demands, that the *economic* role of schools has been elevated to levels of pre-eminence in education.

The increased emphasis on the economy, technology and the pressure on educators to serve the needs of what has now been deemed 'the knowledge society' have significant implications for technology enhanced learning. In Australia, for example, the *National STEM School Strategy* (Office of the Chief Scientist, 2013) and the *Digital Education Revolution* (Rudd, Swan & Conroy, 2007) plus recent reports such as *Challenges in STEM learning in Australian Schools* (Timms, Moyle, Weldon & Mitchell, 2018) saw the rapid increase in access to technological resources, which required students and teachers immediately use them. Adopting technological resources without sufficient pedagogical dialogue, critique and reflection limits the effect an "educational revolution" can have on learning. Each student must be equipped to seize learning opportunities throughout life, to broaden his or her knowledge, skills and attitudes and to adapt to the changing, complex and interdependent world.

This is education reform focused heavily on the 'here and now'; hastily equipping students with hardware and software, installing broadband connections, the technological up-skilling of students and teachers, focusing on raising the performance levels in the National Assessment Program, Record of School Achievement (RoSA) and Higher School Certificate (HSC), and releasing school league tables based on quantitative student results. These are all reflective of short-term measures that are unlikely to adequately prepare students for a twenty-first century world of uncertainty, complexity and technological innovation. In the government's attempt to reposition education - underpinned by an economically driven vocational rationale - they have altered the conventional educational paradigm. In the name of educational reform, the policy makers have confused "structure with purpose, measurement with accomplishment, means with ends, compliance with commitment" reform is cultivating a culture of Fast knowledge.

Fast knowledge

Fast knowledge (Orr, 2002) a treasure from some time ago rests on the following seven assumptions: 1) only that which can be measured is true knowledge; 2) the more knowledge we have, the better; 3) knowledge that lends itself to use is superior to that which is merely contemplative; 4) there is little distinction between information and knowledge; 5) we will not forget old knowledge, but if we do, the new will undoubtedly be better than the old; 6) whatever mistakes we make along the way can be rectified by yet more knowledge; and 7) we will always be able to retrieve the right bit of knowledge at the right time and fit it into its proper social, ecological, ethical, and economic context. Fast knowledge has come to represent the essence of human progress because it appears effective and powerful in the reshaping of education, communities, cultures, lifestyles and the economy (Orr, 2002).

Fast knowledge is a result of education's short-sightedness, buoyed by "the acceleration of technology, the short-horizon perspectives of market-driven economies or the distractions of personal multi-tasking" (Brand, n.d.). Policy makers, bureaucrats and educators who ascribe to this rationale - consciously or otherwise - assume that knowledge is simply information that can be acquired via a laptop and accessed through a high-speed broadband connection, at any time and in any place. Teaching students how to use technology can take only a few moments, which implies Fast knowledge. Teaching students how to realise the deeper potentials of the technology through emphasising the importance of digital and critical literacy, creativity, innovation and evaluation is a task that requires time and reflection. It assumes a body of knowledge about society, ecology, ethics and culture that students may not have, but need to acquire. This type of learning does not yield the immediate and visible economic benefits of the technology and is often under-emphasised or overlooked during policy development. I refer to this type of knowledge as Slow.

Towards Slow

The exploration of Slow is best approached through Slow Food, which was the Slow Movement's founding organisation. Slow Food was a response to the increasing popularity of fast food over food that was 'good, clean and fair'; food connected to people, culture and place – Slow.

Slow in education is embryonic, as most debate has occurred only in the last 10 years. There have been a few advocates for Slow in education, for example: Holt (2002), who called for the commencement of the Slow school movement; Payne & Wattchow (2008) who applied a Slow pedagogy of place to an outdoor education program; Hartman & Darab (2012) and Berg & Seeber (2016), who challenged the culture of speed through exploration of Slow scholarship in the academy.

Methodology

The larger research study, from which this concise paper is drawn, was conducted in three phases. Each phase utilised phenomenology to study lived experiences of Slow and of digital technologies, in education. In the first phase, a range of advocates of Slow and educators, were interviewed in order to find out more than can be found in their writings alone about what Slow means to them, and to tease out some connections in their thinking about Slow and their thinking about Education and/or digital technologies (only one of these people was formally involved in Education). Four common themes began to appear in the analysis of these interviews: Slow as a state of mind; reconceptualising time; valuing process and the connectedness of self, people and place. In Phase Two, in-depth interviews were conducted with people who have recent experience of working with digital technologies in Education. Analysis of these interviews was coupled with philosophical reflections on aspects of Slow to illuminate an ontology of Slow in the educational context. An artefact was designed and produced to capture what was emerging as the essence of Slow – in relation to Education. This artefact – a simple but carefully designed document – was used as a focal point and stimulus for a small group discussion: the centrepiece of Phase Three of the research. This focus group consisted of experienced educators and their reflections on the Slow ideas, practical aims and their own professional experiences produced some further insights into the challenges of applying Slow ideas in rethinking digital technologies in education.

Having briefly outlined the methodology the next section of this concise paper will present a summary of the exploration of Slow in thinking about education, and life more broadly. It uncovers and interprets the four main themes to emerge from the research: Slow as a state of mind; reconceptualising time; valuing process and the connectedness of self, people and place.

Results

Issues surrounding Slow and Fast and the long term were explored through participant lived experiences and stories. Analysis of interviews, presentations, publications and television appearances revealed characteristics, contexts, practices and effects of Slow, generating themes - some of which are shared between all of the research participants and some of which appear to be unique to the individual. However, four convergent themes emerged to illuminate characteristics and principles of Slow, as revealed in Figure 1.

The themes to emerge from the study were:

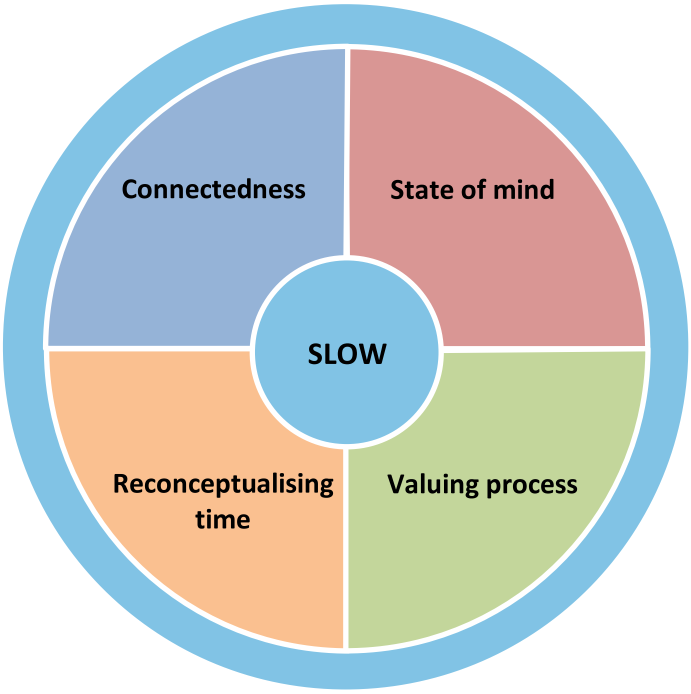

Figure 1. Slow conceptual framework

1. State of mind

An important finding that emerged concerned the way in which Slow comes into and out of the foreground of the technological experience. For the participants, this may involve the phenomena of mindful awareness. The Slow state of mind implies that moving into a Slow, open and responsive relationship with technology, is not a state which is gained simply by being who we are, or where we are. Nor is it gifted by knowing what we know. Instead it is crucially brought about by becoming more aware. A Slow state of mind in technology rich contexts requires continual examination, and reflection on one's experiences with technology and education. It was evident across the data from all three phases that in both personal and educational contexts it was easy for technology use and the characteristics of Fast to become unconscious or forgotten. As this theme (state of mind) identified, Slow is negotiated repeatedly and the tensions between Fast and Slow are evaluated on an ongoing basis – they are not frozen.

A heightened sense of consciousness was a theme in the phenomenology of Slow developed in this inquiry. There was potential for participants to be physically disconnected from all technology, yet Slow remains elusive. In response to this, it might be argued that a person is predisposed to experiences of Fast, but might not realise they are. Hence a Slow state of mind encourages us to engage with the moments of our everyday lives in a more considered and meaningful way, more than simply noticing the influence of technology on the world, but as a way of engaging with technology that reveals and entices potential forms and functions.

2. Time

Slow requires time - time to think deeply, talk more, explore, reflect, engage and rejoice in each moment. The advocates of Slow exercised choice and control of what felt like the right number of tasks to undertake; reflecting tempo, rhythm and pace in tune with, and unique to, each individual. This is in contrast to descriptions of school time as organisational, monochromic, compartmentalised and calendar based – characteristics inimical to learning and working *with* rather than *in* time (Lafleur, 1999; Giddens, 1987). Through technology, time and work no longer need to be competing for status. In fact, participants demonstrated that work could be reorganised enabling alteration of the perceptions and experience of time in order to accommodate, transform and enhance time.

Such a view of time, one that is more subjective, personal, dynamic and supportive of the connection and engagement with learning and learners, resonates with the ideas of Dewey (1933/1986). According to Dewey, such a view of time connects education with meaning and authenticity, which is important for understanding the question of being. Such a view of time can be achieved through the integration of technology. Technology offers students an opportunity to make significant connections to their own place and time and in their own way. Technology use can transform time, providing an opportunity for learning to resonate with students as the learning activities flow naturally and in tune with each student's world, tempo and rhythm.

3. Appreciating process

Each participant who engaged in the study expressed dissatisfaction with the current educational system. They saw it as focused on content, assessment and teacher accountability – a focus on ends, rather than on processes that encourage thinking, and that develop empathetic, caring and compassionate people who value learning. Dewey (1916 & 2004) warned of education with a focus on the end rather than on experience and action. He identified the importance of the student as an active participant, not passive recipient, with a call for each student to be engaged in continual thought, inquiry, discovery and action. Dewey was an advocate for learning through projects and problems: as a way of piquing student interest, offering intrinsic motivation, and awakening curiosity and demand for information over extended but flexible periods of time, with which the research participants broadly concurred.

The role of technology within the process of learning is to enhance and strengthen the process. Students utilise technology, not as the focus but as a tool to empower them to problem-solve, present data, share information, communicate and collaborate with their peers and the wider community. The continuity of this learning process moves a learner from one experience into the next with a deeper understanding and appreciation of its relationships with, and connections to, other experiences, people and ideas. A focus on technology in this way shifts the emphasis of education to encompass humanistic qualities.

4. Connectedness

Furthermore, participants in the study communicated the importance of connectedness, a theme that features prominently and which is interwoven with many other themes. Whilst community and connection to others were discussed extensively during the focus group and interviews, connection to self and place also emerged from the conversations.

Connectedness to self has similarities with the Slow state of mind. Connectedness is a way of thinking described as looking inward to the internal rhythms of the self. It involves asking life's bigger questions to gain clarity, insight and wisdom. In Dewey's writing, we can see potential for connectedness to self - not just in the cognitive sense - but as a way of being. Understanding ourselves is to be able to give sense and purpose to life and can be recognised via learners questioning, trying, challenging, testing and experimenting (Dewey, 1916/1985). For example, two participants use of Twitter became a searching activity; inquiry into their own beliefs progressed through questioning, giving further meaning to their world and existence, rather than merely validating knowledge.

In addition, connectedness to others and culture was a core element of Slow, as revealed by the participants. Emphasis was placed on the importance of the community to generate new ideas and initiatives as a way to broaden one's perspective, and help increase empathy and awareness for the consequences personal decisions and actions can have on others. Participants shared ways with which technology can be used to strengthen communities via online connections with peers, parents and members of the wider community. Connecting through Skype™, Facebook™, and blogs revealed excellent potential to foster what Heidegger (1966) identifies as existential authenticity. In this way, technology presents a unique perspective from which to view the world, and others, and the unique possibilities that flow from such perspectives are the basis, Heidegger claims, for authenticity.

Conclusion

Slow, in technology–rich environments in education, as understood through this research, is not something that will naturally occur: it needs to be made explicit. Making Slow experiences a part of education requires systems, school leaders and teachers to be conscious of the value and role of Slow. The implication is that educators need to open up these areas of inquiry. It is also through awareness that Slow can cause educators to question personal epistemologies, so that Slow might be adopted in their own lives too. Educators need to re-conceptualise technology in their personal and professional lives in order to foster an alternate, slower, reality in the future. This is thinking that would take us into the depth of our experiences: ourselves, others and nature. The implication is that such thinking and understanding could see the personal experience and technological education effectively pursued through the experience of Slow.

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Parts of speech in Bloom's Taxonomy Classification

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This paper analyses parts of speech in a training corpus with 13,189 learning outcomes in which Bloom's Taxonomy levels were previously classified by human experts for 3,496 subjects offered at an Australian university. This paper explores the automatic identification of verbs and other parts of speech impacting the semantic meaning and Bloom's classification of learning outcome statements. The frequency with which words in learning outcomes appear as different parts of speech and at different Bloom's levels is described as a preliminary step of a larger project that aims to automatically classify Bloom's levels using a combination of table lookup and machine learning approaches. It is indicated that automated parts of speech classification can assist human learning and teaching designers to write clearer learning outcome statements. This is in addition to playing a role in automated Bloom's Taxonomy classification, and identifying cases requiring review in conjunction with normal institutional curriculum management processes.

Keywords: Bloom's Taxonomy, Learning Outcomes, Machine Learning, Parts of Speech.

Introduction

Bloom's Taxonomy is widely used as a means of describing the level of cognition expected in student learning activities and assessments (Bloom, Kratwohl, & Masia, 1956). Table 1 shows the 6 hierarchical levels of the revised Bloom's taxonomy (Anderson & Krathwohl, 2001), the meaning associated with each level, and a partial list of indicative verbs that can be used to classify associated learning outcomes.

Table 1: Bloom's Taxonomy

Bloom's level	Semantic meaning	Indicative verbs
1. Remembering	Simple recall often associated with memorisation	list, name, state, define
2. Comprehending	Basic understanding sufficient to explain ideas to others	identify, explain, describe
3. Applying	Use of information or knowledge in new ways	apply, use, solve, compute
4. Analysing	Establishing connections or relationships	analyse, compare, classify
5. Evaluating	Form a judgement or critique	evaluate, appraise
6. Creating	Synthesising something new	create, design, plan, compose

Stanny (2016) conducted a meta-analysis that identified Bloom's Taxonomy verbs from 30 sources. Her analysis considered verbs and the frequency with which they were included in verb tables available online. She included a verb in a conservative aggregation if a verb occurred at a given Bloom's level in 10 or more of the 30 tables included in the study. This resulted in a table with 104 unique verbs, out of 128 verbs in total. That is, some verbs can be indicative of more than one Bloom's category. For example, the verb *identify* can be indicative of the *comprehending*, *applying*, or *analysing* category depending on the context in which it is used.

Machine learning and probabilistic parsers can automatically identify parts of speech in an arbitrary sentence (Klein & Manning, 2002, 2003; Müller & Guido, 2016). In such an approach, parts of speech are determined using a model based on a training corpus in which a human expert has previously tagged parts of speech. Once identified, verbs can be used in lookup tables to identify indicative Bloom's categories. In those instances in which a verb can indicate different Bloom's categories, Omar et al. (2012) assigned a weight determined by subject matter experts in a rule based approach to determine the likely classification. Similarly, Yahya, Sman, Taleb, and Alattab (2013) have used Machine Learning to classify cognition levels based on training data in which human experts had previously assigned Bloom's level to classroom questions.

Objectives and Methodology

This study used automated parts of speech tagging and verb table lookup to: 1) explore how the approach can assist human experts to write learning outcome statements that clearly articulate what is expected of students and that are free of grammatical ambiguity; 2) examine how parts of speech other than verbs impact outcome semantics; and 3) serve as a base-lined for subsequent Machine Learning based Bloom's classification.

A total of 13,189 learning outcomes from all undergraduate and postgraduate subjects were downloaded from the curriculum database of an Australian university. There were 8115 learning outcomes from undergraduate subjects and 5074 were from postgraduate subjects. The University's central teaching organisation had previously participated in the Bloom's classification of each learning outcome as part of the institution's curriculum management process. The distribution of learning outcomes by Bloom's level is shown in Table 2. There were relatively few examples of *Remembering*. In undergraduate subjects, there were more examples of *Applying* than any other Bloom's category (24.6%, *N*=1996). For postgraduate subjects, there were more examples of Creating than other categories (31.3%, N=1598), followed closely by Evaluating (30.2%, N=1533).

Table 2: The distribution of Bloom's levels for undergraduate and postgraduate subjects.

Bloom's Classification	Undergraduate (%)	Undergraduate (N)	Postgraduate (%)	Postgraduate (N)
Remembering	1.36	110	0.67	34
Comprehending	11.61	942	5.22	265
Applying	24.60	1996	15.16	769
Analysing	19.57	1588	17.42	884
Evaluating	21.84	1772	30.21	1533
Creating	21.04	1707	31.32	1589

Parts of speech were automatically identified for each outcome statement using a public domain parser from Stanford University in a Python program using the Natural Language ToolKit (NLTK) package. A pre-processing step appended each learning outcome to: "On successful completion of this unit students can". This was done to form grammatically correct sentences before processing. From this, a feature set consisting of all 7929 unique words in the learning outcome corpus was constructed. This recorded the number of times that each word was categorised as a given part of speech or appeared in an outcome statement at a given Bloom's level.

Verbs were automatically identified to determine the indicated Bloom's level using a lookup table based on the full meta-analysis by Stanny (2016). In those instances where a verb appeared in the lookup table in multiple Bloom's categories, the level with the highest corpus frequency was selected. Outcome statements were classified using the highest cognition level indicated by identified verbs. The Bloom's level of each outcome statement in the corpus was classified using this approach and compared to the classification made in conjunction with prior institutional curriculum management processes and recorded in the University database.

Results

Figure 1 shows the accuracy of predicting the Bloom's level using the verb table lookup approach.

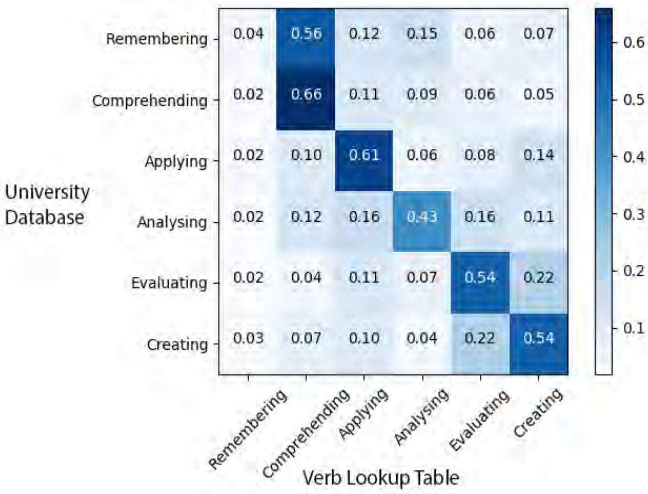

Figure 1: The accuracy of classifying the Bloom's level using the verb table lookup.

The figure shows the fraction of times that the Bloom's level as classified by humans and recorded in the University database was consistent with classification using automated verb table lookup. The goal is for high accuracy shown by darker cells along the diagonal axis of the matrix. Of the 13,189 outcome statements, the verb table lookup approach identified the same Bloom's level that was recorded in the University database for 55% (*N*=7081) of the outcome statements.

Results suggest that the verb table lookup approach had difficulty in differentiating between the *remembering* and *comprehending* Bloom's levels, with 55.6% (*N*=80) of the *remembering* outcome statements being identified as *comprehending*. There were 22.4 % (*N*=742) of the *evaluating* outcome statements that were identified as *creating*, and 22.2% (*N*=732) of *creating* cases were identified as *evaluating*. There were 6.9% (*N*=10) instances of *remembering* outcome statements that were categorised as examples of *creating*. Similarly, 2.7% (*N*=92) instances of *creating* were categorised at the *remembering* Bloom's level.

Potential sources of difference between the actual and predicted Bloom's levels include: 1) failing to consider the semantic impact associated with parts of speech other than verbs; 2) parser errors associated with identifying pats of speech; 3) verbs missing in the lookup table; and 4) tacit knowledge about assessments and errors impacting the original classification.

As will be shown, classification discrepancies can be used to flag outcome statements for review as part of an institution's normal curriculum management process.

For example, an outcome statement that was recorded in the University database as *remembering*, but which was classified by as *creating* was: "develop understanding of the concepts of electronic devices and circuits." The verb *develop* is in the verb table as an example of *creating* because it is usually used in the context of synthesising something new. The word *understanding* is a noun and so it was not considered in the verb table classification. Moreover, this statement should be rewritten, as it does not say what the student must do to demonstrate that understanding has been developed.

Similarly, the outcome statement: "prepare management accounting data" is listed in the University database as being an example of the *applying*. Tacit knowledge about how this outcome is assessed may reasonably lead one to conclude that this is an example of applying a basic accounting management skill. Automatic table lookup, however, classifies this as an example of *creating* because *prepare* is at that level in the lookup table and can reasonably suggests that something new is being synthesised. Based on this tacit knowledge, this outcome statement might be left unaltered after review.

Note that identifying parts of speech is necessary when using automated table lookup because some verbs can also be nouns. That is, the presence in the lookup table of a word from the outcome statement by itself is insufficient for classification. Table 3 shows a portion of the feature set for the five most commonly occurring words in the corpus that were tagged as both verbs and nouns, but not other parts of speech.

Table 3: The five most frequently occurring words classified as both verbs and nouns

Feature	Verb	Noun	Adverb	Adjective	Other	Sum	%LO
research	111	1280	0	0	0	1391	10.5
design	407	650	0	0	0	1057	8.0
practice	29	796	0	0	0	825	6.3
use	371	201	0	0	0	572	4.3
work	198	280	0	0	0	478	3.6

In some cases, inspection of the tree produced by the parser demonstrated an accurate grammatical interpretation of the outcome statement, but with a meaning other than the one intended. For example, consider the outcome statement: "analyse design decisions and report findings". The intention had been that students would report on the findings of an analysis. The tree produced by the parser for this outcome statement is shown in Figure 2. The parser identified a verb phrase (VP) consisting of the verb (VB) *analyse* and a noun phrase (NP) with two parts combined by a coordinating conjunction (CC). The first part of the noun phrase consisted of the singular noun (NN) *design* and the plural noun (NNS) *decision.* The second part consisted of the singular noun (NN) *report* and the plural noun (NNS) *findings*. The parser tagged *report* as a noun rather than verb and interpreted the outcome statement to mean that both design decisions and report findings were to be analysed.

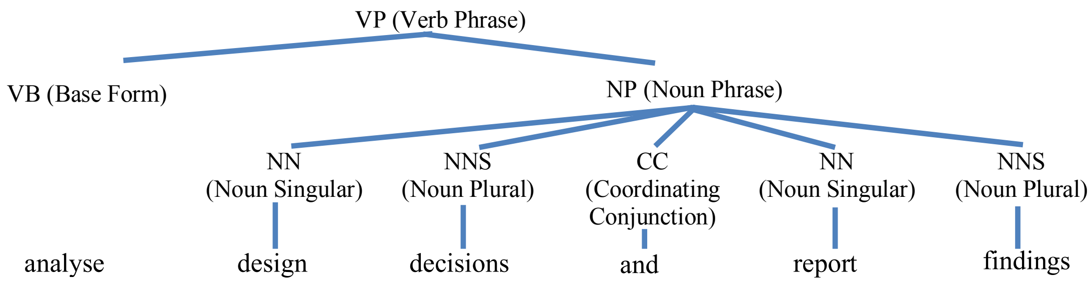

Figure 2. Parse tree for "analyse design decisions and report findings"

Confronted with this interpretation, a learning designer might choose to rewrite these as two separate outcome statements, or rewrite the statement to avoid the ambiguity. For example, changing the outcome statement to "analyse design decisions and then report findings" corrects the ambiguity and the statement parses as expected.

Not surprisingly, *apply*, *evaluate*, *analyse*, *explain*, and *demonstrate* were the 5 most commonly occurring verbs in the feature set, with frequency counts show in Table 4. The table shows the number of times that these features appeared in outcome statements that were tagged at a given Bloom's level, with the maximum value for each feature being shown with a blue background. Outcome statements often contain more than one verb, so the frequency does not necessarily indicate that a feature is representative of that Bloom's level. However, the maximum frequency for each feature is generally consistent with expectations. The frequency with which features were tagged in outcome statements at given part of speech is also shown. The maximum value is shown with an orange background.

Table 4. The 5 most frequently occurring verbs.

Feature	Occurrences as a given Bloom's Level						Occurrences as a given part of speech					Sum
	Remembering	Comprehending	Applying	Analysing	Evaluating	Creating	Verb	Noun	Adjective	Adverb	Other	
apply	7	44	1094	295	291	222	1953	0	0	0	0	1953
evaluate	2	12	58	81	1021	503	1662	0	15	0	0	1677
analyse	1	21	86	966	271	208	1542	0	10	1	0	1553
explain	12	366	167	327	80	42	994	0	0	0	0	994
demonstrate	3	43	461	95	121	112	831	0	4	0	0	835

The verbs in Table 4 were tagged as an invalid part of speech less than 1% of the time. That is, the verb *evaluate* was misclassified as a adjective 0.8% (N=15) of the 1677 times it occurred in as a feature in the corpus. The verb *analyse* was misclassified as either an adjective or adverb 0.7% of the 1553 times it occurred in the corpus (Adjective, N=10; Adverb, N=1). The verb *demonstrate* was misclassified as an adjective 0.5% (N=4) of the 835 times it occurred in the corpus.

Inspection showed that misclassification sometimes occurred in complex sentences containing adjectives where those adjectives are words that also have a verb form in other contexts. For example, misclassification occurred for "critically evaluate food processing unit operations and related equipment". In this example, *related* should have been classified as an adjective, *critically* as an adverb, and *evaluate* as a verb. In other contexts, however, *related* could form the past participle of the verb *relate* and the parser failed to correctly tag the outcome. Less complex sentences with the adjective *related* were seen to parse correctly.

In this example, the adverb *critically* could be removed with no impact on statement semantics or the resulting Bloom's classification. This is because the verb *evaluate* is already indicative of the *evaluating* Bloom's category, which expects the student to form an opinion or make a judgement. That is, "evaluate food processing unit operations and related equipment" would be classified at the same Bloom's level as the original statement. The meaning and Bloom's classification is not changed by removing the adverb *critically* in this case.
This is different than situations in which the adverb *critically* is used in conjunction with the verb *analyse*. Consider the following outcome statement: "critically analyse the characteristics of different industry sectors and explain a firm's competitive strategy". The University database identifies this as an example of the

evaluating Bloom's category. That is, to *critically analyse* something is different than just *analysing* it because the student is being asked to critique the analysis and form a judgement and do more than just establish connections or relationships. In this instance, the adverb *critically* has changed the semantic meaning of the outcome statement and hence the resulting Bloom's classification. This suggests that the verb *evaluate* may be a better choice for the outcome statement over the semantically equivalent *critically analyse*.

Similarly, the adjective *significant* in "analyse data and communicate significant findings" calls for the student to make a judgement about findings that have been analysed. Although the verb analyse might suggest that this outcome statement is an example of the *analysing* Bloom's level, the adjective *significant* has changed the classification to make this an example of *evaluating*.

The adverb appearing most frequently in outcome statements was *critically* (*N*=762). The frequency with which the *adverb* critically appeared in outcome statements at each Bloom's levels were: remembering, 0% (*N*=0); understanding, 2.2% (*N*=17); applying, 2.4% (*N*=18); analysing, 20.8% (*N*=159); evaluating, 46.6% (*N*=355); and creating, 28.0% (*N*=213). Excluding simple adverbs like *how*, *when*, *as*, and *well*, other adverbs in decreasing order of frequency and with 20 or more occurrences were *effectively* (*N*=300), *independently* (*N*=70), *appropriately* (*N*=65), *professionally* (*N*=64), *clearly* (*N*=44), *collaboratively* (*N*=43), *culturally* (*N*=43), *internationally* (*N=30), orally* (*N*=29), *safely* (*N*=25), *commonly* (*N*=22), and *accurately* (*N*=20). Occurring only once, the adverb *innovatively* was used in the outcome statement: "innovatively apply knowledge and skills, techniques and methods to the process of studio practice…" The university database identified this as an example of the *applying* Bloom's level. However, to innovatively apply knowledge suggests that the student is being asked to do something new that has not been done before. As such, this outcome statement is arguably an example of the *creating* Bloom's level because of this adverb.

Conclusion

Automated parts of speech identification and verb table lookup provides a means to automatically classify Bloom's outcome statements. This can be used to identify statements for review in the context of institutional curriculum management processes, or to assist in writing clear outcome statements that are free from ambiguity. The verb table approach will serve as the baseline for a subsequent Machine Learning approach to Bloom's classification that is currently under investigation, which will include words other than verbs in the training data. As shown in this paper, although not widely discussed in the literature, parts of speech other than verbs can impact the meaning of a learning outcome statement and the resulting Bloom's classification. As such, it is anticipated that a Machine Learning approach will improve the accuracy of Bloom's classification.

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Investigating MOOC users' persistence in completing MOOCs from network externalities and human motivation

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This study investigated how network externalities affect users' persistence in completing massive online open courses (MOOCs) through the mediation of human motivation. A theoretical model was built utilizing network externalities and self-determined theory, and was validated with the responses from 346 students in a public university in China via partial least square structural equation modelling (PLS-SEM). The findings indicate that network externalities constituted essential social contexts that directly and indirectly impacted the development of learners' self-determined motivation. Learners' persistence in completing MOOCs was significantly predicted by learners' competence, followed by relatedness, autonomy, and network benefit; network benefit, which was predicted by network size (direct network externalities) and perceived complementarity (indirect network externalities) also had greater indirect influence on learners' persistence in completing MOOCs. As to gender differences, relatedness showed stronger influence on female learners' persistence in completing MOOCs than males. Network benefit had stronger prediction on female learners' perceived relatedness; but it exerted greater direct influence on male learners' persistence in completing MOOCs.

Keywords: network externalities; human motivation; MOOCs; PLS-SEM; completion

Introduction

Network externalities are concerned with the factors that yield network effects, including network size and complementary goods or services (Economides, 1996), and have been considered of high importance in generating and diffusing technological innovation (K.Y. Lin & Lu, 2011). One example is Microsoft Windows operating systems. As more people use the systems, Microsoft collects more feedback to fix the system bugs, thereby refining its systems. Consequently, existing and new users have a better user experience with its systems. Furthermore, with the increased user base, more third-party developers develop application tools and software related to its systems, giving it an edge over its competitors such as Linux or Macintosh. The wide range of third-party tools and software, in turn, not only improves the work efficiency for existing users, but also serves as a great attraction for new users. The phenomenon of network externalities also applies to MOOCs and the improvement of their low completion rates.

In the context of MOOCs, network effects are manifested when the benefits that people attain from completing certain MOOCs depend on the number of other people joining the same MOOCs and the availability of complementary products or services (e.g., official recognition by conventional universities and employers in the market) that generate additional value for people attending these MOOCs (C. P. Lin & Bhattacherjee, 2008).

In online learning environments as MOOCs, motivation has been considered one of the most important factors influencing learners' persistence and performance in the courses (Ryan & Deci, 2000; Watted & Barak, 2018). Strong motivation often leads to enhanced engagement and improved achievement, while poor motivation results into otherwise. Among various theories of motivation, self-determination theory (SDT) has been used effectively in examining the multifaceted nature of motivation in networked online learning environments such as MOOCs (Tschofen & Mackness, 2012; Zhou, 2016). This is because SDT, consisting of autonomy (the sense of agency and control), competence (the desire to be effective in achieving expected outcomes), and relatedness (the desire to be connected with others), could provide in-depth insights into the relationship between networked learning and individuals within networks (Deci & Ryan, 2008). However, many studies utilizing SDT seemed to underplay the role of the social context (the environment and people surrounding learners) in SDT and its effect on factors such as engagement and performance in online settings. Nevertheless, without the support from the social context, learners will find it difficult to develop their motivation from amotivation (lack of motivation) to intrinsic motivation.

Among the varied factors that are considered important for the development of learners' self-determined motivation, such as the instructor's role in online discussion, timely feedback, and relevance of learning content, network externalities may constitute fundamental social contexts for such purpose in MOOCs (Deci & Ryan, 2008; C. P. Lin & Bhattacherjee, 2008).

In line with the discussion above, the present study, which is informed by Li, Wang, and Tan (2018), hypothesizes that the combined use of SDT and network externalities could offer stronger theoretical explanation and empirical insights into the factors that cause learners to persist in completing MOOCs. Thus, this study is guided by the following research questions: *How do SDT and network externalities collectively affect learners' persistence in completing MOOCs?*

Theoretical framework

Existing research distinguishes between two forms of network externalities: direct and indirect (Katz & Shapiro, 1985). Direct network externalities are associated with the number of users in a given network. With increasing numbers of users utilizing network products, existing users are likely to have access to greater network benefits, which consist of the utilitarian benefit concerning the practical value generated by network products, and the hedonic benefit related to the pleasurable experience associated with using network products (C. P. Lin & Bhattacherjee, 2008). Indirect externalities concern the additional benefits users can get as a result of the network growth, including the development of complementary products and services, which result indirectly from the increased number of users (Katz & Shapiro, 1985; C. P. Lin & Bhattacherjee, 2008). Drawing on existing studies on network externalities, application of SDT in online settings, and MOOCs by taking into consideration the current research context, the theoretical framework for this study is developed (see Figure 1).

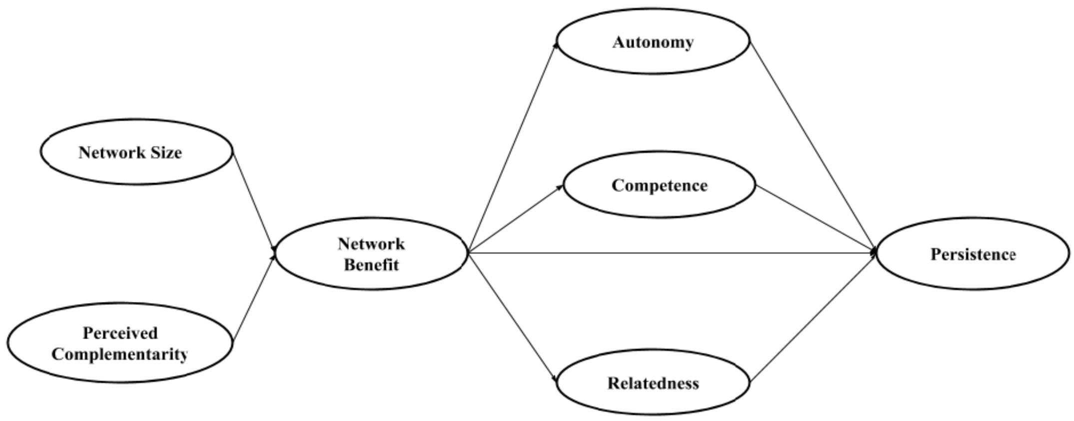

Figure 1: Proposed research model for this study

Methodology

Participants

Participants came from a public university in mainland China, which has launched two MOOC platforms starting in early 2014. Some of the courses carry equivalent credit as onsite courses. 500 participants in total were approached with their informed consent through an online survey application. Eventually, 346 valid responses were attained. The demographic information of the recruited participants is presented in Table 1.

Table 1: Demographic information of the participants (*N*=346)

		N	Total (*N*)
Gender	Female	197	346
	Male	149	
Duration of MOOC usage	0-1 Year (including 1 year)	183	346
	1-2 Years (including 2 years)	140	
	2-3 Years (including 3 years)	17	
	3-4 Years (including 4 years)	6	
Age	17-22 years old		

Instrument development and data analysis

The validated survey instrument was adapted from such studies as C. P. Lin and Bhattacherjee (2008), Sørebø, Halvari, Gulli, and Kristiansen (2009), and Tan, Ooi, Leong, and Lin (2014). It contained 7 constructs with 35 valid items in total. All items were evaluated on a 5-point Likert scale with 1 representing *Strongly Disagree* and 5 *Strongly Agree* with the items.

PLS-SEM was utilized to analyze the research model that explored how network externalities and self-determined motivation collectively affected MOOC users' persistence in completing MOOCs. The PLS-SEM package (Sanchez, 2013) in the R programming language was employed.

Results and discussion

The findings indicate that learners' persistence in completing MOOCs was significantly affected by learners' competence, followed by relatedness, autonomy, and network benefit. These four factors explained 69% of the variance in learners' persistence in completing MOOCs (see Figure 2). Moreover, network benefit also exerted greater indirect influence (with indirect path coefficient of 0.52) on learners' persistence in completing MOOCs by satisfying learners' psychological needs of autonomy, competence, and relatedness. Network externalities constituted essential social contexts, greatly influencing learners' self-determined motivation. Specifically, network size (direct network externalities) and perceived complementarity (indirect network externalities) significantly predicted network benefit, which further predicted learners' autonomy, competence, and relatedness, with the explaining power of 0.47, 0.40, and 0.40, respectively (see Figure 2).

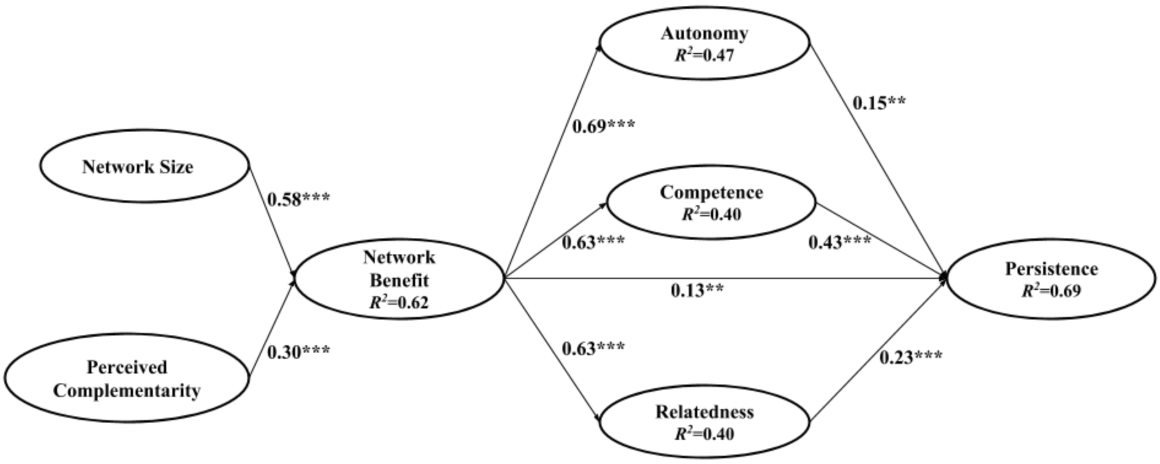

Figure 2: Structural model for the whole participants
Note. ** p<0 .01; *** p< 0.001

As to the gender difference, this study found that relatedness had more influence on female learners' persistence in completing MOOCs than males. And network benefit more strongly predicted female learners' perceived relatedness than male learners. Nevertheless, compared with females, network benefit had much stronger influence on male learners' persistence in completing MOOCs.

The finding that learners' self-determined motivation predicted their persistence in completing MOOCs largely corroborated the studies of Deci and Ryan (2008) and Vanslambrouck, Zhu, Lombaerts, Philipsen, and Tondeur (2018). They have shown that self-determined motivation is crucial in deciding learners' performance in online environments. And it has great influence on learners' initial engagement and retention in MOOCs (Hartnett, 2015).

However, among the three constructs in self-determined motivation, learners' competence had the highest influence on their persistence in completing MOOCs; whilst autonomy demonstrated the lowest influence. The reason could be that although MOOCs provide learners an unfettered learning environment where learners have autonomy to choose what and when to learn, it is ultimately learners' competence that determines whether they can complete the courses. Even though the feelings of relatedness and autonomy are important in retaining learners in online environments (Butz & Stupnisky, 2017), those who perceive insufficient competence in their learning endeavors are not likely to persist. This implies that MOOC providers could design tests to evaluate potential learners' prerequisite knowledge regarding the learning content before they register for the courses. Such tests could inform potential learners of the basic knowledge needed and the effort and time involved in order to prepare them well for further learning in the MOOCs.

Furthermore, network externalities not only directly influenced learners' persistence in completing MOOCs, but also exercised a more significantly indirect influence through learners' self-determined motivation, including competence, relatedness, and autonomy. This finding highlighted the role of network externalities as proper social contexts underpinning learners' self-determined motivation (Hartnett., 2015; Sørebø et al., 2009; Tschofen & Mackness, 2012). As such, MOOC providers seeking to retain more learners in their platforms could expand their networks of learners and collaborations with third-part product or service providers in order to increase network benefits.

The multi-group comparison revealed that for female learners, relatedness influenced their persistence in completing MOOCs more than male learners; and that network benefit affected their perception of relatedness more than male learners. This could be because that female learners care more about the interactions and relationships with others in online environments (González-Gómez, Guardiola, Rodríguez, & Alonso, 2012). Compared to males, female learners are more susceptible to the influence of other people in the use of new technologies. The increased connections with peers in MOOCs that have large network sizes are more likely to retain female learners (K. Y. Lin & Lu, 2011), thereby strengthening their persistence in completing MOOCs (González-Gómez et al., 2012; Ryan & Deci, 2008).

In contrast, compared with females, network benefit more directly influenced male learners' persistence in completing MOOCs. As revealed by Padilla-MeléNdez et al. (2013), male learners are more motivated by the usefulness of learning technologies than female learners. The utility associated with network benefit generated by a large user base of MOOCs and the availability of learning support tools and services complementary to MOOCs are likely to incentivize male learners to persist in completing MOOCs (Padilla-MeléNdez et al., 2013; Zhang, Li, Wu, & Li., 2017).

Conclusion

To sum up, network externalities form the social contexts that are necessary for stimulating learners' self-determined motivation in MOOCs. Consequently, individuals within networks tend to feel more autonomous, competent, and related to other learners in MOOCs with larger networks of learners and third-party product or service providers, thus being more persistent in completing MOOCs eventually.

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Peer review of learning designs: interdisciplinary SoTEL

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For academics participating in graduate certificates of higher education, the advice and feedback of their teacher peers is a potentially powerful resource. This paper reports on an evaluation-in-progress of one subject in a graduate certificate for university teaching, a fully online unit on the scholarship of technology-enhanced learning (SoTEL). Two demands are made of participants in this unit: that they should develop a prototype activity using technology for learning and teaching, and that they should review and receive a review from a class peer to enhance these individual prototypes. The assumption at the heart of this unit design is that, by undertaking a review of a colleague's learning design, the teacher learns from these additional perspectives and can then improve their own designs for learning. Challenging this assumption are multiple aspects of the context, including the relative value of design reviews from academic developers versus less experienced peers; the multiple criteria by which a design might be evaluated; and interdisciplinary work between peers. Artefacts from participants and the academic developers teaching them are analysed to probe this underlying assumption, and to consider the value of peer review in SoTEL.

Keywords: academic development; interdisciplinarity; learning design; peer review; SoTEL

Background: peer review in teaching with technology

In launching her concept of "SoTEL" (scholarship of technology-enhanced learning), Wickens (2006) identifies peer review of teaching as one of the practices that technology ought to enable, and one that would bring teaching into a more public discourse, approaching the status of scholarly research. Peer review of different dimensions of teaching is recognized in institutional and government policy documents (for example, Chalmers et al., 2014; Tertiary Education Quality and Standards Agency, 2016) as an indicator of quality teaching, and peer advice and feedback is one of Brookfield's four lenses for critical reflection on teaching (Brookfield, 2017). Peer-to-peer feedback, effectively implemented, is strongly supported by Nicol and Macfarlane (2006, quoted in Gikandi and Morrow, 2015); the implementation of technology-enhanced learning in particular can benefit substantially from scaffolded peer review, as, for example, in the 2007-10 "Peer Review of Online Learning and Teaching" project led by the University of South Australia (Wood & Friedel, 2009).

These factors advocate for the use of peer review of technology-enhanced learning, but there are conflicting signals from the higher education context. While classroom teaching is provided with peer review processes via institutional guidance and established projects, the procedures for providing peer review of blended and online teaching in Australian and New Zealand universities are not as well developed. The contributions of peers in professional development events, including in certificate courses such as a graduate program in higher education, are often informal and incidental. While the "study buddy" is a serviceable social structure within formal courses (for example, Madland & Richards, 2016), often, rather than structured interactions, a higher goal is set for these academics: the establishment of a community of practice or a goal of lifelong learning (Kukulska-Hulme, 2012). It is not clear how well the review of the online design work of a class peer will be received, and whether there is a perceived difference in the value of design reviews from academic developers versus less experienced peers. Lelis (2017) documented the doubts that Masters students had of the expertise of their peers, but Delahunty, Verenikina and Jones (2014) show that, with some qualification, peer review may be welcomed and used.

One further complicating factor is disciplinary knowledge, given that professional development for academics can be conducted within a faculty or across an institution. How transferable is design and practice in one discipline to the teaching of another? How useful can a review from someone in a different discipline be? Are there discipline-specific qualities in learning design (Cameron, 2009, 2017) and in academic development as a whole (Quinn & Vorster, 2014; Rienties, Brouwer, & Lygo-Baker, 2013) and might they invalidate cross-disciplinary peer review?

With some trepidation, then, given these uncertainties, we chose, in teaching a fully online unit on technology-enhanced learning as part of our institution's graduate certificate in higher education, to centre the assessment in the unit on a peer review of a class colleague's learning design. The assumption at the heart of this unit design is that, by undertaking a review of a colleague's learning design, the teacher learns from other perspectives and can then improve their own designs for learning. The perspectives taken can differ widely, given, as a starting point, the disparate goals of designs, their different target student groups, and the range of skills and knowledge being dealt with, but then differentiating further with each design decision taken. Teachers taking on the role of peer reviewers are directed in the learning materials to examine these decisions, their links to theory and scholarship of technology-enhanced learning, and the functionality of the technology.

Methodology

Participants and data collection

Human Research Ethics Clearance was sought and approved (2017-332E) and all academics were invited to make available to the researchers the peer review which they submitted as one of the assignments for the unit. Six academics enrolled in the Semester 1 unit agreed to make their reviews available for analysis, and these pilot participants (Table 1) exemplify the cross-disciplinary pairings made by many of the enrolled academics.

Table 1: Demographics and disciplines of pilot participants

Reviewer			Designer		Topic match?	Co-located?
Pseudonym	Faculty	School	Faculty	School		
Faith	FHS	Occupational therapy	FEA	Religion	no	no
Evan	FHS	Physiotherapy	FHS	Exercise-Science	near	no
Burton	FHS	Physics	FHS	Biology	near	yes
Bridget	FHS	Nursing	FHS	Bioscience	no	yes
Kate	FEA	Education	FEA	Education	yes	no
Milton	FEA	Education	FHS	Exercise-Science	no	no

In designing the assessment, we chose not to blind the name of the reviewer to their reviewee, but to encourage conversations. The peer reviewers may be on a different campus to the designers that they are working with, and in only half of these pairs are the disciplines of the teachers close or matching. In Semester 2 further participants will be sought from the enrolled academics, with the aim of obtaining the same range of artefacts as data (Table 2).

Table 2: Artefacts collected as data for pilot analysis (Semester 1)

Artefact	Author	Description	Items
Peer review on design	Reviewer	Usually written responses and annotations on design document (combined word count approximately 2300 words per review); occasionally provided as video feedback	6
Tutor feedback on design	Academic developer	Feedback to the designer from one of the academic developers teaching the unit, subsequent to the peer review and commenting on the peer review as well as the features of the draft design (around 370 words each)	6
Marking the peer review	Academic developer	Feedback to the peer reviewer as part of the marking of the assignment 2 submission.	6

Data analysis

Using QSR NVivo 11 to develop a database of these documents, an initial set of codes was derived from the text of the artefacts but informed by terms from the literature used in the design of the Graduate Certificate unit. In the next phase of analysis, after sourcing additional artefacts, any connections between the recommendations of the peer reviewer, the academic developer, and the designer will be identified.

Preliminary results and discussion

Structuring the peer review

There are multiple criteria by which a design might be evaluated, including its quality, effectiveness, efficiency, appropriate match of technology and desired learning outcomes. For the taught unit, enrolled academics taking the role of reviewers were directed to look for and provide feedback on:

1. the theoretical rationale of the learning sequence: how the choice of activity matches or does not match with the intended learning outcome of the sequence
2. the design rationale (why this technology might work to support the chosen activity).

In the assignment specifications, reviewers were able to choose the form that their review took. They were able to develop their own structure, or they could choose between two peer review formats which were provided in the learning materials to encourage a systematic review of the design. These two peer review formats were derived from different sources, one from the program *Teaching Online* (Epigeum, 2014) and the other based on the activity-centred analysis and design format ("ACAD") presented by Carvalho and Goodyear (2014, 2017; Goodyear & Carvalho, 2016) as extended by Thompson, Gouvea and Habron (2016).

Of the peer reviews analysed, half used one of these structured review formats, one review using the *Teaching Online* template, one using the ACAD framework, and one combining both. (One of the design-review pairs who were co-located went beyond the review template and process to meet face-to-face for mutual critique and enhancement of the design.) Our hypothesis, that a structured template or peer review sheet would assist the reviewer to provide useful and actionable recommendations, is not contradicted by this initial sample. Mention of the two rationales requested (that is, 1. and 2. above) were only found in the reviews of enrolled academics who used the suggested templates.

Types of contributions

The usefulness of the review was increased by the provision of recommendations for the designer. Clear recommendations, labelled as such, were ideal, but statements which were phrased (and therefore coded) as "reviewer suggestions" and "reviewer hints" were also identified as actionable feedback.

Comments from reviewers indicated gaps in the design; urged designers to follow through on the design; extended activities described in the design; and noted additional phases and activities to achieve the stated teaching goals more thoroughly. It was often the reviewer's role to note what was *not* present in the design, particularly links to institutional policy. Reviewers suggested technologies other than those in the design, or in addition to the design elements, and occasionally disagreed with the technologies chosen.

In several cases the reviewers expressed gratitude for the opportunity to evaluate and learn from their colleagues' work, and noted the mutual learning that the review activity provided.

Tone and purpose

Any criticism in the reviews was coupled with positive appreciation of strengths elsewhere in the design. The most useful reviews were also marked by highly encouraging remarks and strong praise of the designer's achievement. The tone was warm and personal, even where the reviewer and designers had never met face-to-face.

Scholarly discussion and extension

Sections of the review that offered additional literature on technology-enhanced learning to extend the design were important components of the peer reviews. Recommendations for design improvements coupled with SoTEL support were valued highly by the markers of the reviews.

Sensitivity to context

The references to "students" in the reviews do not discuss the implications of any special needs or characteristics of the students, even though some contextual information forms a required section of the design document. The students' mode of engagement and their level of motivation are assumed by the reviewers as generic, that is, as interchangeable with students of their own experience.

Disciplinary constraints

The designer-reviewer pairs seem to exaggerate in their reviews and discussions the differences in knowledge bases between what seem, at least institutionally and from the external vantage point of the academic developers in the Learning and Teaching Centre, to be closely related disciplines. What we as generalists class as "sciences", for example, chemistry and physics, are seen by the academics in the Schools as very different disciplines. The response rate so far has been too low to decide whether, for optimum peer review, reviewer and designer should share a disciplinary background. It could be noted in passing, however, that the review rated highest by the academic developers involved interactions between rather remote disciplines.

Conclusions

Looking intensively at this small collection of data has been unexpectedly rewarding. Productive points for revision of the learning design of the Graduate Certificate of Higher Education (GCHE) unit are evident, with the justification for using a structured review template being the most significant.

The core task of peer review, however, seems from these participants' self-reports to be a deep learning experience. Effortful and at times confusing, giving feedback to a colleague on any learning design is a complex task exercising multiple professional skills for the teaching academic, particularly from a remote discipline. The value of a class colleague as a peer reviewer is different from that of an academic developer, particularly when the latter has the role of arbiter and bestower of marks in a formal course. The colleague's feedback can be just as relevant to the enhancement of the design.

The aims of this ongoing investigation are to improve the operation of this GCHE unit on technology-enhanced learning and to test tools to help academic staff share and learn from each other's work in higher education. Each iteration of the unit design has trialled auxiliary tools within the learning management system, most recently an eportfolio (in our case, this is Mahara). In the next minor redesign of the unit, we expect to use Moodle's Workshop activity to manage the workflow of design submission, peer review using a structured format, feedback and self-reflection.

Our goals in offering the unit are not to seek high levels of innovation in the use of technology to enhance learning and teaching (although these are welcome and some exemplars are evident from past offerings of the unit). Instead, we wish to find practical support for all academics in developing technology-enhanced learning sequences, including, where possible, the confidence to re-use and adapt existing, trialled designs for learning. We therefore intend to continue to trial a modified ACAD/*Teaching Online* framework as a means of making the scholarship of technology-enhanced learning more useful and accessible to the academic practitioner, and perhaps contribute to a community, or, rather, a "college of practice".

Acknowledgment

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Considerations for designing H5P online interactive activities

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Online Interactive Activities are becoming increasingly popular at many universities as a method for introducing Blended Active Learning experiences. The advancement of technology has meant that the toolkits no longer require experienced multimedia designers to create content. Teachers and Educational Support Staff have been given the power to design and develop their own activities. Whilst many people understand that the technical parameters of the tools need to be understood, elements of design also need to be considered and appreciated for the development of quality learning experiences. In this paper we consider design principles to prompt active learning and encourage student engagement.

Keywords: Online Interactive Activities, H5P, Design Principles,

Introduction

Victoria University, similar to many other universities is currently engaged in a large-scale project to implement blended modes of delivery (Wilkie, Zakaria & McDonald, 2017). Blended learning provides a more flexible learning approach, enabling students to balance their studies with commitments outside of education, than is available by the traditional face-to-face lecture mode of delivery. Furthermore, Martinenz-Caro and Campuzan-Bolarin (2011) found that student satisfaction was significantly greater in courses taught via a blended learning method than those taught via face-to-face lectures. Instructors also report that including Online Interactive Activities as part of their subject's delivery increased learners' success with an improvement in grades, increased student engagement with their own learning, and maintained the student retention rate (evaluating the all, in McKenzie / Ballard, 2015).

In addition to providing the benefits associated with Blended Learning, Online Interactive Activities provide the opportunity for instructors to teach using active learning methods for delivery, with activities that can be undertaken both in-class, and pre-/post-class. This is an attractive teaching option for many universities.

At Victoria University, we identified that H5P (with its large suit of activities) was a suitable toolkit to meet this purpose of providing Blended Active Learning experiences.

Examples of the variety of activities that were developed to facilitate blended active learning includes Interactive multimedia with guest speakers, case study scenarios, interactive technical demonstrations, 360° virtual lab tours (both videos and still images, that include hotspots, roll-over information, animated .gifs, quizzes), Interactive diagrams with clickable hotspots and drag & drop activities; templated note-taking study guides; and check your knowledge quizzes.

In addition to implementing Blended Active Learning via the H5P toolkit, another of Victoria University's aims was to upskill staff (both academics and support staff) in their ability to develop Online Interactive Activities – in effect to become their own content creators. The project has been a success with staff at the university having built over 6000 Online Interactive Activities of which more than 2000 have been shared across the University for other Staff to use and adapt for their own teaching purposes.

The initial stages of professional development training often focus' on learners comprehending the technical parameters of the toolkit, such as learning how to use the wide range of tools, to build different activities, modifying technical parameters for different outcomes, and developing an overall increase staff digital literacy skills.

However, another equally important factor is considering elements of design to ensure the activities are engaging, user friendly, visually pleasant, that the information is easy to read and comprehend, and promotes active learning

Teaching basic design skills and developing an appreciation for good design can be a challenge. Besides learning the technical parameters of building the activities, content itself is often viewed as king. However, anyone who has watched a lecture recording knows that video lectures can at times just be a bad lecture on video. The medium itself, whilst having made the presentation and the information presented therein easily and widely accessible has not improved the viewing experience or improved comprehension of the information. It is important to shift the focus away from the belief of *Content is King*, as if the information is not presented in an easily digestible method, the information itself will not be understood.

Furthermore, Design elements can be subjective - many people have not received any formal training in regards to design principles and simply rely on their own opinion as to what looks good to them, or how they are used to seeing information presented (usually text heavy PowerPoint presentations which are many slides long).

Here we identify a number of Design Principles for content creators to consider when designing and developing the Online Interactive Activities:

- Management of Cognitive Load
- Design Principles for Maximising engagement (chunking, self-checking, presenting the information via a variety of methods and modalities, reducing mind wandering)
- Active Learning

Design Principles

Management of Cognitive Load

Cognitive Load theory (Sweller 1994, 2011) proposes a model whereby memory is comprised of three components, namely Sensory Memory, Working Memory, and Long-term Memory. Further explanations of the theory is detailed in Sweller's research, however to summarise the processes Sensory Memory acquires information from our surrounding environment, it is transient and information may be temporarily stored or processed in Working Memory. Working Memory is a pre-requisite for encoding information into the long-term memory, however as working memory has limited capacity, our minds are selective about what information is incorporated from Sensory Memory.

Cognitive load theory also proposes that a learning experience is affected by three factors, namely Intrinsic Load, Extraneous Load, and Germane Load. Again, further information about these models is can be read in Sweller's research but to summarise, Intrinsic Load (and the amount of load) is the level of difficulty associated with instructional processes; Extraneous Load (and the amount of load) is generated by the method used to present the information or a task; and Germane Load is the amount of cognitive effort required to achieve the learning outcome / schema.

An example relating to the development of H5P online interactive activities for the unit psychology, would be learning the anatomical terminology structure and functionality of the brain (see Figure 1).

Learning the names of the lobes and their regions would have lower intrinsic load, than understanding how these regions function and interact with each other. By placing the lobe terminology on a diagram with the different coloured regions reduces the amount of extraneous load – the amount of cognitive effort generated by the presentation of the concepts, than, for example, having purely textual definitions as was originally provided on the lecture PowerPoint slides (see Figure 2). The presentation also reduces the amount of Germane Load – the amount of cognitive effort required to understand the concepts.

Furthermore, by embedding further information as Hotspots in introduces active learning instructional strategies to reinforce the theoretical concepts, and assists from encoding the information from Sensory to Working Memory, and into Long-Term Memory.

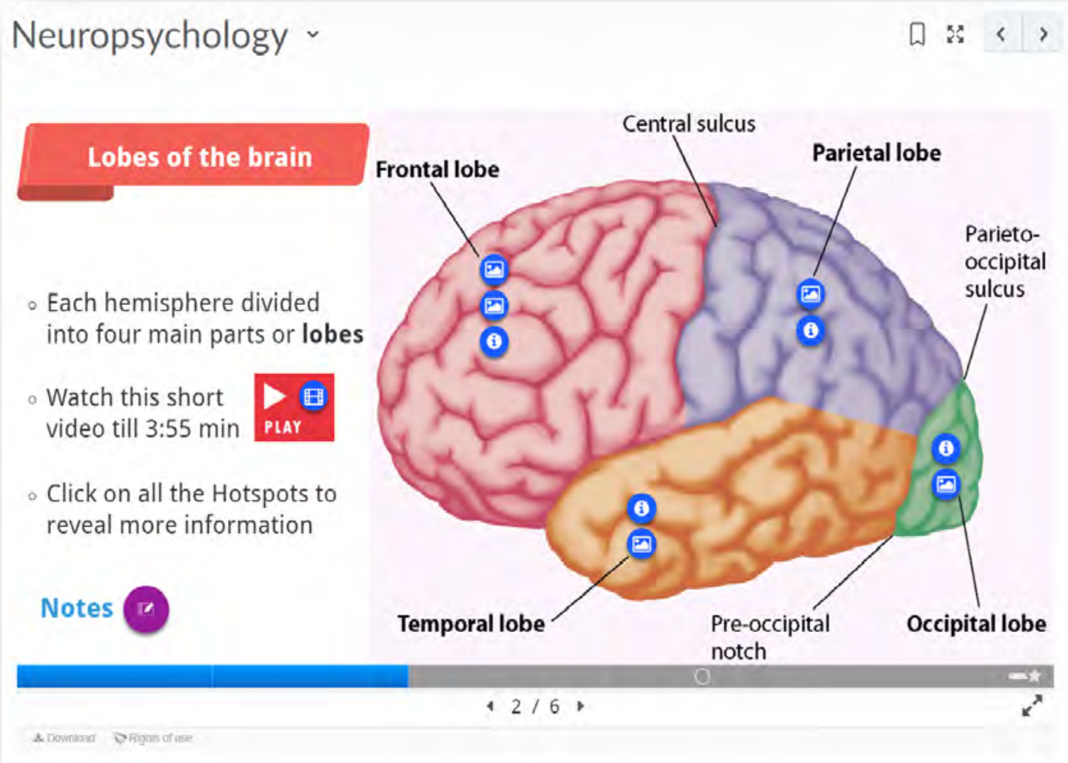

Figure 1 Course Presentation Online Interactive Activity for Neuropsychology. Originally segmented into a 22 slide powerpoint presentation it was reduced and condensed to a 6 slide 'H5P Course Presentation' with clickable hotspots that provide further detailed information, diagrams, and demonstratiion videos. It turned the passive learning into active learning.

By taking these factors into consideration when designing and developing the Online Interactive Activities, content creators can reduce cognitive load so that learning is clearer and simpler.

Furthermore, understanding how Cognitive Load affect learners of different levels (e.g. the novice learner versus the experienced learner) can also have an impact on ease of comprehension. For example the addition of instructional cues (icons or instructional text) such as those provided by the red and white 'Play; icon in Figure 1 placed directly beside the instructional text of "Watch this short video till 3:55 min" are essential instructions for the novice learner who has limited experience with active learning via Online Interactive Activities. However, for the experienced learner who does have experience with Online Interactive Activities, these instructional cues would act as a distraction away from the key information, unnecessarily increasing extraneous load. As Ibrahim et al. (2012) states "It is important to prompt working memory to accept, process, and send to long term memory only the most crucial information". Therefore, we would recommend only including the instructional icons in only the first few activities.

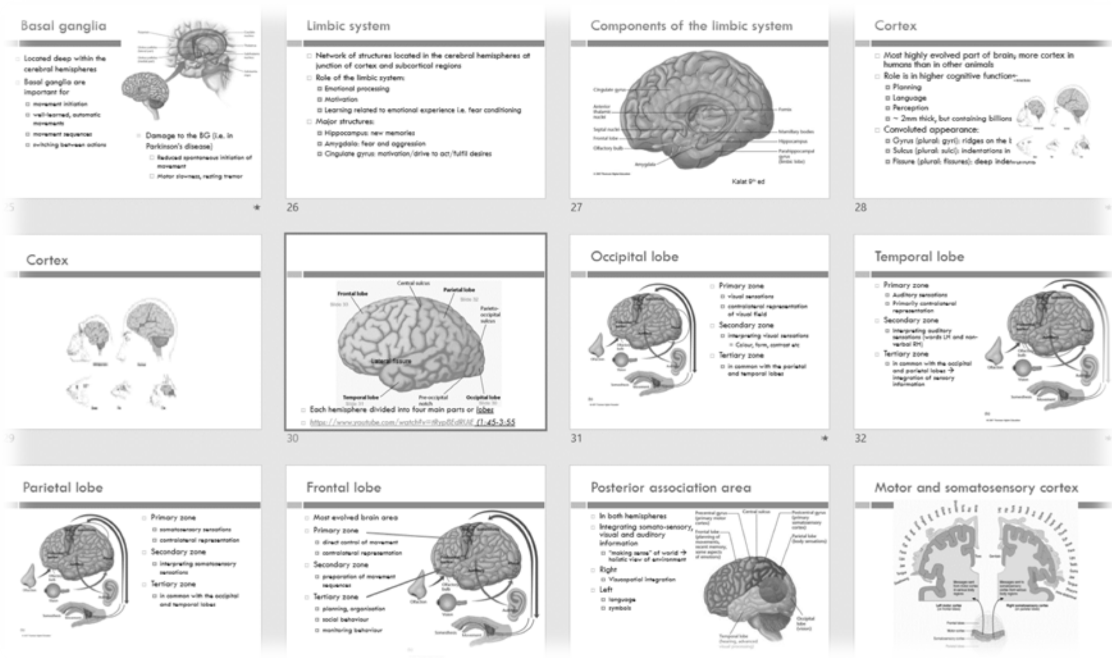

Figure 2 Powerpoint Slides illustrating how Neuroscience was previously taught. Text heavy Powerpoint slides that were originally 66 slides long, before being segmented and further condensed.

Design principles to prompt engagement

Highlights and Hotspots

Using text or symbols to highlight key information, a change in colour or contrast, or a symbol / icon to draw attention to a key feature on the activity. For example, arrow icons to remind novice learners to click on the hotspots to reveal further information; play bar icons remind learners to watch a video presenting more information (see Figure 1).

Presentation Methods and Modality Appropriateness

Considering the different methods and modalities available to present information, for example, many people's experience with PowerPoint is of a visual text method for presenting information. However, certain concepts may be more easily understood if presented via a different method. For example, technical explanations may be more clearly presented and understood if presented as a visual diagram containing interactive hotspots that reveal further information, and research suggests that students find the inclusion of demonstration videos as a more engaging mode of delivery (Stockwell et. al, 2015).

Another example related to Case Studies as learning activities. A case study that was previously presented to students as text-based scenario, could be presented as a video or a podcast which provides how these examples would be experienced in the real world (and rarely as a text document).

Consideration of the different modalities used to gain the information also impacts on Germane load and how easily information is acquired. Presenting information via a video employs multiple modalities (both the audio and visual sensory systems). It is appropriate that the auditory and visual sensory systems are used to gain information presented as a case study as that is how the information would be acquired in real-life scenarios.

Selective about which information is presented

As we discussed in the Section 0 Management of Cognitive Load, selecting information which is important for learners' level is important for reducing cognitive load, and encoding information into the Long-term memory. Including text, icons, or information that is beneficial to a novice learner may actually be an already understood concept that causes a distraction for advanced learners. The information (whether it be icons, images, or text) will occupy valuable space on the slides, space which could better be used as 'white space' so other key information is not missed, or disregarded by the amount of information which is presented on the slide.

Segmenting Content into Bite Sized Pieces
Presenting the information in bite-sized portions not only increases sustainability of the modules as the small portions are easily transferred and adapted across different subjects, but also allows the learners to engage with the content with minimal distraction from external factors. For example, a greater proportion (if not all) of a chunked learning activity could be completed without the distraction of email notifications, phone calls, messages, and conversations. Having completed a learning activity the learner feels rewarded and it is easier to progress on to the next bite-sized portion, rather than finding the exact location of a larger learning module in which to resume their learning before another distraction ensues, and reward for completion is delayed.

People are also more motivated to undertake their learning at free moments. For example, a learning activity may consist of an Interactive Video that is 4 minutes long. Learners would be able to successfully complete this activity on their commute, between classes, or wherever they can find 5 minutes to dedicate to their learning. This in turn provides control for the learner to scaffold their learning with regular points of success.

Size of the chunks?
For video material, research suggests that clips are presented at a maximum duration of ≤ 6 minutes (Gui et al., 2014) as students tend to view the entire content for clips at shorter durations than longer. Gui's study demonstrates that as the duration of the video clip increased, student engagement decreased, with only 50% of students viewing entire clips which were a duration of 9-12 minutes. Studies also indicate that students report greater mind wandering and retain less information when presented with longer clips (Risko et. al, 2012). For slide show presentations (eg, using the Course Presentation tool) we aim to have a maximum number of slides in a Presentation at approximately 15 slide chunks.

Active Learning Strategies

Interactivity
Interactivity can be created by using many of H5P's tools. This includes incorporating hotspots that when clicked reveal further information which could be text, an image, a diagram, weblink or a video.

Exportable text and document builder tools provide opportunities for learners to make notes, compile their thoughts, reflect on their learning and prior knowledge, and structure their writing.

The Incorporation of video clips such as demonstration videos, case studies, guest speakers, instructional videos, introduction videos, virtual tours, has been popular. However, requiring learners to simply watch a video clip is still considered as passive learning. By adding hotspot interactivity to highlight key information, activities, and quizzes for learners to check their understanding, it is turning a passive learning experience into an active learning experience. Furthermore, research by Lawson et al. (2006) have found that by providing learners with guiding questions to think about whilst viewing the clip improved students results when quizzed on the information.

Student check your knowledge activities
Bjork et. al (2013) demonstrated that novice learners do not accurately judge their understanding of a topic and tend to overestimate their comprehension. By providing activities (such as single / multiple choice quizzes, fill in the blanks, true / false) at regular points where learners can check their understanding will assist learners in gauging their comprehension. This in turn will allow them to scaffold their own learning and prompting revision of concepts which they have not yet grasped. Check your knowledge activities also prepares learners for any larger exams and assessments which they may be working towards in the future, reducing any elements of surprise at crucial moments.

Design of activities across the unit:

Another factor for consideration is how the activities are scaffolded across the subject, and on a broader level across the course. Whilst it is important to provide a level of consistency with the learning experience across the course, we have found that once online interactive activities have been introduced in a particular unit, students often request for the activities to be provided for other units within the course. The students found that the activities assisted them to learn the concepts.

The transferability of the resources between units also means that the activities can be included in a unit as a revision tool for topics studied in a previous subject, and provide a foundation for bridging into now topics.

It is also important to consider which activities and tools from the H5P toolkit are being used across the unit (and across the course). It is easy to slip into a habit of using the same preferred tools to design activities, for example to consistently use the drag and drop tool as an activity to match key terminology with descriptions. However, as the research by Rekhari and Sinnayah (2018) demonstrate, using a variety of activities across the delivery provides novelty, and maintains student engagement, more than consistently using a favoured tool or activity.

Looking into the distribution of activities across the colleges provides a broad overview of which activities are favoured, and perhaps where content creators can consider including greater diversity with the activities. In the evaluation of H5P activities developed in 2017, Anonymised authors explored the distribution of activities across the university, and found that while the Course Presentation tool (which not only presents information but includes many types of activities) was the most popular, a wide variety of tools was also being employed.

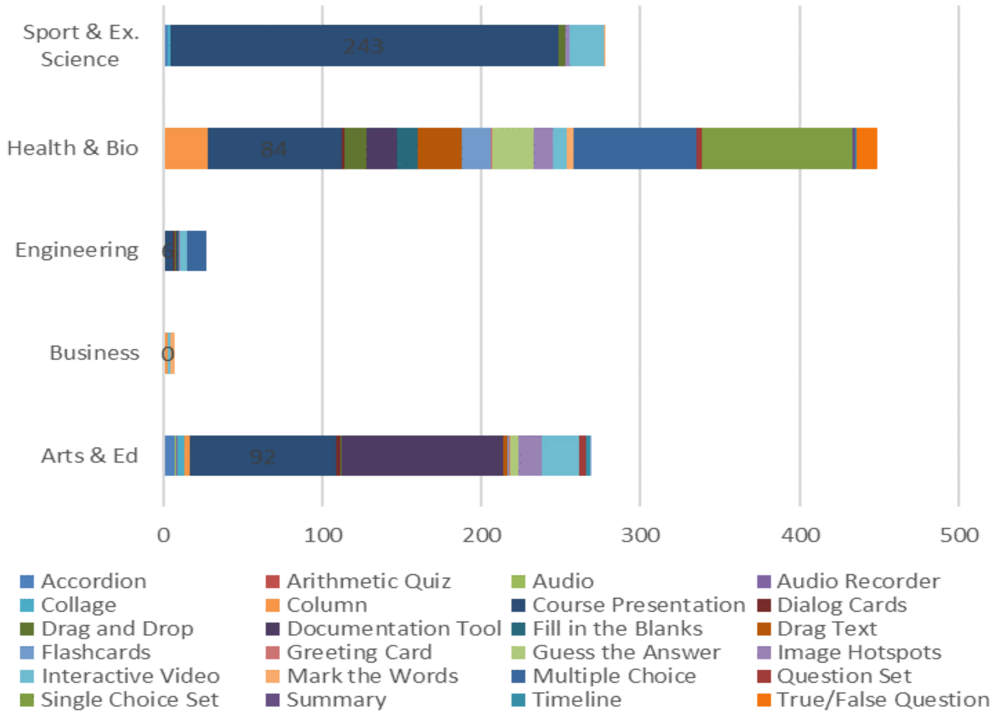

Figure 3. The range of different H5P activities per department

Many academics would also like to use the activities for summative assessments as the variety of tools within the H5P toolkit is broader or more engaging than many of the LMS tools. At this stage however, we discourage the use of the activities for summative assessments. This is partly based on technical reasons related to the current integration within our LMS, how marks are sent to the gradebook, and the technical parameters on how H5P calculates the results.

Discussion

Introducing the H5P online interactive activities for Blended Active Learning has been a success at Anonymised university. The anecdotal evidence from both staff and students has been positive, with verbal feedback from students including: “They are great – I like the interactive nature”, “They are good for breaking up learning compared to full lecture”, and “Great flexibility, thanks!”.

The success of the uptake of the tool is evident by the number of activities that have been built, by the number which have been shared across the university, and the community of enquiry that has been formed as a result.

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Beyond Constructive Alignment: A debate

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Constructive Alignment has been with us for quite some time. From its origins in education theory in the 1990s, partly as a means to address some of the pedagogical challenges of scale in mass, higher-education, it has now become the dominant pedagogy in Australian higher education. Originally intended as a means to consistently and holistically design syllabi around learning outcomes and delivery and assessment methods (Biggs, 2003), it is now—as claimed in a recent book on the subject—an overly mechanistic, industrial process that may stifle innovation and creativity, some of the key skills of a 21st Century workplace and society (Nelson, 2018). This is because of its slavish, uncritical application and lack of imagination regarding refreshing and building upon its significant legacy. Is there a Post-Constructive future and what may this future look like? And what does this mean for digital education, in its various guises, one of the more transformative areas of higher education? In this debate we will survey the various applications of Constructive Alignment and perhaps imagine a Post-Constructivist future!

Keywords: Constructive Alignment, eLearning, digital education, Post Constructive Alignment

Same same, but different

Significant efforts have been made to integrate constructive alignment principles in all aspects of the learning process. From writing the subject outline, the inclusion of subject content to align with the learning outcomes, the methods used to engage with the students and communicate the subject content, and the methods used to assess students through rubrics and fine-grained quantification. As a means to explicitly delineate the architecture of learning, it is, at times, a useful solution; however, problems arise when this architecture becomes too rigid, reductive and pragmatic, as it engenders conformity, passivity, and a strategic, instrumentalist approach to education that undermines the independence, judgement, curiosity and creativity of both educator and student (Nelson, 2018).

Digital mediated education, one of liveliest area of innovation in higher education, has a lot to lose from the uncritical embrace of Constructive alignment as computer technology can easily be co-opted for instrumentalist, industrial processes. It is rigid architectures that we must resist in designing our education as it was flexibility, creativity, risk, and imagination that brought us computing technology in the first place.

Is it possible to imagine a Post-Constructivist future, one with fewer rubrics, fewer criteria; with fewer pre-packaged learning outcomes and with more independent learning and creativity? Is there a limit to the extent of 'constructive alignment' that a topic may bare; the more fine-grained the rubric, it seems, the more it privileges the actual creator of the rubric, rather than the creators of knowledge that it seeks to quantify. Can we imagine something beyond Constrictive Alignment; a scaffolding of the learning process in a less mechanistic, less prescriptive, and less reductive manner? Constructive Alignment may become the uncritical and unimaginative deference for an emergent generation of followers rather than leading creatives and innovators.
Can we revitalise Constructive Alignment or can we imagine a Post-Constructivist future?

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The dimensions of being open: What does open educational practices look like in Australia?

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Based on the concept of a continuum of openness, this session will respond to the Australian contextualisation of Open Educational Practices (OEP) in higher education, and openness more broadly within different institutions. This will be undertaken through brief cases of implementation at the panellists' institutions, with an invitation to the audience to expand, and contribute to, the ongoing Australian OEP dialogue. The complexity, considerations for engagement, and practical examples will be considered to catalyse discussion with the audience. The panel will also discuss possible challenges facing practitioners and their institutions, and opportunities to explore future directions, as well as the roles the OEP SIG, as part of the ASCILITE community, could play in progressing and nurturing OEP developments in Australia.

Keywords: Open Educational Practice, Open Educational Practice in Australia, Open Educational Resources, Learning & Teaching, Educational technology, Continuum of openness, Dimensions of openness in Australia.

Open Education Practices in Australia

According to Cronin (2017), Open Educational Practices (OEP) represent "collaborative practices that include the creation, use, and reuse of Open Educational Resources (OER), as well as pedagogical practices employing participatory technologies and social networks for interaction, peer-learning, knowledge creation, and empowerment of learners" (p. 18). There are several reasons why OEP has been attracting attention from educational institutions, governments, learners and educators around the world. The growth of the open educational trend "is a response to the rising costs of education, the desire for accessing learning in areas where such access is difficult, and an expression of student choice about when and how to learn" (Johnson, Levine, Smith, & Stone, 2010, p. 6). Whilst the cost of higher education has focused international media attention, practitioners engage in many other 'dimensions of being open'. These practices represent an emergent movement that is re-shaping learning and teaching in higher education worldwide, by supporting educational designs that lower barriers to higher education, reduce costs for students and faculty, catalyse authentic assessment practices with societal impact, and promote open access to knowledge and digital tools.

Despite gaining momentum worldwide, OEP initiatives and programs at higher education levels are still limited in Australia (Bossu & Stagg, 2018; Stagg et al., 2018). However, there are some important developments taking place. For example, at institutional levels, most Australian universities have an open access repository where thesis, research data and outputs from government funded projects and initiatives are made available, typically using open licenses, including Creative Common licenses, for other researchers to use and re-use (Picasso & Phelan, 2014). Also, many institutions have developed capacity building programs and events in order to raise awareness and disseminate OEP internally (Stagg et al., 2018).

There have also been national level developments to engage a wide range of stakeholders with OEP. One recent development is the establishment of the Australian Open Educational Practice Special Interest Group (OEP SIG). This is a practitioner-facilitated community designed to bring open educators (primarily those in higher education) together to explore issues of common interest, collaborate on shared projects, undertake research, and to advocate for the place of OEP in national learning and teaching discussions, strategy, and policy. This is a 'grassroots' community, and engagement with OEP varies greatly across the membership (https://oepoz.wordpress.com/). This SIG is supported and sponsored by ASCILITE, which represents an important networking environment for this new OEP Community of Practice to flourish. ASCILITE as an institution represents the synergy between education and technology that is needed to truly push the OEP initiative forward. Whilst recognising that there is value in putting pedagogy before technology, it's clear that a major driver of the OEP practice is the ability of technology to make these resources available widely regardless of physical location or socio-economic factors. This panel will therefore discuss the value of OEP whilst also using the ASCILITE community as a platform to understand how education and technology can be intertwined to push the OEP initiative forward.

About the Panel

This interactive panel will explore key developments in OEP in Australia. The panel session will be chaired by Valerie Peachey (Professor - Open Education; Charles Sturt University) and will include panellists Julie Lindsay, Open Pathways Design Leader, Charles Sturt University; Michael Cowling, Senior Lecturer - Educational Technology, Central Queensland University; Carina Bossu, Adjunct Senior Lecturer, UTAS; and Adrian Stagg, Manager - Open Educational Practice, University of Southern Queensland.

Based on the concept of a continuum of openness, where the word "open" can have different meanings in different contexts and in practice it is a continuous (not binary) construct (Hilton, Wiley, Stein & Johnson, 2010), this session will respond to the local contextualisation of open educational practices, and openness more broadly at their institutions. The complexity, considerations for engagement, and practical outcomes will all be considered to catalyse discussion with the audience. It is recognised that members of the audience may already engage at different points across a continuum of openness, and thus have contributions to, and an evaluation of, the discussed examples. The panel will also welcome critiques and discussions considering the complexities of OEP at the various levels such as learners, educators, institutions and the sector.

In addition, this panel will also argue that despite technology providing us a massively connected world, for some reason curriculum is still hidden behind large barriers. It will be argued that the culture of technology and of openness needs to come forward and help inform the use of OEP, and that the ASCILITE community is the place to do this. Areas such as the use of proprietary software to achieve open goals, the challenges of sharing in a digital environment within higher education, and even concepts of sharing/access to course content and student-generated resources post-graduation will be discussed. Doing this allows for true "learning without borders", because it equalises practice across the globe.

Finally, a way forward for the synergy of OEP will be discussed, with recommendations summarised for the OEP website. To this end, the audience will be engaged in discussion at different stages of the panel presentation. These discussions will invite participants to critically reflect on their current learning and teaching practices and how OEP can be useful to them and their institutions. In addition, the session will make use of a special Twitter hashtag (and other technologies) to encourage ASCILITE attendees to share their best practice, challenges and questions both before and during the session. Questions and issues raised in the Twitter feed will be discussed during the panel presentation, contributing to the discussion of a way forward in the space. In the vein of OEP, a recording of the session will also be made available on the SIG webpage (https://oepoz.wordpress.com/) for further discussion via social media, where it will be shared

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Redefining Close Quarters: Discussing transitioning business academics from traditional to blended delivery

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The partnership between designers and subject matter experts creates an ill-structured problem whereby the marrying of design skills with discipline knowledge are not always seamlessly combined. The meaning of definitions and by association interpretations can become blurred in this partnership and understanding the different perspectives contributing to the activity can assist in guiding design activities. Each participant in the partnership has a contextual journey that is guided by their own perspectives, discipline specific experiences as knowledge and interpretation of such and this can result in a unique experience for this problem-solving activity of design. This panel allows academics to share their own interpretations of the process as a way to alert all participants to the blurred understandings that occur in design processes.

Keywords: design partnerships, lived-experiences, experiences to support problem solving

Introduction

Transitioning from face to face delivery to a blended delivery format can be out of necessity or general interest (Allen, Seaman, & Garrett, 2007). The necessity of moving from one delivery method to another is typically based on organizational needs. The needs can include the diversification of offerings to address retention and/or to address the act of engaging both learners and instructors in the learning process (Bonk & Graham, 2012; Boyle, Bradley, & Chalk, 2003; Graff, 2008). Whatever the reason for the transition, the process of an academic making that transition themselves when they are the subject matter experts for a specific discipline requires a combination of intrinsic motivation with guided assistance. Documenting and by extension, discussing the different learning phases in this transition is seen as key knowledge to academics in the learning community - and for this panel specifically in a business learning community.

The role of technology

Understanding the role that technology plays by mediating the learning process within the environment also highlights the need for activating unknown knowledge to facilitate the transition (Van de Wiel, Szegedi, & Weggeman, 2004). Educational designers and developers provide this necessary support to academics by creating an almost ***just-in-time-like*** learning support (Austin & Sorcinelli, 2013; Brandenburg & Ellinger, 2003; Cole, Fischer, & Saltzman, 1997). This support is manifested through the use of context-dependent cognitive skills and expertise to create a solution that is iterative and mission-focused (Jonassen, 2008). It is with this contextualized-support combined with the academic's motivation that progress towards the transition can be made.

Panel Discussion

This panel of academics will discuss the process of transitioning from delivering for face to face to preparing to deliver in a blended mode using their own lived-experiences (Cervero & Wilson, 2006). This autobiographical method allows each presenter to share whilst self-reflecting on their thoughts, behaviours and ultimately their own actions, with the view that this information would assist educational designers to find the right language and methods to guide academics through similar processes. The uniqueness of each academic's experience as well as the contextual nature of the academic's faculty and by association, the overall institution, creates for a number of factors that can influence how the process is executed by the designer as well as how the final design is received.

The panel discussion is not so much of a discussion on what is right or what is wrong, but more along the lines of what are the interpretations of the discussions, what were the motivating factors for the transition undertaken, what are the belief systems going into the design activities and most importantly what does the process look like from various hats participating in the process?

The Panel will discuss their individual perceptions on questions that are not explicitly asked during design consultations. These may include but are not restricted to:

1. How long does it take to convert your course to blended?
2. Why should I blend?
3. What are the workload implications?
4. Will it save me work/time?
5. Will it reduce my teaching hours?
6. How will it benefit students?

Along with these are assumptions such as "…All I need is help with the blended part, I already know how to teach?" and "Students don't want to come in class so if I blend I'll address all of their needs" or "If I blend my course, students will come and my satisfaction scores will go up".

The questions/assumptions above may seem simplistic but include numerous definitions and with it differing interpretations to discipline specific academics. As [learning] designers, guiding the process hearing these assumptions and interpretations through this panel can help us align our practices and guidance towards a more successful approach, thus acting as lessons learned for general practice.

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Everyone on board: Creating accessible online learning through universal design

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This symposium will examine the potential barriers experienced by students with disability who choose to study online. Participants will consider the challenges as well as the opportunities educational technology affords an increasingly diverse student cohort.

Co-presented by an educational designer and a student liaison officer specialising in assistive technologies, the benefits of proactively addressing accessibility will be argued. Participants will be introduced to the principles of Universal Design for Learning (UDL) and how they may be incorporated into the curriculum, with a particular focus on online delivery. Participants will be invited to critique their own teaching materials such as Learning Management System (LMS) sites, lecture materials and public facing websites to identify accessibility issues. Participants will experience practical strategies and tools to increase accessibility within their learning design and teaching. These activities will be complemented by a list of resources for future reference. Participants will leave the session with a heightened awareness of accessibility issues within higher education and what actions they can take to be more inclusive within their own professional practice.

Keywords: Universal Design for Learning (UDL), university, disability, inclusive teaching

Why worry about disability issues within online learning and teaching?

In 2015, over 2 million Australians between the ages of 15 and 64 were living with disability. Trends within this group show an increase in the completion of year twelve or equivalent; growing from 25.6% in 2012 to 41.0% in 2015 (Australian Bureau of Statistics, 2017). Obvious indicators such as these suggest universities will attract more students with disability in coming years.

The Department of Education and Training explain how educational institutions can meet their obligation to students with disability. This includes a requirement to make reasonable adjustments to curriculum for students who self-identify and register for assistance. The process involves consultation with individual students, consideration of whether adjustment is necessary, identification of a reasonable adjustment and finally the making of that adjustment. If the educational institution complies to this process, they cannot be said to have discriminated (Department of Education and Training, 2005, p. 3).

The problem with the current protocol of students self-identifying to initiate inclusive learning design is two-fold. First, this places the onus on the person with the least power in the relationship (DET, 2015, p.ii). Secondly, it occurs after the educational design process, often leaving the lecturer on the 'back foot'. One strategy to address such issues is to incorporate principles of UDL and web accessibility into the curriculum design process and to support such a plan with targeted professional development for lecturers.

Applying UDL to online learning and teaching

Universal design is the process of creating products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialised design (CUD, 1997). In the application of universal design to learning, lecturers anticipate the presence of students with diverse abilities and make design decisions that result in learning opportunities being available to all, rather than focussing on what might be considered the 'typical' student (Burgstahler, 2015, p. 71). This approach acknowledges that students with disability may learn differently, but are not less academically capable (Australian Disabilities Clearinghouse, n.d., para. 2). Universally designed online curricula and course materials should provide learning experiences which address three broad objectives. They are:

1. Students should be able to interact and respond to materials in multiple ways,
2. Students should be able to find meaning and thus motivate themselves in different ways, and

3. All web-based course material must be accessible to all (Australian Disabilities Clearinghouse, n.d., para. 3).

The accessibility of webpages, as in LMS content or online readings, is measured against the *Web Content Accessibility Guidelines* (WCAG 2.0). These guidelines cover a variety of recommendations for making web content accessible to people with a range of disabilities (W3C, 2018, para.2). Examples include descriptive text alternatives for images, meaningful URLs, transcriptions for videos, and clear navigation. These types of practices seem reasonable, perhaps even common sense in nature, but there is no guarantee they happen within online university courses. Perhaps this is due to several factors such as increasing demands placed on lecturers, the ever-growing list of educational technologies and faculty initiatives around new pedagogical strategies.

Empowering lecturers to be inclusive teachers

The current lack of training to equip lecturers in supporting students with disability is recognised internationally (see, for example, Burgstahler, 2015; Cunninghame, Costello, &Trinidad, 2016; Yuknis, 2014). Key findings from the *Final report on the 2015 review of the Disability Standards for Education 2005* are consistent within these claims, reporting Australian educators are aware of disability standards, but unclear as to how they should be implemented within their teaching practice (DET, 2015, p. v). Kent's 2016 investigation into the experiences of Open University Australia students with disability echo these concerns (p. 154).

Educational designers and disability support staff are well placed to collaboratively address this need. Opportunities exist in the area of professional development for university staff (both academic and professional) along with consultative roles throughout the curriculum development process.

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Learning analytics in the classroom

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The field of learning analytics has progressed significantly since the first *Learning Analytics and Knowledge* (LAK) conference in 2011. In recent years, the emphasis on technical and statistical aspects of data and analytics has given way to a greater emphasis on what these data mean in the classroom context. This panel session is aimed at examining the emerging role that data and analytics play in understanding and supporting student learning in higher education. Specifically, the panel will focus on the importance of transdisciplinarity and how translation from data to action can occur in the classroom context. The aim of this session is to broaden the conversation about learning analytics within the ASCILITE community. From there, the panel will discuss ways in which learning analytics can have a greater impact on learning design in physical and digital learning environments.

Keywords: learning analytics; transdisciplinarity; student learning; teaching; learning sciences

Panel background and aims

Since its emergence as a field in the early 2010s, learning analytics has evolved beyond the initial focus on technical and analytical aspects to become more tightly integrated into practice. For example, there has been increased emphasis on learning analytics incorporated into learning design (Bakharia et al., 2016). There has also been extensive discussion about integrating learning analytics with the learning sciences (e.g. Friend, Wise & Shaffer, 2015). In tandem with these trends, there is an increased emphasis on the processes of translation of research into practice in education (e.g. Horvath, Lodge & Hattie, 2017) and on the necessity of examining educational issues from a transdisciplinary perspective (Lodge, Alhadad, Lewis & Gašević, 2017). These trends both align with a broader emphasis on what is being referred to as 'implementation science' or the deliberate translation and application of foundational research and science in applied settings.

Recent publications (e.g. Thompson et al., 2018; Martinez-Maldonado et al., 2017) have attempted to capture these trends through outlining how exactly learning analytics can impact on the physical and virtual classroom. For learning analytics to deliver on the potential the field promises, there is a need to consider the translation and implementation process. In conjunction with the release of the new edited volume: *Learning analytics in the classroom: Translating learning analytics research for teachers* (Lodge, Horvath & Corrin, 2019), we will bring together authors and editors to discuss these issues.

This panel aims to explore with the ASCILITE delegates how areas of the learning analytics can help to understand learning and inform teaching practice in virtual and physical classrooms in higher education.

Within this broader aim, three overall themes will be covered as outlined below:

- Translation from data and analytics to student learning and teaching practice;
- Data and analytics for better understanding how students are learning. In particular, what can data tell us about how students are progressing as they learn?
- Data and analytics informed design and intervention.

The session will draw on the expertise of the panel members to show how collaborations between data scientists, learning scientists, educators, educational technologists, and computer scientists are fundamental to furthering our understanding of data and analytics in the context of the virtual or physical classroom.

Format, Strategies, Audience

The format of the panel session will involve each of the panel members providing a brief overview and provocation (presentation) on one of themes above. After these three, short presentations a range of questions will be posed for the audience that will drive a semi-structured discussion. This discussion will be guided by questions posed by members of the audience. The session will be designed to be as interactive as possible, drawing on the experiences and questions raised by delegates, and the experience and presentations of the panel.

This panel session will be relevant to researchers, teaching academics, academic developers, learning designers and those with an interest in the use of data and analytics in higher education. The session will be designed so that it is accessible to ASCILITE delegates who have no experience in data science or learning analytics. The expectation is that through a clear, structured presentations and carefully prepared, open questioning attendees will leave the panel with a better sense of the intersection between data, analytics and practice; and between the fields of learning analytics, the learning sciences and educational technology.

Biographies of Panel Members

Associate Professor Jason M. Lodge (Chair)	Jason Lodge, PhD is Associate Professor of Educational Psychology in the School of Education and Institute for Teaching and Learning Innovation at The University of Queensland. Jason's research focuses on the cognitive, metacognitive, social and emotional mechanisms of concept learning and conceptual change. He also conducts research on the translation of the science of learning into practice in educational settings, particularly in digital learning environments and higher education.
Dr Kate Thompson	Dr Thompson is a Senior Lecturer in Educational Technology in the School of Education and Professional Studies and Head of the Creative Practice Lab at Griffith University. Kate's main area of research is situated in the Learning Sciences, she researches the activity of participants in complex learning environments (e.g. with technology, in groups, engaged in design), applying innovative approaches to the analysis of complex data (including interdisciplinary approaches to research).
Dr Jared Cooney Horvath	Jared Cooney Horvath is a research fellow at St Vincent's Hospital in Melbourne and the co-founder of the Science of Learning Group – a team dedicated to bringing the latest in educationally relevant brain and behavioural research to students and educators at all levels. Currently he teaches at the University of Melbourne, prior to which he spent a number of years working as a teacher and curriculum developer for several institutions around Los Angeles, Seattle, and Boston.
Paula de Barba	Paula de Barba is a Research Fellow in Higher Education in the Melbourne Centre for the Study of Higher Education at the University of Melbourne. Paula's research focuses on students' cognition and emotions when learning in digital environments. Topics of her interest include self-regulated learning, motivation, interest, and feedback.
Dr Marion Blumenstein	Marion is biologist by training, a researcher by heart, and a teacher by passion. Since switching career from biomedical research to higher education ten years ago, she became interested in student learning, in particular how to foster data-informed course design towards student success. She provides a practical perspective on learning analytics approaches for teachers to better understand their students, and to act on the insights gained. Marion is at The University of Auckland.

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Shifting our focus: Moving from discouraging online student dishonesty to encouraging authentic assessment of student work

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The rapid and consistent rise in online delivery of university credit courses, and the corresponding requirement to assess student work in this mode has resulted in a proliferation of academic enquiry in the areas of contract cheating and online proctoring, including discussion and publication surrounding the verification of student identity when engaging in online formal examinations. The increasing availability of commercially-written academic essays (submitted by students as their own work), commonly referred to as "contract cheating," has become another hot area of academic enquiry.

This symposium will provide a forum for an important discussion surrounding whether or not too much emphasis is being placed on discouraging a very small percentage of students from performing in dishonest ways, as compared to the amount of effort that should be placed on finding valid and reliable ways to assess student achievement that is aligned with stated learning outcomes. Presenters will contend that many of the concerns relating to online students' academic dishonesty could be allayed if the two most common university assessment tools – the formal academic essay, and high-stakes formal examinations were not used to measure the achievement of online students. Several suggestions for authentic, workplace-related tasks will be discussed.

Keywords: authentic assessment, contract cheating, academic integrity, online assessment, online proctoring

Panel Discussion

This issue of contract cheating has been the subject of a growing number of major research initiatives (Harper et al., 2018; Taylor, 2014) with a concentration on the percentage of students who would purchase academic papers for submission relating to formal essay assignments. Considerable concentration has been focussed on enumerating the percentage of students engaged in contract cheating, with reports from less than 1% to nearly 8% being published (Bretag, et al., 2018). We must acknowledge, however that this is still a relatively small percentage of our students being paid a high degree of attention.

As more and more examinations are being delivered online (for both online and on-campus students), many educational technology and software providers have begun development and distribution of "solutions" to the issue of verifying student identity and other potential online cheating practices (Amiguda et al., 2018). Online proctoring solutions include browser lockdowns, webcam technology recording student behaviour during exam completion, as well as other software and devices have been employed with varying success (Foster & Layman, 2013). Much research and development has been directed toward finding a solution to an issue that in reality relates to a small percentage of students completing assessment items that may be argued to be inauthentic in the real world.

While all of the discussion continues surrounding how we can identify and discourage those students who are inclined to engage in academic dishonesty, less effort is being targeted toward supporting those students honestly attempting to meet the learning outcomes of their courses, and providing evidence that they have done so. It must be acknowledged that research is revealing that this group is the overwhelming majority. It is heartening to see that research regarding the up to 98% who don't cheat is beginning to be published as the reasons people don't cheat are at least as important as the ways that people do cheat (Rundle and Clare, 2018). Removing the opportunity to cheat through modification of assessment tools would therefore seem to make infinite sense when trying to address this issue.

The drive to dissuade academic dishonesty has led to the presentation of assessments through a number of platforms to assure student identity and appropriate behaviour. The types of assessments that can be delivered in these modes substantially limits the types of authentic assessment that can be utilised, and makes an inherent assumption that all students completing the assessment must be discouraged from cheating (Beck, 2014). This results in a limited suite of assessment tools delivered to all students, even though research has shown that only a small percentage will attempt to cheat.

Considering the very low percentage of students who have been reported as engaging in academic dishonesty online (generally reported as approximately two percent, and no more than eight percent (Beck 2014), the focus on valid and reliable, authentic assessment tasks for the online environment should be paramount. This discourages both contract cheating and identity tampering for those few students who are inclined to cheat or plagiarise while presenting students with authentic ways to demonstrate their learning achievements.

As academic administrators continue to devise methods to discourage academic dishonesty in this small percentage of students, it takes priority over the development and delivery of valid and reliable authentic assessments. Over ninety percent of our online students may be being assessed with substandard methods merely because of this over-concern that all assessment tasks much be primarily designed to discourage academic dishonesty.

Rundle and Clare (2018) reported that students are more inclined to cheat if the opportunity exists, and that certain styles of assessment (such as academic essays) present clear opportunities. Levels of anxiety induced by assessment tasks that have not been scaffolded, and high stakes tasks such as online exams carrying a high percentage of the overall grade, will also induce normally academically honest students to consider cheating strategies that they would not normally attempt.

The contention of this symposium is not that researchers and educational administrators should turn their back on concerns about cheating, but rather that it should not be the primary focus of work in the field. This should be the assurance that the overwhelming majority of our students, who are academically honest, are able to reliably demonstrate their achievement of stated learning outcomes.

Given the range of assessment tools currently available, a disproportionate number of university assignments require a formally constructed and referenced academic essay (Brown, 2010). This is done in the belief that students need to learn to write academically whether or not it is a learning outcome of that course. The primary focus of marking these assignments is often the adherence to referencing formats and citation monitoring rather than whether or not the course outcomes have been achieved.

These traditional types of assessments are frequently required of online students, and represent the most common target of contract cheating providers. Rather than continue to struggle with the issue of combatting academic dishonesty for those few students who are inclined to cheat, we now have an opportunity to redesign assessment to not only discourage academic dishonesty, but to present our online students with valid, reliable, and most importantly, authentic and engaging ways to demonstrate their achievement of learning outcomes. Accomplishing this requires a substantial transformation in the ways that we measure student achievement.

By designing and delivering authentic assessment tasks to replace the traditional essay and formal online examinations, we will not only be acknowledging the learning needs of all students (not just focusing on those that relatively small number that may be academically dishonest), but will also provide online students with workforce-relevant assessment tasks constructively aligned with learning outcomes (a goal that all good assessments should include). Authentic, tasks aimed at student workplace performance are much more difficult to obtain from contract cheating agencies, who focus on the traditional academic essay.

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Digital Equity: Not just an 'add on' but business as usual

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Digital equity is a moral and strategic imperative in higher education in Australasia, especially as more universities provide online only offerings of courses and programs. Often, however, equity issues are considered remedially as an 'add-on' after the fact in terms of business-as usual in tertiary education institutions. There are many cohorts that may not have access to the digital technologies and connectivity they need to participate fully in higher education including those from low socio-economic (SES) backgrounds, those from regional and remote areas, refugees and incarcerated students. This symposium shines a spotlight on digital equity, capturing both the student and staff experiences, thereby suggesting ways in which equity matters may be considered. The symposium is timed to contribute to the inaugural World Access to Higher Education Day (28 November 2018).

Keywords: digital equity; students; higher education; access; participation; inclusion

Digital Equity

The degree of access to digital technologies and connectivity across Australia varies considerably (Thomas et al., 2016), which becomes particularly significant when considering access to higher education. Universities are increasingly moving online in either blended or fully online modes (Farley & Willems, 2017), and access to digital technologies and reliable Internet connectivity is necessary to enable full participation by students. Inclusiveness is also essential for considerations in course design, instruction and facilitation, including when developing teacher presence (Richardson et al., 2015). Consequently, digital equity is a vital consideration in higher education.

In line with the Bradley Report (2008), higher education institutions are aiming to widen participation for certain equity groups including those from low socio-economic backgrounds, remote and restricted communities, Aboriginal and Torres Strait Islander Australians among others. In addition, there are differences in the use and adoption of technologies between genders, with women being less likely to access both technology and the Internet (Dixon et al., 2014). However, it is also these groups who are least likely to have access to digital technologies and reliable connectivity. For example, just over half of the Aboriginal and Torres Strait Islander Australians living in remote Australia accessed the Internet in the last 12 months (Thomas et al., 2016). As universities strive to recruit an ever more diverse student cohort, and to deliver more education through online learning experiences, they are struggling to meet those cohorts' needs in terms of technology and access (Farley & Willems, 2017).

Digital equity has strong implications for learning design. Aside from the considerations around accessibility of learning materials and the tools and platforms institutions use, there is a consistent increase in embedding digital literacy development into the curriculum across all disciplines at all institutions (Morgan, et al., 2017). In disciplines under pressure to transform more traditional forms of assessment, such as long form essays in the humanities, access to digital content producing equipment and consistency in use of comparable equipment, present challenges. One example is students in history subjects being given the option to submit video essays or vlogs. This digital medium is well suited to the narrative and storytelling approaches embedded within the discipline but requires careful scaffolding on the behalf of learning designers and teaching staff (Tong, Evans, Williams, Edwards & Robinson, 2015).

Symposium structure

This one-hour symposium has three distinct parts.

A. Voices of the educationally disadvantaged

First, it introduces participants to the multi-faceted nature of digital equity, the lens of the student experience. The symposium will commence by sharing the lived student and related educator experiences in access and participation in higher education in Australasia, as seen through the lens of equity groups and equity overlap (Willems, 2010). These student experiences will be highlighted via role play.

B. Discussion with participants about shared experiences in digital equity issues

Following the role play, the session will shift into an active sharing and participatory phase wherein participants will be asked to share digital equity experiences that either they or their students have experienced, providing insights into both the student and educator perspectives.

C. What changes can be made?

Finally, the session will conclude by offering practical examples of things that can be done to assist students in various situations. We will be promoting a move towards a more proactive business-as-usual model for considerations around digital equity, rather than the way it is sometimes considered remedially as an 'add-on' after the fact. The symposium will conclude by inviting participants not already involved to join ASCILITE's Digital Equity Special Interest Group (SIG).

Conclusion

This symposium will provide insights into the student experience of those without reliable access to digital technologies and the Internet. These cohorts would include incarcerated students, Aboriginal and Torres Strait Islanders, students from refugee backgrounds, students living in regional and remote Australia, those from low SES backgrounds, first in family, language other than English (LOTE), and those with disability which precludes them from accessing digital technologies. The Symposium aligns with a range of the United Nations' Sustainable Development Goals (SDGs) (Gough, 2018; United Nations, 2015), which seek to redress inequality with regards to access, education and participation. Examples are SDG 4 'Quality Education', SDG 5 'Gender Equality', and SDG 16 'Peace, Justice and Strong Institutions'.

Further, the timing of this symposium adds to the activities around the globe to highlight access to, and participation in, higher education. World Access to Higher Education Day is a new day to heighten awareness and global attention towards inequality in access to higher education and to accelerate action, held this year on 28 November 2018. This symposium will contribute to this call for collective global action.

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Pre-Conference Workshops

The following pre-conference workshops were offered at ASCILITE 2018.

1. **Integrating learning analytics and learning design: Smooth sailing or a rough journey**
   Sakinah Alhadad, Griffith University
   Hazel Jones, University of Southern Queensland
   Linda Corrin, The University of Melbourne, and
   Cassandra Colvin, Charles Sturt University

2. **Designing and researching peer assessment using an evidence-based framework**
   Joanna Tai, Deakin University, and
   Chie Adachi, Deakin University

3. **Engaging Learners in online discussion**s
   Kirsten Schliephake, Monash University, and
   Silvia Vogel, Monash University

4. **Designing authentic assessments for the online environment: A pro-active approach to assuring constructive alignment and combating academic dishonesty**
   Keith Foggett, The University of Newcastle, and
   Carol Miles, The University of Newcastle

5. **Understanding the student digital experience: national and international insights**
   Helen Beetham, JISC
   Ruth Drysdale, JISC
   Tabetha Newman, JISC, and
   Fiona Salisbury, La Trobe University

Conference Poster Presentations

POSTER VIEWING	PRESENTER(S)	THEME
“Digital identity: making your mark!” Developing students’ digital literacies through an adaptive eLearning module	Al-Mahmood Reem, Jenny Corbin, Logan Balavijendran and Caroline Ondracek	Theme B
Identifying the indicators of optimal student outcome in online education	Lilani Arulkadacham and Zahra Aziz	Theme H
Across oceans: intercultural treasures built through collaborative online culture	Kim Balnaves	Theme F
Rocks amongst the pebbles: playing the long game introducing Pebblepad into program designs	Karin Barac, Henry Cook and Michael Gleeson	Theme G
Curiouser and curiouser: the wonderland of LMOOCs	Elaine Beirne, Mairéad Nic Giolla Mhichíl and Mark Brown	Theme A
The UNE bespoke model: student as architect of their own learning	Airlie Bell, Kate Pardy and Jennifer Lawrence	Theme D
Enabling scaffolded work integrated learning	Francesca Bussey, Friederika Kaider and Iain Doherty	Theme C
Embedding a digital literacy activity in a museum environment in a 1st Year Doctor of Optometry curriculum	Kwang Cham and Heather Gaunt	Theme D
A social media research network framework for open social scholarship	Thomas Cochrane and Vickel Narayan	Theme F
Flashcards and spaced repetition–fending off forgetfulness	Stephen Colbran, Wayne Jones and John Milburn	Theme G
Design thinking: examining a collaborative approach to designing fully online subjects	Belinda Davey, Maria Bora and Kristine Elliott	Theme C
The crossover between learning design and interactive design	Peter Di Lorenzo, Carly Milanovic and Siva Krishnan	Theme C
Strategies for supporting and developing a culture of innovation in technology enhanced learning	Vebica Evans, Meghan Appleby and Anna Gemmell	Theme F
An evaluation of digital literacy and digital capability in higher education	Rachel Fitzgerald	Theme B
Trip advisor approach to higher education–situating the academic developer	Rachel Fitzgerald and Henk Huijser	Theme D
Visualised feedback: start of a dialog	Cedomir Gladovic	Theme D
Designing a collaborative professional development series for cultivating a scholarly digital presence	Richard Hayman and Erika E. Smith	Theme F
Blended learning bootcamp; professional development to enhance active learning pedagogies.	Meredith Hinze	Theme F
The future of information systems with mixed reality	Blooma John, Emily Rutherford and Jennifer Smith	Theme C
Assessment, technology and the future of higher education through the lenses of postgraduates as emergent leaders	Shelley Kinash, Madelaine-Marie Judd and Linda Crane	Theme C
Linkedin: showcasing and connecting students towards employable horizons	Louise Lexis, Brianna Julien, Jason Brown and Michael Healy	Theme H
Adaptive leaning analytics: Insights from our mistakes.	Kelly Linden and Lucy Webster	Theme G
Scaffolding digital academic integrity in business education	Leanne Ngo and Wendy Webber	Theme C
Upscale: adapting an effective pedagogy to open online delivery	Emily Purser	Theme H
A deep dive into student data: gauging the influence of new campus spaces on student learning	Carol Russell	Theme A

Understanding significant networks of academic teachers on blended learning–an exploratory study	Swee Kit Alan Soong, Adrian Michael Lee, Lyn Fung Jeanette Choy and Li Charina Ong	Theme F
The development of a tailored, career-focused interactive online learning tool for physical activity and health students: a pilot study	Megan Teychenne, Shannon Sahlqvist, Sarah Costigan, Danielle Teychenne, Phillip Dawson and Susie Macfarlane	Theme H
Postgraduate.futures: design in action, action in design	Carmen Vallis	Theme F
Flipping the classroom using technology-enhanced Team Based Learning	Panos Vlachopoulos and Ioannis Kalaitzidis	Theme H
Encouraging deep learning in the twenty-first century: can student-created videos help to teach anatomy?	Alexandra Webb, Katherine Esteves and Krisztina Valter	Theme H
"Digital identity: making your mark!" Developing students' digital literacies through an adaptive eLearning module	Al-Mahmood Reem, Jenny Corbin, Logan Balavijendran and Caroline Ondracek	Theme B

Conference Streams

A	Checking the gauges : Measuring Learning and Advancing Impact
B	Sink or swim : Improving digital literacy
C	New ways of moving : Pedagogies and practices
D	New treasures : Alternative and out-of-the-box thinking
E	The waters in which we swim : Redesigning Learning Spaces
F	Exploring foreign shores : Advancing Cultures of Innovation
G	Avoiding the rocks : Lessons learnt from failures
H	Deep Diving : Approaches that Foster Deep Learning