



Conference Proceedings of the Australian Computers in Education Conference 2014

ISBN: 978-0-646-92095-5

Welcome to the conference proceedings for ACEC2014

The ACEC2014 Now IT's Personal conference explores the three themes of Innovative Learning, Inspiring Leadership, and Redefining Education. The conference has been organised by EdTechSA (formerly CEGSA) for, and on behalf of, Australian Council for Computers in Education (ACCE). The Conference Program Chair Dr. Trudy Sweeney together with Program Executive Sue Urban have edited the proceedings.

The first iteration of the conference proceedings is on USB and available to all delegates on the first day of the conference. After the conference the ACEC2014 website will be available as an "up-to-date" conference proceeding.

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PRINCIPAL AND TEACHER BELIEFS ABOUT ONLINE LEARNING TECHNOLOGIES

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Abstract

This paper explores the link between principals' and teachers' pedagogical beliefs regarding the benefits of integrating online learning technologies into language teaching and learning contexts. Principals who have the leadership ability to carry out the pedagogical requirements for technological change in teaching and learning approaches can direct the use of technology to enhance the school learning environment (Baylor & Ritchie, 2002; Ertmer & Ottenbreit-Leftwich, 2010). The paper reports on the initial phase of data collection for a PhD thesis at an Australian University. Two surveys were developed and conducted for this study to determine principals' and teachers' existing pedagogical beliefs regarding online learning technologies. The participants included 67 principals and 82 Arabic language teachers across 33 secondary schools in Saudi Arabia. The results show a strong alignment between principal and teacher beliefs in that both indicate positive constructivist beliefs, particularly regarding the ability of online learning technologies to improve teachers' and students' research skills, promote students' learning both inside and outside school and convert teacher-centred teaching approaches to student-centred teaching approaches. The study also shows that principals' beliefs were consistently stronger than teachers' beliefs.

INTRODUCTION

Online learning technologies are at the forefront of recent advanced educational technologies (Heirdsfield, Davis, Lennox, Walker, & Zhang, 2007). In this study, the use of online learning technologies refers to the use of the Internet and other types of information communication technology (ICT) to assist teaching in the classroom and to enhance and facilitate student learning. Examples include the use of online communication tools (e.g. email, thread discussions, instant messengers and text messages), digital resources (e.g. online dictionaries, YouTube videos, e-books and online literature libraries), oral/written presentations, audio recordings, social networking (e.g. Facebook and Twitter), Web 2.0 tools (e.g. wikis and blogs) and online learning management systems (e.g. Blackboard and Moodle). The use of online technology tools such as these has become a significant component of pedagogy in many parts of the world (Suanpang & Petocz, 2006). Educators and parents now consider integrating online technologies into classroom teaching and learning activities as an effective and essential part of providing high-quality education and increasing opportunities for lifelong learning (Heirdsfield, Walker, Tambyah, & Beutel, 2011). In comparison with traditional learning or non-technology use, teaching through online technologies has several advantages, particularly in allowing for "learning anytime and anywhere" (Peerapat, 2010). Classroom teaching and learning can be effective when online technologies are used as interactive learning tools that support student-centred education and knowledge construction, allowing students to obtain disciplinary knowledge while accommodating their personal learning preferences (Tu, 2005).

In the last decade, a number of studies in the United States, the United Kingdom and Australia have been conducted regarding the use of online learning technologies (Jones, 2008; Kennedy, Judd, Churchward, Gray, & Krause, 2008; Kvavik & Caruso, 2009; Lenhart, Madden, Smith, & Macgill, 2009). In Saudi

Arabia, the government has allocated a large portion of its recent national budget to the development of public education. Attempts are currently being made to encourage teachers in Saudi public education to use online learning technologies as an integral part of traditional education; this method is being applied in some schools located in major cities (Hamed, 2012). In spite of these significant endeavours, using technology in the classroom remains a big challenge for teachers because they have to learn how to use technology, know how to identify and cope with the strengths and weaknesses of technology and select the most appropriate form of technology for lesson activities (Al-Abdullatif, 2012). Online learning technology implementation implies changes to the planning and delivery of lessons and, subsequently, a change in teaching approaches. It also involves changes in the student assessment processes. Rather than merely passing on knowledge, teachers are facilitators who show students how to use technology and engage in a more self-directed learning process (Guri-Rosenblit, 2005). Therefore, the need for this study stems from the potential usefulness of exploring the beliefs of principals and teachers about teaching through online learning technologies and examining to what extent their beliefs can affect classroom practices of online pedagogical approaches in Saudi Arabia. This study may also contribute to developing research-based understanding of the actual experiences and beliefs of principals and teachers as they manage the teaching and learning processes at their schools.

The research literature on how teachers effectively apply online learning technologies has primarily catalogued the availability and considerable increase in technology and online pedagogical approaches in higher education institutions (Bowen, Chingos, Lack, & Nygren, 2014). The majority of research has been conducted at the higher education level, focusing on the use of learning management systems, particularly in areas such as faculty participation (Maguire, 2005), involvement, adaptation (Baran, 2011; King, 2002), satisfaction (Bolliger & Wasilik, 2009), perception about the value and effectiveness of online learning implementation (Al-Abdullatif, 2012; Ulmer, Watson, & Derby, 2007) and approaches to teaching postgraduate online distance courses (Gonzalez, 2009). There is less research on the extent of the use of online pedagogical approaches as an integral part of public school education.

An organisation's leadership beliefs can shape the use of online learning technologies and affect the willingness of college faculty members to teach using online technology (Harrison, 2011). A survey by Mitchell and Geva-May (2009) indicated that online technology implementation can be affected by the administration's attitude. This is because the majority of administrators are inclined to encourage staff to teach using online technologies to enhance student learning. Therefore, a study linking principals' beliefs and teachers' beliefs may be able to identify the convictions influencing the role and application of online learning technologies in educational processes.

While the study of teachers' beliefs is in itself important, it is more significant to identify a connection between principals' and teachers' beliefs and their impact on classroom practices, whether positive or negative. In addition, there is a lack of research in Saudi literature on the relationship between principals' beliefs and teachers' beliefs about the benefits of integrating online technologies into language teaching and learning contexts. The current study seeks to fill this gap. Particularly, it seeks to explore (1) principals' and teachers' beliefs regarding the benefits of online technology integration and (2) how teachers' beliefs regarding online technologies relate to principals' beliefs.

LITERATURE REVIEW

Online Technology Use and Constructivism

The literature seems to be in agreement that teaching in integrated online learning environments differs from traditional or non-technology classroom teaching and, as such, requires the development of its own pedagogies (Kreber & Kanuka, 2006). Kenny (2003) and Porter (2004) demonstrated that implementing online learning systems was likely to be most effective when used in conjunction with other face-to-face pedagogical approaches. Collaborative learning techniques, long-term problem-based exploration and greater use of online learning environments are the key features of pedagogical approaches in online environments (Lim, Hung, Wong, & Hu, 2004). These approaches represent the constructivist view of

learning and teaching. The constructivist approach gives the learner an active role in meaning and knowledge construction; students can create knowledge, hypothesise, inquire, investigate, imagine and invent, rather than passively receive knowledge from the teacher.

Johnson and Aragon (2003) pointed out the importance of associating learning theories with a new philosophy of teaching and learning in online learning environments. There is a close relationship between technologies and constructivism; various benefits can be obtained from this relationship, such as encouraging both teacher and student to search through digital resources and encouraging them to read more to build their knowledge (Gilakjani, Leong, & Ismail, 2013). Constructivism is based on the perspective that “students construct their meaning during learning based on their experiences and through a social negotiation of that meaning during the learning process” (Davidson-Shivers & Rasmussen, 2006, p. 45). This learner-centred approach focuses on encouraging ongoing interaction between students and actively engages them in constructing their own learning. Although constructivism is considered a form of cognitive theory, it differs from cognitivism in two ways: it focuses on learners constructing their knowledge and depends on social settings in the teaching process (Davidson-Shivers & Rasmussen, 2006). In the context of online technology use, constructivism is employed in teaching when teachers encourage students to become active constructors of their own knowledge within the context of experience.

Constructivism has generated a number of teaching approaches based on the following principles: (a) active learning by encouraging students to participate in learning activities, (b) learning through opportunities to search for information and experiment and (c) scaffolded learning and collaborative learning (Harasim, 2012). Online collaborative learning groups informed by constructivist theory can be an appropriate pedagogical approach for some features of online technologies, including online seminars, discussions and group assignments that require students to work together. In collaborative theory and pedagogy, the teacher’s role is to involve students in the language and activities associated with building discipline as well as the language and processes of the knowledge community. The teacher is also responsible for establishing the processes of discussion and the problem to be discussed, providing students with feedback or analytical terms that lead them to discuss and understand the topic deeply, and supporting students to reach a level of intellectual convergence and come to a position on the topic or a resolution of the problem (Coll, Rochera, & de Gispert, 2014).

Benefits of Online Technology Use

The benefits of online technologies can have a significant impact on classroom teaching and learning. Jones (2004) wrote a report on the results of BECTA’s online survey of 170 participants’ perceptions on the barriers to ICT use in education. The report identified the lack of perceived benefits of ICT use as one of the obstacles to implementing ICT in the teaching and learning process. Research exploring the impact of online learning has identified several benefits that could overcome some shortcomings of traditional or non-technology classroom teaching and some learning barriers. One of these benefits is providing students with a creative learning experience and removing the limitations of time and place (Alaugab, 2007) to support classroom-learning activities. This could be achieved by enabling students to broaden their knowledge and experience outside of school using available online resources, taking into account their desired learning styles (Gail & Terry, 2011).

Mason and Rennie (2008) identified additional benefits of the use of online learning technology such as social media in the classroom. They found that the use of online technologies enabled students to participate, think, contribute and become active in their learning. In addition, using online learning technologies in the classroom allows the teacher not only to incorporate multimedia but also to share information quickly and easily, providing a collaborative learning environment where students can communicate at any time. Other benefits of online technology use are related to facilitating self-directed learning, problem-solving skills, higher-thinking skills and research skills for students, along with collaborative feedback from other students and the teacher in learner-centred environments (Seok, 2008).

The use of online learning technologies places high expectations on students, since they are able to monitor the quality of their responses in online activities until they are confident enough to submit them to their teacher. They have more time to think before answering questions, and they can do more research and review materials before submitting or discussing their work with their classmates. Online learning technologies can help students keep up with their classmates and discuss lessons they do not understand in the classroom. They can also ask questions via email or e-learning communication features (Trangratapit, 2010).

Finally, Hsieh and Dwyer (2009) concluded that using various learning styles and approaches increases student achievement, self-esteem and self-confidence. Online technologies provide an opportunity for communication between the teacher and students, as well as among students, about the lesson content. They communicate either in real time (synchronous) using teleconferences or in chat sessions with no preset times (asynchronous), which allows students to participate in class at their preferred times (e.g. through email and online discussion forums).

Principals' and Teachers' Beliefs

Since beliefs are thought to influence and shape classroom practices (Ertmer & Ottenbreit-Leftwich, 2010; Prestridge, 2012a), it is important to identify the beliefs of teachers and principals of the school community. A principal can play a critical role in facilitating teacher change when he/she believes in the significance of supporting teachers and giving them an opportunity to try new technological approaches to effectively implement modern educational technologies in the classroom (Somekh, 2008). The school leadership should create change-oriented environments supporting experimentation and innovation, as well as include teachers in the decision-making process (Sociocultural, Reio, & Lasky, 2007).

School principals who have the leadership ability to initiate and carry out the pedagogical requirements of technological change in teaching and learning approaches can also direct the use of technology to enhance the school learning environment (Baylor & Ritchie, 2002; Ertmer & Ottenbreit-Leftwich, 2010). Facilitating technology use in classrooms, having a plan, articulating the vision, sharing leadership and rewarding teachers as they strive to integrate technology are significant indicators that may affect teachers' classroom practices (Baylor & Ritchie, 2002).

However, a misalignment between principals' and teachers' beliefs about online technology use is likely when principals ignore teachers' beliefs or when principals' beliefs are incongruent with teachers' beliefs. Haney, Lumpe and Czerniak (2003) stated that teachers with a constructivist philosophy regarding effective classroom teaching and learning may be impeded by school community members who hold views that are incongruent with their own beliefs. Therefore, the belief structures of both principals and teachers must be investigated to guide extant efforts in online technology integration.

METHODOLOGY

Research Context

This paper reports the results of the first stage of a PhD research project at an Australian university. This project aims to explore the beliefs of Saudi school principals and teachers about teaching in online learning environments. It will also examine the connection between the beliefs of principals and teachers. Secondary school principals and teachers of Arabic-language literature were selected to participate in this study for two reasons. First, the current project of the Saudi Ministry of Education pertaining to integrating online learning technologies into Saudi Arabian public education focuses more on secondary schools, and some secondary classrooms now have access to the Internet. Second, Arabic literature was selected because the impact of the teachers' beliefs on classroom instruction has been noted in other disciplinary fields such as math and science, yet little research has been conducted to identify a similar link to teachers' classroom use of online learning technologies. The teaching of Arabic literature in Saudi schools focuses on literary arts such as articles, novels, poetry and plays from both classical and contemporary literature.

The Ministry of Education has encouraged teachers to use the following teaching methods: discussion, role-playing exercises and collaborative learning and research, along with integrating online technologies into classroom practice (Ministry of Education, 2005). Each school is provided with two teacher guidelines (Developing Teaching Strategies, Teach Me How To Learn), which cover all those teaching methods. In grade ten, which this study will focus on, the contents of Arabic literature include the nature of Arabic literature, types of literature, eras of literature, textual analysis of literature and examples of literary arts.

Like most countries, the approach for teaching the Arabic language in Saudi secondary schools is face to face and requires that students attend classes. In Saudi Arabia, online technologies in secondary schools are an integral part of classroom activities. Classrooms have Internet access, interactive whiteboards, smartphones, e-readers and laptops that provide an opportunity for students to use online communication tools and digital resources. Arabic teachers in secondary schools have approximately 24 Arabic language classes including Arabic grammar, Arabic literature and rhetoric. Each secondary school has one or more principals who are responsible for managing all school issues concerning teaching and learning.

Research Design

A survey of principals' beliefs and a survey of teachers' beliefs regarding online learning technologies were used for gathering data. This study analysed the survey results to explore what participants believe about teaching in an online learning environment. It also examined the connection between principals' and teachers' beliefs. There were nine closed questions on principals' and teachers' beliefs about the benefits of integrating online technologies into the process of language teaching and learning in secondary classrooms. Respondents were asked to indicate their agreement with the statements on a 5-point Likert-type scale (where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree).

The survey was constructed based on previous studies conducted by Alaugab (2007), Al-Abdullatif (2012), Baran (2011), Harrison (2011) and Prestridge (2012b). It was also validated and tested through a pilot study to ensure its validity and reliability in the context of language teaching and learning. The survey instrument (items 1–9) had high reliability, with a Cronbach's alpha of 0.832. Descriptive statistics were used to present the data on the value of online learning integration.

Procedure

Schools were selected to identify any difficulties they might encounter during the data collection stage. An invitation to attend a group information session for this research project was distributed by the Department of Education in Jeddah to each of the selected schools. A total of 33 schools across eight districts were chosen to participate.

Participation in the survey was voluntary. The researcher conducted eight group information sessions for each of the eight school districts. At each information session, the researcher provided participants with a written and verbal description of the research project and explained the purpose of the proposed surveys. The researcher distributed information sheets along with the surveys to all participants in each information session. The survey took approximately 20–25 minutes to complete.

The survey was conducted on a sample of 67 principals and 82 teachers. The principal survey included questions on background and demographic information, followed by questions about the benefits of using online learning technologies, technical competence for online technology integration and teaching practices with online learning technologies, focusing on the teachers' use of online pedagogical approaches in class. The teacher survey provided descriptions of the participants' demographic information and general insights into teachers' beliefs regarding the benefits of teaching in online learning environments, their confidence levels with respect to teaching students through online learning technologies, their personal technical competencies and their classroom practices of online pedagogical approaches.

Survey data were analysed using the Statistical Package for the Social Sciences (SPSS). A descriptive statistical analysis of the responses, including frequency distributions, percentages, means and standard deviations, was performed for each statement of the questionnaire and for the overall responses. All the participants in this study were native Arabic speakers. Therefore, to ensure the validity of the surveys, the principal and teacher survey were translated into Arabic by an authorised translation centre in Saudi Arabia. Furthermore, to ensure validity, the study used a random probability sample and collected data from various secondary school principals and teachers to effectively examine variations in principals' and teachers' beliefs. Cohen, Manion and Morrison (2011) stated that a random probability sample is one of the best methods for selecting a research sample because it has less risk of bias compared with a non-probability sample. Moreover, to ensure validity, the principal survey and teacher survey were evaluated by a community of researchers and interested and informed individuals.

RESULTS AND DISCUSSION

This paper analyses the connection between the beliefs of Saudi secondary school principals and teachers regarding the advantages of using online learning technologies. In general, principals and teachers had positive beliefs regarding online technology use in classroom teaching and learning. All statements achieved agreement levels of no less than 78.6%. Additionally, the principals' ratings were higher than the teachers' ratings for each belief statement, as shown by the high mean scores for principals' beliefs (Table 1).

Table 1. Principals' and Teachers' Beliefs ($N = 149$)

Belief statements:	Participant	Mean	Standard Deviation	% of Mean	Response
I believe that using online learning technologies					
1. accommodates students' personal learning preferences.	Principal Teacher	4.37 4.26	0.573 0.644	87.45% 85.2%	Agree Agree
2. promotes students' learning both inside and outside school.	Principal Teacher	4.63 4.48	0.517 0.633	92.6% 89.6%	Strongly Agree Agree
3. converts teacher-centred teaching approaches to student-centred teaching approaches.	Principal Teacher	4.46 4.32	0.611 0.799	89.2% 86.4%	Agree Agree
4. maintains high expectations of students.	Principal Teacher	3.99 3.93	0.728 0.828	79.8% 78.6%	Agree Agree
5. is more effective than non-online technology-based or non-technology-based classroom	Principal Teacher	4.16 4.01	0.914 0.975	83.2% 80.2%	Agree Agree
6. improves the research skills of teachers and students.	Principal Teacher	4.63 4.61	0.517 0.583	92.6% 92.2%	Strongly Strongly
7. enhances collaboration among students.	Principal Teacher	4.40 4.09	0.780 0.958	88.0% 81.8%	Agree Agree
8. improves students' learning achievements.	Principal Teacher	4.24 4.28	0.818 0.742	84.8% 85.6%	Agree Agree
9. helps organise student learning.	Principal Teacher	4.27 4.11	0.790 0.737	85.4% 82.2%	Agree Agree
Grand Mean	Principal Teacher All	4.3499 4.2304 4.2841	0.449 0.515 0.489	87.0% 84.6% 85.7%	Agree Agree Agree

Criteria for data analysis: 4.50–5 = Strongly agree; 3.50–4.49 = Agree; 2.50–3.49 = Neutral; 1.50–2.49 = Disagree; 1–1.49 = Strongly disagree.

The results reveal that the overall belief of principals about integrating online learning technologies into classroom-based language teaching and learning is positive ($M = 4.35$, $SD = 0.449$). Principals strongly agreed with three statements. The first statement was “using online learning technologies promotes students' learning both inside and outside school” ($M = 4.63$, $SD = 0.517$). Approximately 92.6% of the principals strongly agreed with this statement. “Using online learning technologies improves the research skills of teachers and students” ($M = 4.63$, $SD = 0.517$) was the second strongly agreed upon statement among principals. The third statement was “using online learning technologies converts teacher-centred teaching approaches to student-centred teaching approaches”. Approximately 89.2% of principals agreed with this statement. These three strongly held beliefs support constructivist beliefs that focus on meeting students' needs and helping them become independent learners. The least agreed upon statement among principals was “using online learning technologies maintains high expectations of students”.

The overall belief of teachers about the value of integrating online learning technologies in classroom-based language teaching and learning is also positive ($M = 4.23$, $SD = 0.515$). The first strong belief indicated by the teachers was that “using online learning technologies improves the research skills of teachers and students” ($M = 4.61$, $SD = 0.583$). Approximately 92.2% of teachers strongly agreed with this statement. The second strongest belief shown by the teachers was that “using online learning

technologies promotes students' learning both inside and outside school" ($M = 4.48$, $SD = 0.633$). A large percentage of teachers agreed that online learning technologies convert teacher-centred teaching approaches to student-centred teaching approaches. The three most strongly held beliefs among the teachers were the same as those of the principals, which supported constructivist beliefs. The least agreed upon statement among teachers was "using online learning technologies maintains high expectations of students" ($M = 3.93$, $SD = 0.828$).

The results shown in Table 1 indicate that teachers' beliefs were consistent with principals' beliefs. Both principals and teachers indicated positivist views regarding integrating online learning technologies into the classroom teaching and learning process. Both groups held constructivist pedagogical beliefs that online learning technologies improve the research skills of teachers and students and promote students' learning both inside and outside school. Both principals and teachers agreed that online learning technologies convert teacher-centred teaching approaches to student-centred teaching approaches. This supports the findings of Gilakjani et al. (2013), who emphasised the close relationship between technology use and constructivism, in which students are encouraged to build their knowledge using digital resources. This finding also concurs with those of Al-shehri (2012) and Peerapat (2010), who argued that teaching through online technologies provides students with meaningful opportunities to learn inside and outside the classroom.

The study highlights the important link between principals' and teachers' beliefs about the advantages of online technology in teaching and learning. It is therefore significant to take into consideration the principals' views and involve them in the process of integrating online learning technologies into classroom teaching and learning. In addition, principals' beliefs regarding the benefits of integrating online learning technologies significantly impacted on teachers' beliefs and may also influence the online pedagogical practices of teachers in the classroom.

CONCLUSIONS AND IMPLICATIONS

The current study is significant for several reasons. First, it explored the beliefs of a group of 67 principals and 82 teachers of the Arabic language. The number of participants provided a snapshot of what principals and teachers think, know and believe when they integrate online technologies into the teaching and learning process. It is interesting to note that the three most strongly agreed upon statements (using online learning technologies improves research skills, promotes students' learning inside and outside school and converts teacher-centred teaching approaches to student-centred teaching approaches) among principals and teachers are related to constructivist pedagogical beliefs. Tamar and Rivka (2007) stated that such constructivist beliefs can meet students' needs and help students become independent learners.

Second, the study offers a significant contribution to the exploration of teachers' beliefs. The study found that teachers' beliefs are consistent with principals' beliefs about the benefits of integrating online technologies in the context of language teaching and learning. The theoretical significance is that principals' beliefs regarding the benefits of integrating online learning technologies significantly impacted on teachers' beliefs and may also affect the online pedagogical practices of teachers in the classroom. This supports the findings of Baylor and Ritchie (2002), who suggested that technology may be more widely valued and integrated in the classroom if teachers believe that the administrators value and promote the use of technology.

Finally, belief identification encourages principals to reflect on their own views and construct their views with teachers. Additionally, the study shows that principals held stronger beliefs than teachers did. This may indicate that principals are the active decision makers. Therefore, principals who are strongly interested in online technologies may reinforce the importance of integrating online technologies in teaching and learning, thereby directing and influencing its use by teachers in the classroom.

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INSTRUCTIONAL WRITING STRATEGIES USING TEXT-TO-SPEECH TECHNOLOGY

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This paper describes an ethnographical case study about how one primary school teacher integrated text-to-speech technology into her instructional writing strategies to develop students' knowledge-telling revision procedures. The text-to-speech technology enabled the teacher to personalise writing instruction by providing novice and more experienced writers with similar writing instruction but with differentiated writing goals. The findings suggest that text-to-speech technology is valuable for developing students' understanding about the relationship between the author and the reader by enabling them to review what they have written as a cognitive tool to help them revise the meaning and mechanics of their texts. The use of text-to-speech technology for collaborative class writing activities served to de-privatise the writing process for response by a larger audience.

All students need to learn to write to communicate meaningfully in today's world. The Program for International Student Assessment (PISA) claims that students will need to analyse, reason and communicate their ideas effectively (OECD, 2011). School pedagogical environments are a major influence on shaping national efforts to "help students to learn better, teachers to teach better, and school systems to become more effective" (p.4). In 2008, the Melbourne Declaration on Educational Goals for Young Australians, a framework for Australian schooling recognised Information Communication Technology (ICT) as a foundation for success in all learning areas and for further learning and adult life (Ministerial Council on Education Employment Training and Youth Affairs, 2008). The opportunities that technology may provide for educational reform is not going un-noticed by the governments, school authorities and classroom teachers.

Teachers are experimenting with new and different modes of learning with technologies as they strive to support students to develop their writing skills. However, writing with the use of technology does not guarantee that students develop the necessary knowledge and skills to create meaningful texts. There is debate about how technology can impact positively on students' writing through changing approaches to teaching practice, the use of word processors, effective instructional practices, computer mediated communication and with the use of technological tools to create shared knowledge through collaborative social practices (Akbiyik & Seferoğlu, 2012; Hakkarainen, 2009; Morphy & Graham, 2012; Peterson-Karlan, 2011; Turner, 2011).

This paper investigates how Stephanie (pseudonym), a teacher in the study, designed instructional approaches using text-to-speech technology within personal and collaborative writing environments, using the process approach to writing to develop her students' writing goals. Stephanie was in her first year of teaching and at the time of the research, she was teaching a composite class of Year 4 and 5 students. She believed she was a competent user of technology, using technology daily for classroom management processes, to access information and to support her teaching.

Writing to communicate with technology challenged Stephanie to think differently about her current teaching practice and what it meant for her students to be literate. She had been using technology in her writing classroom as a typing tool or for students to publish their written texts. One of the challenges for Stephanie and the implications of the changes in computer technology, is the audiences that students write for have changed. Written communication is changing in the world and Stephanie understood that she needed to think about this from a teaching point of view if she wanted her students to become authors for global audiences. If her students were to use technology in their writing so they could communicate effectively, then they needed to know about technology and have a different set of writing skills.

Literature Review

A review of the literature suggests that technology can transform and deepen students' writing experiences influence teachers' pedagogy and classroom instruction. There are five main components to consider when investigating the role of technology in instructional writing strategies. Each of these five components will now be briefly discussed.

Teaching Reading and Writing to Enhance Literacy Learning. When reading and writing are taught together student's literacy learning can be enhanced (Vygotsky, 1978b), student's comprehension skills can be developed, and students are enabled to become more critical thinkers (Vygotsky, 1978a). Researchers suggest that communicating meaningfully through writing can be a collaborative process between the writer and the reader (Stahl & Hesse, 2006; Vass, Littleton, Miell, & Jones, 2008; Vygotsky, 1978a). Shanahan (1998) recommends that instructional principles can be used to promote the relationship between reading and writing and that teachers should make the reading and writing connections explicit to students.

Researchers have shown that there are similar cognitive processes between reading and writing that enable students to develop their literacy skills (Hattie & Yates, 2014). The remodelled cognitive process theory approach to writing by Hayes (2012) provides a means for teachers to focus on the thinking processes between good and poor writers within the different writing process activities. This especially includes the monitoring and revising of texts (Graham & Perin, 2007; Peterson-Karlan, 2011). Teachers who have awareness for how writing concepts can inform their practice, may then design effective scaffolded learning experiences for students (Bereiter, 1994).

Using Technology for Writing. The impact of using computers for writing has shown positive outcomes on student learning (Akbiyik & Seferoğlu, 2012; Morphy & Graham, 2012; Riley & A°hlberg, 2004; Turner, 2011). This includes commercially produced software and freeware, which is used by teachers today to individualise classroom instruction (Abell & Lewis, 2005; Brunelle & Bruce, 2002; Lange, McPhillips, Mulhern, & Wylie, 2006; Lovell & Phillips, 2009). However, the creators of writing software programs do not generally consider the potential of emerging technologies as a means to promote writing for communicating in today's world (Vojak, Kline, Cope, McCarthey, & Kalantzis, 2011). Read&Write Gold™ is a literacy based software (TextHelp Systems Ltd, 2012) which is an exception, as the creators of this program did consider how the technology can promote the learning to write process. The different technological tools within the software can be personally customised in the learning environment and used as cognitive tools.

While software creators suggest how teachers can best use their products, teachers themselves possess deep content knowledge about their subject domain and the pedagogical strategies effective for exploiting the interactions with the features of technology. Researchers suggest that the creators of many programs promote outcomes that may reinforce traditional classroom practices or testing outcomes (Al-Alaoui et al., 2008; Brunelle & Bruce, 2002; Englert, Wu, & Zhao, 2005; Garrison, 2009; Silió & Barbetta, 2010).

Learning Theories. Researchers have reported on how teachers can use knowledge about learning theories and cognitive load theory to develop instructions (Hattie & Yates, 2014; Hollender, Hofmann, Deneke, & Schnitz, 2010; Kirschner, Ayres, & Chandler, 2011; Roblyer, 2004; Sweller, Ayres, & Kalyuga, 2011). Findings have shown that effective teaching practices are based on the principles of learning theories and the human cognitive information processing system. Pressley, Mohan, Raphael, and Fingeret (2007) described that success in writing instruction is dependent on how teachers enable students to use technology effectively within the writing process.

Text-to-speech as an Instructional Tool. The functionality of text-to-speech as a technological instructional tool has been found to be beneficial for individual students to achieve writing autonomy, to sustain improvement in their literacy skills and the revision of their texts (Englert et al., 2005; Garrison, 2009; Lange et al., 2006; Silió & Barbetta, 2010). The knowledge-telling model of writing typically adopted by primary school students as novice writers engage in reflective or revision processes, can help

teachers to understand how technology can be used to enhance students' writing skills (Scardamalia, Bereiter, & Steinbach, 1984).

Hayes (2012) differentiated the knowledge-telling model three ways: the flexible-focus model, fixed-topic model, and topic-elaboration model. He proposes that if teachers have knowledge of these three knowledge-telling strategies, they can differentiate student learning by implementing specific instructional procedures for individual students. There is a gap in the literature about how text-to-speech can be used as a technological and cognitive tool to support students to reflect on the ways in which experienced writers and readers backtrack over their texts as they read and write to plan, write and revise their work.

Teacher Knowledge about Technology Integration. The technological pedagogical content knowledge (TPACK) Framework is a valuable conceptual lens for exploring the knowledge that teachers need to integrate technology into classroom learning (Mishra & Koehler, 2011; Wetzel & Marshall, 2011-2012). It is argued that teachers need to focus on effective technology integration as it relates to teachers' knowledge of the relationship between technology, pedagogy and content knowledge (Hofer & Swan, 2008). The SAMR Model provides an additional conceptual lens to reflect on how teachers use technology to design learning activities for students (Kervin & Mantei, 2009; Puentedura, 2008). The model can be used to guide teachers to consider four different levels of technology adoption from basic substitution, to augmentation through added functional improvement, to the transformation and redesign of learning activities where technology facilitates the creation of new tasks previously inconceivable. The TPACK Framework and SAMR Model have been widely used in research about the integration of technology. This research does not appear to have included the role of technology in instructional strategies to develop primary school students' narrative writing.

Methodology

This study formed part of a larger PhD research project involving eight teacher participants across four primary schools. This paper describes the case study of Stephanie based on research conducted in her classroom during a twenty-week teaching time-frame in 2012. The school promoted a flexible learning approach to education with a focus on Learning Technologies and Science.

An ethnographic approach enabled the researcher to act as a participant of inquiry in the research (Creswell, 2012b; Denzin & Lincoln, 2005; Fetterman, 2010) to explore ways of describing and interpreting what was happening in the classroom when technology was being used (Fetterman, 2010; Freebody, 2003). Specifically, the ethnographical conceptual framework of Fetterman (2010) guided the selection of the multiple data collection tools used for analysing and interpreting teacher practice (Creswell, 2012a; Freebody, 2003; Yin, 2009). The data tools included a teacher and student survey for each participant, twice weekly field work observations, audio recordings of classroom workshops, the collection of student writing samples, informal interviews, observations of a whole school staff meeting, observations of the school's Learning Design Writing Team (LDWT) meetings, teacher interviews, documentation collection and informal reflective feedback by the research participants.

Stephanie was encouraged to aim for 10 separate writing samples from each student, to be completed over the twenty-week period of the study using the Read&Write Gold™ software. Students were to use computers to write their narratives within a minimum of two, forty-five minute lessons each week. Stephanie identified her own weekly narrative topics. The study focused on identifying patterns of technology use during the writing process and collecting data on how Stephanie integrated technology into the design of student learning activities.

The data was validated through the creation of a categorised case study database. Cross analysis and pattern mapping processes facilitated the converging of data through the development of matrices, theoretical modelling and crystallization procedures. This provided a means to develop new insights and identify the emerging themes. A matrix aligned to the Hayes (2012) writing process model was designed

to map and record the content, pedagogical and technological themes that emerged through a cross analysis of data related to the case study of Stephanie. The findings were interpreted through the theoretical construct of the Hayes (2012) writing model, the TPACK Framework and SAMR Model. Stephanie explained how the use of technology in her writing classroom had made learning to write a more communal and shared process:

I think your immediate head set is when kids are working on their own with their own story, that, that's how it stays. That it is a personal relationship that they've got with it and I think that through group editing we've de-privatised that ... and opened it up" (Stephanie final interview, 2012).

During the study, Stephanie explained that she had redefined her teaching practices using a combination of exploratory, explicit and collaborative practices. She used exploratory practices to understand the text-to-speech preference settings and how to use the functionality of text-to-speech as a comprehension tool. Students were encouraged to play with the preference settings of speak by sentence, continuous reading, listening by three sentences, three words or a paragraph. Stephanie explicitly modelled how to use the functionality of text-to-speech as a comprehension tool, by backtracking over texts to listen for meaning. She also used collaborative practices to encourage her students to share how they were using text-to-speech while they were writing and also to reflect on texts during Writer's Workshop sessions with the whole class.

It became evident that Stephanie's practice was closely related to the leadership provided by her ICT Leader, and teachers at the school participating in the study. Together, they formed a Learning Design Writing Team (LDWT) with the aim of collectively understanding how they could explore, implement and sustain their teaching practices. The team reflected on what they needed to know and how they could transfer their collective knowledge to their individual classrooms.

Findings: Instructional strategies for writing using technology

This following section reports on how Stephanie used technology to support students' instructional writing strategies and how she thought about this in relation to her pedagogy. In particular, it highlights the role of technology in instructional strategies within the writing process. The strategies are expressed through the conceptual lens of a plan, write, revise approach to writing.

The Writers' Environment. The school's Learning Design Writing Team decided that they knew how to teach writing, however they needed time to understand how they could approach the teaching of narrative writing with technology. Stephanie wanted her students to develop a level of competency in using the functionality of text-to-speech technology before developing students' narrative writing skills and knowledge. She spent three weeks in establishing a technological writing environment. This encompassed developing students' organisational skills and understanding of using text-to-speech technology, the distribution of computers, creating folders to save and retrieve written texts, understanding how to organise text on a screen, creating student's personalised Read&Write™ tool bar settings and developing student's comprehension competencies and typing skills.

The Tool Bar. The text-to-speech toolbar (refer Figure 1), is a software system within the Read&Write Gold™ software that can read texts aloud (TextHelp Systems Ltd, 2012). Text-to-speech technology can be an enabling tool to support students when composing and revising their writing to facilitates their development as independent confident writers (Englert et al., 2005; Garrison, 2009; Silió & Barbeta, 2010).



Figure 1. The Text-to-Speech Tool Bar used by Stephanie to teach narrative writing (TextHelp Systems Ltd, 2012).

The icons from left to right represent: backwards; read on or go; pause; forward reading and stop. The last two icons relate to the setting of the software preferences.

Stephanie modelled how to set the tool bar to only use the functionality of text-to-speech with the Australian voices of Tim and Tina. This included voice settings of 75% pitch of voice and 40% speed of voice. When listening to texts being read aloud, some of Stephanie's students preferred to set the text-to-speech function at 'speak each sentence', while others preferred continuous reading. Novice students who wrote at a letter-by-letter or word by word level, preferred to use text-to-speech on a 'speak each sentence' setting. When Stephanie used text-to-speech as an instructional tool with the whole class, she set the play back speed at a slower instructional level than students used when composing. Student feedback highlighted how this enabled them to focus on the prompts Stephanie used to guide them to develop meaning in their stories.

Developing Comprehension Competencies. Stephanie found the sample comprehension texts on the Read&Write™ website useful to bridge the gap between writing with paper and writing on a screen (TextHelp Systems Ltd, 2012). Her students used the comprehension texts to practise how they wanted to personalise and use the text-to-speech technology for planning, writing and revising texts.

Developing Listening Skills. Developing student's listening skills was important for being able to reflect on the meaning of texts while writing and reading. Stephanie encouraged her students to listen for what she termed 'run on sentences', (Stephanie Writer's Workshop 2, 2012). These were the sentences where students continued to write without using full stops. She provided instructional prompts to support students to develop meaningful listening skills. These included the following questions:

1. Is this what your story should say?
2. Is this what you meant?
3. Do you want to change it?
4. Does that sound right?
5. Is this your story?
6. Is this what you want?

Touch Typing. Touch typing was an important teaching activity for establishing the writing environment. Stephanie used touch-typing freeware as a 10 minute 'finger warming' exercise at the start of every writing lesson (Dance Mat Typing, 2012). She explained that many of her students were able to type without looking at their fingers in a very short time.

Print Appearance. When Stephanie observed her students engaged in learning how to use text-to-speech with texts, she realised that line spacing was important for print appearance on a screen. Her students were listening and watching text-to-speech as an editing tool, rather than focussing on the meaning of what they wanted to write. To focus students' attention on the screen, Stephanie used the Interactive White Board (IWB) to model the narrative genre. She scaffolded students through an understanding for how to set paragraphs with white spaces to emphasise genre structure. Stephanie also explained where and how the tool bar could be placed on the screen and then set the text size to Arial 16. As students became

familiar in viewing the texts on both the IWB and on their laptop screens, they reduced the font size to Arial 14.

Working with technology provided opportunities for Stephanie and her students to focus on the relationship between the reader and writer while they were composing their texts. Stephanie designed instruction to enable her students to develop critical and evaluative thinking skills so they could understand how the different functions of text-to-speech could be used to achieve their writing goals. Stephanie focused on reflective thinking and explicit instruction with the plan, write, and revise process in student's personal writing time and within whole class discussions.

There were five different instructional approaches that Stephanie used to develop her students' thinking skills when they were composing texts in their personal writing time.

Personalise Text-to-speech. At an individual student level, Stephanie worked with her students to explore the advantages of the text-to-speech tool bar preference settings. This included settings of: speak by sentence, continuous reading and listening to sentences and paragraphs to comprehend written texts. When students were listening to their stories, Stephanie prompted them to focus on the print appearance on the screen, by looking for white spaces to facilitate ease of thinking.

Comprehension Strategy. Stephanie explicitly modelled how students could use text-to-speech to create meaning in their texts. She prompted students to use questioning and screen reading skills, by backtracking to check over what they had written to check for meaning. She developed a 'Read, Filter, Understand and Reapply' strategy to scaffold student thinking about developing meaning in their texts. This strategy facilitated students to plan, write and revise their texts using a cyclic approach to enhance how they could re-skim and re scan over their texts.

Language Development. When Stephanie focused on editing texts and the development of descriptive language, she used the text-to-speech technology to focus was at a word or chunks of words. She adjusted the text-to-speech settings to slow the speed and support students to reflect on the meaning of their texts.

Editing Process. Stephanie developed a 'Write, Edit and Print' process for students to edit their individual stories as they wrote. The process included two stages:

1. Listen to the whole story, check story structure and listen to individual sentences for spelling.
2. Check for capital letters and full stops, organisation of white spaces and look to see if you have or can make conjunctions.

Writer / Reader Relationship. To internalise student thinking for how a writer imagines a reader may respond to a text, Stephanie promoted the use of the text-to-speech technology for problem solving and revising texts. She used a cognitive apprenticeship approach to scaffold student thinking. She designed revision strategies for processing words, sentences, and blocks of texts. Her revision approaches reflected the knowledge-telling writing actions or developmental writing approaches used by novice or more experienced writers to plan, write and revise their narratives. This approach is characteristic of the flexible-focused and fixed-topic knowledge-telling strategies described by Hayes, (2012).

Flexible Topic Approach. When using a flexible approach to editing with text-to-speech technology, Stephanie encouraged her novice writers to revise for meaning using a linear approach from the beginning of the text through to the end. Changes to the text were made as required. A change could relate to the mechanics of writing (i.e. grammar, spelling and/or punctuation) and then the next change could relate to developing meaning. Stephanie encouraged students to listen, pause and then listen to a minimum of two or more sentences before effecting changes. To facilitate student thinking to focus on the meaning of texts, Stephanie explicitly modelled how students could personalise the functionality of text-to-speech technology at a word level. This ensured that the text-to-speech technology correctly enunciated names and sight words correctly. Stephanie used the 'say like' feature of the software to enter the correct spelling and phonetic playback of proper nouns or more commonly used sight words. She modelled how students could use a 'Look Like, Sound Like, Achieve Strategy', to listen, adjust and reflect on the appropriate

reading of names and individual words. When Stephanie focused on teaching sentence length, correcting texts, idea generation and adding detail to texts, she asked her students to, “listen for emphasis and sentence length”, or “listen to the sound of sentences” (Stephanie, Writer’s Workshop 1 and 2, 2012).

Fixed-Topic Approach. When using a fixed-topic approach to editing with text-to-speech technology, Stephanie encouraged her students to choose how and when they employed text-to-speech technology as a revision tool. Stephanie encouraged students to determine how they wanted to revise a text. They could begin by revising the whole text or sections of a text for meaning, knowing they would ignore any spelling or grammatical errors as they occurred. They could then backtrack to the beginning of the text or section and then revise for spelling and grammatical errors. Some students chose to use text-to-speech only when their first drafts of writing were complete, while others used the text-to-speech technology during the writing process with suppressed distractors.

Not all students were observed to use the text-to-speech tool effectively in their personal writing time due to the technology being a distractors of their attention away from composing. Some students also experienced problems with the use of the grammar and spelling checks in Microsoft Word™ and the Read&Write™ software. Specifically, the red and green lines that often appeared under their words while writing confused some students. When this problem was evident, Stephanie encouraged students to turn-off these software features until they were ready to focus on revising the mechanics of their writing rather than composing and developing meaning. Stephanie encouraged her students to use the text-to-speech technology at the paragraph or whole text level to support them to backtrack to the beginning of a paragraph and re-read the whole text using continuous reading.

Stephanie provided students with opportunities to self-regulate their learning, express their ideas and retain the authorship over their texts through the social construction of texts. This was evident through the collaborative strategies she used when texts were being read back during the explicit teaching of language skills on the IWB or during Writer’s Workshop sessions with the whole class. Students’ texts were used as instructional worked examples and were uploaded onto the IWB as texts to be critically appraised. Stephanie guided her students to split their attention between focussing on developing interesting texts and then to attend to the mechanics of their writing (i.e. checking for spelling, punctuation and grammatical errors). During these sessions, the text-to-speech function was reset to a slower instructional level.

Topic-Elaboration Approach. Stephanie used a more elaborate or structured approach to using the text-to-speech technology when revising texts with the whole class or groups of students. At this time, she focused students’ attention on the whole text, specific paragraphs or groups of sentences in order to improve the overall quality or compositional standard of a text. Specifically, during the Writer’s Workshops Stephanie encouraged students to revise the text from an author’s point of view. Thereby empowering the author to use the support from the whole class to revise their narrative. To facilitate this approach, Stephanie taught her students how to upload their texts onto the IWB for whole class review. She then encouraged the author to control the functionality of the text-to-speech technology to enable the whole class to listen to the whole text. The author then determined how the reflective process would be managed before backtracking to focus on a block of text or smaller groups of sentences.

Stephanie used ‘think aloud strategies’ to facilitate student thinking during the Writer’s Workshops to support the author to retain responsibility for the quality and final production of their story. Authors could choose to develop ideation and genre creativity or have the class edit for full stops, sentence length, incorrect word use, spelling errors, grammar and pronunciation, homophone use, typing errors, text organisation and white spaces. Stephanie’s ‘think aloud strategies’ focused on developing the story combined with three questions to encourage the author to consider ways to entertain a reader. Stephanie termed the questions the ‘Big Three’. She believed these questions helped to focus her students’ thinking on entertaining a reader and maintaining the identity of the author. Stephanie’s Big Three questions were: Who are you writing to? What are you writing as? How do you want to make the reader feel? Stephanie’s story development questions were: Who is the main character? Where and when did the story take place? What do the main characters do? How does the story end?

Discussion and Conclusion

This paper investigated how Stephanie designed instructional approaches using text-to-speech technology within personal and collaborative writing environments. The findings suggest that Stephanie's thinking about the design of instructional writing strategies and learning activities was critical to supporting her aim to make a difference to her students' learning (Hattie & Yates, 2014). Through the theoretical lens of the TPACK Framework (Mishra & Koehler, 2011) and the SAMR Model (Puentedura, 2012), the findings suggest that Stephanie was able to draw together her technological pedagogical content knowledge to modify and transform the design of her instructional writing strategies by using text-to-speech technology as a cognitive tool to support students to compose and revise narrative texts using the three knowledge-telling strategies described by Hayes (2012). Specifically, the text-to-speech technology supported these three knowledge-telling strategies by enabling students to easily listen and review their text as it was read aloud to them at an appropriate pace, and this supported students to focus on the relationship between the author and the reader and check the meaning and mechanics of their texts aligned with their personal writing goals.

Stephanie designed instructional writing strategies, which used technology to personalise and de-privatise their writing experiences. Stephanie developed students' technological skills using the text-to-speech technology before they were able to apply these to focus on the new cognitive scaffolds and prompts designed to support students to think about the writing and revision of their texts and seek support from other members of the class. Writing to communicate with technology challenged Stephanie to reflect and modify her practice and consider what it meant for her students to be literate in a global society. She came to understand that it was not the technology itself but her pedagogical practices as a teacher that determined if the use of text-to-speech technology could develop and improve students' writing skills.

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DEVELOPING EARLY LEARNERS' CREATIVITY AND COLLABORATION USING IPADS

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Abstract

Continuing developments in technology and consequent societal changes have been accompanied by calls for education to emphasise 21st century competencies such as critical thinking, communication, collaboration, and creativity. These competencies are reflected in the general capabilities of the Australian Curriculum and are to be developed across all learning areas. The study from which this paper is drawn investigated how teachers might use iPads to support development of creativity and collaboration in an early primary classroom. The study used primarily observational methods to describe the pedagogical practices of a teacher working in a shared teaching arrangement with 25 Year 2 students and access to 6 iPads. The focus was on discovering and describing effective approaches to enhancing creativity and collaboration in young learners. Results suggest that learning activities using iPads can be successful in separately developing creativity and collaboration among early learners but that learners were less likely to manifest both creativity and collaboration in the same activity. Implications of the findings are discussed.

Background

This paper responds to the interplay between two trends in contemporary education. First is the widespread understanding that, in addition to content knowledge, education must develop what are termed 21st century skills such as critical thinking, communication, collaboration, and creativity (Partnership for 21st Century Skills, 2011). There is an expectation that teachers will explicitly address these skills in their classrooms. Second is the surge in availability of powerful mobile computing devices (smartphones and tablets) and their rapid appropriation for use in classrooms.

While the so-called 21st century skills are not new to education, they have received increased attention in recent years. The *Australian Curriculum* (<http://www.australiancurriculum.edu.au>) promotes the development of 21st century skills by incorporating them as general capabilities (ACARA, 2013). These skills were highlighted in the *Melbourne Declaration on Educational Goals for Young Australians* (MCEETYA, 2008), which underpins the new curriculum.

Smartphones are handheld computers with a telephone function. Tablets are larger variants that lack telephony but have Internet access using WiFi or the phone network. Since Apple released the first iPhone in 2007, followed by the iPad in 2010, uptake of iOS devices and Android equivalents has been rapid. By 2012, 52% of mobile phones in Australia were smartphones and 58% of smartphone owners used them daily to access the Internet (Ipsos, 2012). Although tablets are designed for adult consumer use, characteristics, including their compact and durable construction, day-long battery life, and relative simplicity of use, have made them popular in schools. "Tablets, smartphones, and mobile apps have become too capable, too ubiquitous, and too useful to ignore" (Johnson et al., 2013, p. 16) and there are predictions that by 2015 all K-12 learners in the USA will have their own mobile devices (Norris & Soloway, 2011).

The host school for this study has been moving toward increased integration of information and

communication technology (ICT) for learning. It has deployed laptop computers and iPads in partial class sets and has been considering the implications of 1:1 computing. The availability of iPads in a Year 2 classroom afforded an opportunity to explore pedagogies that would support development of creativity with new hardware and software. Because the number of iPads was insufficient for 1:1 work it was necessary for students to work in groups thereby prompting exploration of collaboration.

Creativity

According to the *Australian Curriculum* (ACARA, 2013), creative thinking involves students in learning to generate and apply new ideas. It includes accepting different perspectives and possibilities and identifying new connections. The curriculum pairs creativity with critical thinking as distinct yet complementary dimensions of thinking (ACARA, 2013).

Some theorists, including Csikszentmihalyi (1996), set a high bar for creativity, arguing that an artefact is creative only when it is recognised by experts in a field as being original and valuable. This accords with the popular misconception that creativity is a rare gift and not an inherent human ability that can be developed. Gauntlett (2011, p. 218) offers a broader view, describing *everyday creativity* as “a process which brings together at least one active human mind, and the material or digital world, in the activity of making something which is novel in that context”. The creativity of highly talented individuals has been characterised as “Big-C” Creativity and everyday creativity as “little-c” creativity. That model has been extended to include “mini-c” creativity, which describes the innovative thought processes inherent in the learning process (Kaufman & Beghetto, 2009).

The *Australian Curriculum* (ACARA, 2013) is based on inquiry principles that require students to develop an inquisitive disposition and intellectual flexibility. Both are promoted and enhanced by the development of creative thinking (ACARA, 2013). Recognising “mini-c” creativity values the creative thought processes of students as they learn new subject matter (Kaufman & Beghetto, 2009). This is essential in fostering and encouraging creative thinking processes (ACARA, 2013). Kaufman & Beghetto (2009) suggest that fostering “mini-c” creativity, emphasising creative thought processes within learning, is more important for supporting creative thinking in young children than the more traditional emphasis on creative products, or “little-c” creativity.

In spite of observed difficulties in assessing creativity, Amabile (1996) maintained that it is assessable provided those assessing it are familiar with the domain. The consensual assessment tool (Amabile, 1996) uses a panel of experts or observers from a field who make judgments about the creative nature of works. The *Australian Curriculum* includes a learning continuum for critical and creative thinking capability that suggests that creative thinking can be both developed and measured (ACARA, 2013). Researchers have also developed frameworks and tools for describing and measuring 21st century competencies such as creativity. Jamieson-Proctor and Larkin (2012) developed and used tools for measuring creativity based on the three components of the creativity systems model: individual, domain and context, described by Csikszentmihalyi (1996). These tools include an observation protocol to assess creative dispositions, the Creativity Checklist developed by Proctor and Burnett (2004), and a consensual assessment process based on the work of Amabile (1996).

Collaboration

Collaborative skills including establishing and building positive relationships, making responsible decisions, working effectively in teams, handling challenging situations constructively, and developing leadership skills, have been included within the *Australian Curriculum* as personal and social capabilities that are applied across the curriculum in all learning areas (ACARA, 2013). These skills are considered important for successful classroom and playground interactions and can be taught using a combination of explicit teaching and opportunities for practice (McGrath & Francey, 1996). Co-operative skills that can be taught in order to promote collaboration include negotiating, dealing with fights and arguments, suggesting and persuading instead of bossing, making decisions in a group, respecting other people’s opinions, sharing, and including others (McGrath & Francey, 1996).

Students can practise and develop collaborative skills through structured collaborative learning experiences (Gokhale, 1995), which have been found to increase engagement and interest among students, as well as promote critical thinking skills. It is also thought that co-operative teams achieve higher levels of thought and retain information for longer than learners who work as individuals (Gokhale, 1995).

The *Australian Curriculum* includes a learning continuum describing the development of personal and social skills, including collaborative skills. It provides a useful basis for an assessment of working collaboratively that would be compatible with the curriculum intent.

iPads for learning

Although the iPad was launched as recently as 2010 it has been readily adopted in educational settings and informal sharing of teachers' experiences through social media is widespread. State education authorities in Victoria (<http://www.ipadsforeducation.vic.edu.au>) and elsewhere in Australia have engaged in trials and reported encouraging levels of success. The Victorian trial found that, when implemented in a supportive environment and by technologically competent, innovative teachers, iPads were effective in enhancing learning outcomes for students. The devices were particularly well used in primary school settings and optimal use was attained when students were able to use the device for content creation, rather than content consumption (Murray & Olcese, 2011).

Although the iPad provides the potential for transformative use of the device in educational settings, an overwhelming number of software applications being developed and marketed through the "education" category within the Apple iTunes Store do not take full advantage of the features which would allow for collaborative and creative use (Murray & Olcese, 2011). Hoover & Valencia (2011) classify iPad apps using three categories: interactive, reference and productivity. Their preliminary research into the use of iPads with tertiary students showed that productivity applications were most beneficial in enhancing learning and that, when students used the iPads collaboratively, learning outcomes were significantly improved, compared to students exclusively using the devices independently.

Lack of both technical knowledge and pedagogical knowledge has contributed to the limited success with iPads in some settings (Hoover & Valencia, 2011; Gasparini, 2011). There is a need for research to expand the pedagogical knowledge for the use of iPads (Gasparini, 2011).

Method

This paper reports selected results from a Master of Education project (Batham, 2014) designed to investigate and describe pedagogies using iPads that develop creative and collaborative skills in young children. The overarching question guiding the research was: *How can teachers use iPads to facilitate the development of creativity and collaboration in early learners?*

The study was conducted in a Year 2 classroom where the first author was one of two teachers in a job share arrangement, with access to 6 iPads for use by the 25 children. Data were collected by the first author, who was also responsible for planning and implementing a series of ten learning activities in which children in small groups used the iPads to create products in response to set tasks.

The primary source of data was a reflective journal maintained by the first author throughout the period of the study. It was guided by a set of questions intended to prompt reflection relevant to the focus of the study on creative and collaborative activity and provide rich qualitative descriptions of classroom practice. The creativity checklist (Proctor & Burnett, 2004) was modified to record observations of children's creative traits during each teaching episode and the creativity of products produced by the children was assessed using the consensual assessment technique (Amabile, 1996). Collaborative skills of the children were measured using a checklist developed by the first author based on the Creativity Checklist published by Proctor & Burnett (2004), the KSAVE model of the ATC21 Framework (Binkley et al., 2012), Friendly Kids, Friendly Classrooms (McGrath & Francey, 1996) and the Personal and Social Capability Learning Continuum developed by ACARA (2013).

Data were used to guide the development of case narratives for each of the ten learning activities with iPads that formed part of the study. The narratives were examined for patterns that might be used to inform recommendations about pedagogical approaches to using iPads to develop creative and collaborative skills in early learners.

Findings

Three vignettes are shared in this paper to illustrate the study's findings. The first teaching episode, "Mealworms", was successful in promoting creativity and moderately successful in supporting students in working collaboratively. The second teaching episode, "Earth's Resources", did not provide the same opportunities for creativity in spite of the students' successful collaboration. The third teaching episode, "Contractions", was unsuccessful in promoting either creativity or collaboration. Together these three examples illustrate the range of results from the study and provide material for further reflection and analysis.

Meet the Mealworms

Students "adopted" mealworms to care for and to observe as part of a science study of how living things grow and change. An introduction was followed by a closer observation using both handheld magnifying glasses and the iPad cameras. Students used the iPads to record and share their thoughts, observations and questions.

Students were organised into six groups of four. Each group was assigned an iPad, but was subsequently broken into two pairs. As this was an early experience for the students with using iPads for recording ideas, the activity was quite structured.

The teacher used the data projector to demonstrate the use of the iPad, showing students how to access the PicCollage app and import their photographs into the app. They were also shown how to crop a photograph to remove the background, how to add text to the image, and how to rotate and resize the objects. Students were told that there were other features in the app such as being able to add background colours and change the font type and colour but these were not demonstrated. Strategies for sharing the iPad among four students were discussed with the class and turn taking was identified as a useful strategy. It was made explicit that all students needed to be involved in the activity and different parts of the task were identified by the students so they had a clear understanding of the different opportunities to contribute to the group task.

The instructions given to the students were to create two PicCollage images, one by each pair, that contained a photograph of a mealworm and some text showing what they knew about mealworms from their observations. They could add other features to their image provided the first two criteria were met.

All of the groups worked together successfully with little extra guidance required. Most pairs who were not actively involved in the creation of an image at the time were still keen to provide advice and suggestions to the rest of their group. Students naturally explored the features of the app and once one group had discovered the ability to add "stickers" such as moustaches and sunglasses, this newfound skill was rapidly shared among the groups. The teacher recorded in her journal:

At one point, I noticed a group who appeared to be off task, taking photographs of inside of one boy's mouth. My initial instinct was to interrupt the group but closer observation revealed that they had discovered that they could layer the images and were creating the appearance of a mealworm being eaten. Their caption read: "Mealworms make a great meal". An interesting insight into their divergent thinking!

All groups managed to successfully fulfil the criteria of the task and the range of final products reflected their ability to be creative and add their own ideas to the completed product. More than one mealworm had grown curly moustaches and developed French accents and groups experimented with patterned

backgrounds and different fonts.

Earth's Resources

As part of the Earth and space sciences for Year 2, the students investigated the various ways that resources are used in the school environment. After some initial learning, the students went on a discovery walk around the school to identify how different resources from the Earth were used. Students worked in an assigned mixed ability group of four to take photos of resources they encountered on their walk. Each group was given a particular resource to look for and needed to take at least four photos, of which three would be selected for inclusion in their presentation. Captions were added using PicCollage and exported to the camera roll.

Once the images had been gathered, students were given very specific roles for creating a collaborative presentation about how the resources were used in the school. Student A was to insert the first image (a standard resource image provided to the students), then Student B (photo taken by students with caption), C (photo taken by students with caption), and D (photo taken by students with caption). A structure was provided for the audio recording: Student A was to introduce the resource and source, including other information the group had learned from previous activities. Student B described the second picture, Student C the third and Student D the fourth.

Most groups followed the instructions to produce a quality product fulfilling the task requirements (Amabile, 1996). A few groups also added their own touches such as synchronised greetings at the beginning or end to say who had worked in their group. Some groups had edited the images to enhance them using features of PicCollage. The students worked co-operatively with little disagreement as they all had very specific roles. A few students did need redirection or encouragement to remain patient when it was not their turn. Some members of the groups displayed leadership in co-ordinating their group to add greetings or other personal touches to their presentation.

Contraction Surgery

Following a learning experience called “contraction surgery” in which students donned rubber gloves and masks and “operated” on words to surgically remove letters, students were asked to use the photographs they had taken to explain their understanding of the process of joining words to form contractions. Students could use iMovie, Explain Everything or SonicPics to create a movie showing what they knew about forming contractions. For this activity, the students worked in pairs using the iPads. This necessitated half the class being involved in a different activity until they swapped activities. Using AirServer to project the iPad onto the interactive whiteboard, a brief demonstration of how to sequence the pictures and how to add an oral explanation was given in SonicPics.

The task had a high cognitive load as many students were still unsure of the process of combining words into contractions. A large number of photos had been taken during the previous activity and these were not sorted in any way for the students. The relative complexity of the task and content knowledge meant that many students were confused about the sequence of photos and they did not explain the process of making a contraction clearly. The students who were successful produced very pleasing results but many students did not complete the task.

Even though a number of apps had been suggested as options for this task, all of the students elected to use SonicPics, a familiar app that had been used in the demonstration. SonicPics does not allow the inclusion of extra creative touches such as sound effects, backing tracks or video. The focus of the teacher was split across monitoring two distinct activities during this session. Students needed a lot of guidance to work together on this task as they were often confused about the content. Their level of frustration with the content may have affected their ability to work together. The pairs were involved in a lot of discussion about the selection of photographs and the noise level impacted on the quality of other groups' recordings. The students not involved in the iPad activity were distracted and needed consistent redirection to remain on task.

The complexity of the task, the difficulty of the concept and the high level of teacher focus on classroom management issues, which distracted from supporting students in learning, are all likely to have been contributing factors to the failure of this experience in promoting creativity or collaboration.

Conclusions

The findings of the research, of which the three preceding vignettes are a sample, suggest that iPads can be used with young students to promote creativity and collaboration but the pedagogy the teacher employs can affect the level of success. This echoes the findings of Jamieson-Proctor & Larkin (2012) who found that the ways in which teachers allowed the device to be used had a significant effect on the level of creativity displayed by students.

In the ten teaching episodes in this study, it was found that the most successful activities were well facilitated by the teacher and the subject content of the lesson was readily understood. The most successful teaching episode, involving hand shadows, was closely facilitated by the teacher and was not cognitively difficult for the children. When the teacher was heavily involved with the supervision of other tasks, students tended to have more difficulties collaborating successfully. During the least successful teaching episode, the contractions lesson, the teacher was working with half of the class completing another task. This task was also cognitively challenging.

Analysis of the ten learning sequences revealed that the children exhibited fewer signs of creativity as the cognitive load increased and were more successful at collaboration when teacher guidance was stronger. The level of teacher direction and the rigidity of the structure were considered. As anticipated from the results of other studies (e.g. Jamieson-Proctor & Larkin, 2012), highly structured tasks were found to impede creativity but they were found to facilitate collaboration. It was hypothesised that creativity typically requires divergent thinking and collaboration requires a degree of convergence. Requiring both in the same learning activity challenges young learners and it will take time for them to learn how to balance or switch between divergent and convergent thinking at appropriate times.

During the ten teaching episodes examined in this study, students were given the opportunity to work in different sized groups using the iPads. Often the students worked in groups of four or with a partner, but sometimes they had their own iPad. The iPad to student ratio did not have a clear effect on the students' collaboration. When they worked individually with an iPad, they often spontaneously supported one another by sharing ideas and assisting each other with technical skills. The iPad to student ratio appeared to have some effect on creativity, with the highest creativity scores being seen when the students worked in groups of four. While this study serves to demonstrate that students are able to work creatively and collaboratively when using iPads, it cannot be stated conclusively that one iPad shared between four students is an optimum ratio for promoting creativity.

Overall this study has demonstrated the importance for teachers of considering pedagogical decisions related to level of cognitive complexity, task structure, level of student support, peer groupings and ratio of students to devices when planning to facilitate the 21st century skills of creativity and collaboration, especially with young learners.

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CAN THE USE OF WEB 2.0 TOOLS HELP DELIVER 21ST CENTURY LEARNING?

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Abstract

It has long been recognized that people need to be literate to function optimally within society. The 21st century has seen technology increase the complexity of environments, so that a literate person must now possess a wide range of abilities, competencies, and literacies. These have often been referred to as “21st-century skills” and while many of them are not new, the extent to which individual success depends on having such skills is new.

The current study seeks to explore ways in which technology can be used to increase literacy and enhance 21st century skills in students. 1193 students attending Sahmyook University in Seoul, South Korea were placed in small groups and asked to make a movie in English. This constructivist, real-world, group-based project required students to collaboratively negotiated their way through a variety of language, technical and social challenges using a wiki.

We can conclude from this study that collaborative projects, supported by web 2.0 tools, can deliver worthwhile learning. Students reported that the project; was interesting and rewarding, improved their relationships with classmates, encouraged teamwork, improved English skills, facilitated positive attitudes and the development of ICT skills. Students experienced improved technical, collaborative, leadership, critical thinking and problem solving skills that enhanced knowledge and contributed to their personal 21st century skill set.

Introduction

Society has been transformed by the ‘democratization’ and ‘consumerization’ of information and communication technologies (ICTs) and these are reshaping how we work and play (Grajec, 2014). To function optimally within this society, students need to be equipped with a contemporary set of skills and competencies. These so-called 21st century skills are not new, but they have become ‘newly important’ and they can no longer be considered ad-ons or optional (Silva, 2009, p.631).

Ubiquitous access to ICTs both on and off school campuses is also opening doors to a multitude of pedagogical opportunities for teachers and students. Teachers can create classroom environments that are authentic, engaging, technically opportunistic, meaningful, creative, and student-minded (Kaufman, 2013).

This study seeks to investigate the use of a combination of ICT applications in an authentic, collaborative project, and how this facilitates student learning through the use and development of 21st century skills in an English classroom. It is proposed that as students use technology as a learning tool, there will be high levels of engagement in learning, deep connections to the content, and students will develop social, technical, and communication skills (Mehdinezhad, 2011).

The present study seeks to use a task that is authentically based, constructivist in nature and collaboratively done, to engage students in learning. The students involved in this study were placed in small groups and asked to make a movie in English. This constructivist, real-world, group-based project required students to collaboratively negotiate their way through a variety of language, technical and social challenges using web 2.0 tools, including a wiki. This movie task enabled students to develop knowledge

and skills, including 21st century skills through:

- having to exercise creativity and innovation in producing a script;
- critical thinking and problem solving when it came to deciding on logistical and technical aspects;
- learning to learn through obstacles that required new skills to overcome;
- being able to communicate effectively within groups and with the teacher;
- developing social skills that enabled them to function well as part of a team;
- developing information literacy through sourcing details and knowledge on various aspects of what at times was a daunting task;
- developing ICT literacy to enable successful completion of a variety of technology dependent facets;
- becoming locally and globally aware through using web tools and resources;
- constructing personal knowledge that resulted in reflection of life and career goals;
- grasping a better understanding of personal and social responsibility through commitment to the group and its objective.

Of particular interest in this study is the use of a wiki to facilitate group work during the movie project. Stahl (2012) analyses collaborative projects on three levels (planes): individual learning, small-group cognition and community knowledge building (Figure 1.). He asserts that sequential small-group interactions bring in resources from the individual, the small group, and the community planes, involving students in procedures of shared meaning making. More often than not, the process becomes more important than the project outcome, and knowledge developed through this kind of collaborative process is retained longer and has more complex structures.

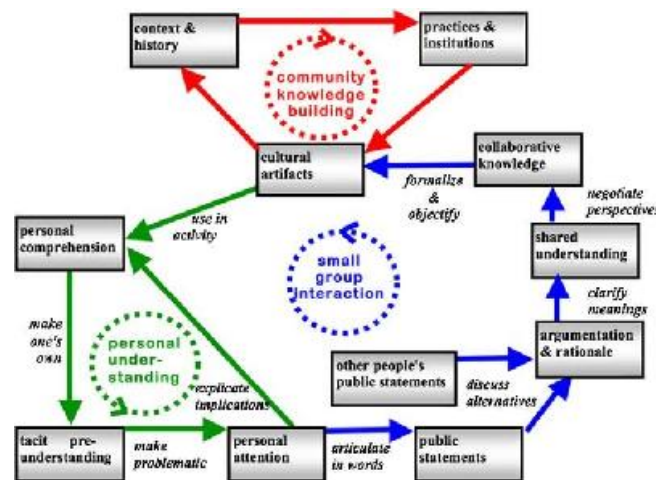


Figure 1. A model of collaborative knowledge building (Stahl, 2012, p. 470)

Within the present study, students are asked to develop individual skills, and also contribute skills to benefit the group. Within their group, students are able to question, explore and assess, use authentic data, and reflect on processes. The group scaffolds weaker members as they navigate their way through the processes. Group knowledge is then eventually shared with the community through the products the groups generate. The outcome is a rich learning environment where students learn from each other, students learn from the group, and groups learn from other groups.

The Study

The current study makes use of a mixed method approach to investigate how web 2.0 tools may be used to increase literacy and enhance 21st century skills in students. In particular, the study sought to engage

students in an authentic context as they created a movie within their English class. Online questionnaires, student reflections in blogs, and student-created artifacts in the form of storyboards, movie scripts, video files and wiki sites were used to collect data from 1193 students attending Sahmyook University in Seoul, South Korea who were placed in small groups for the task. In addition, 6 in-depth semi-structured student interviews were conducted with students from the different groups.

The students in the study were enrolled in a compulsory Practical English course, required of all first year students as English is a second language for these students. The core curriculum for this course is Smart Choice 2nd Edition Curriculum (Wilson, 2011). The course, involving 4 class sessions a week, has a digital slant through the use of a “digital” book used by teachers in fully equipped multimedia classrooms. In addition, students complete part of their course requirements through online exercises and regular blogging assignments.

The movie project encouraged students to be creative in their use of authentic language. This project required students to collaboratively negotiate their way through a variety of language, technical and social challenges and this process was facilitated through the use of a wiki. Participants were randomly grouped into groups of four or five. They were given an introduction to the project and evaluation criteria in the form of a rubric, together with links to tutorials on how to use the relevant technology. All students were provided with clear expectations for the project and access to the ICT tools to complete the task.

An emphasis was placed on the fact that movie scripts needed to be well thought out with relevant and authentic content that included an equal appearance for all students within the group. Movies needed to be between five and ten minutes in length and the entire process completed within six weeks.

Variables and Constructs in the study

A model was developed for use in the study that describes the dynamic learning system that operates in a classroom. This proposed model describes learning in terms of an interaction of background, process and outcome factors and formed the theoretical basis for this study in the tradition of the ‘3P’ model of Biggs and Moore (1993).

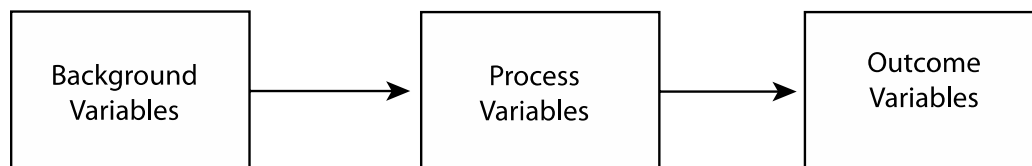


Figure 2. A General Overview of the Proposed Path Model for the Movie Project

The selection of factors to be included in the proposed model was informed by the literature and variables and scales were developed to assess the various factors. The variables and scales included in the study were:

Age – the age of the student.

Gender – the gender of the student.

English Level Background – a measure of student English ability at the start of the project.

Computer Games Experience – a measure of previous student experience playing games on computers.

Blogging Experience – a measure of previous student experience using blogs.

Wiki Experience – a measure of previous student experience using wikis.

Engagement in the Project Process – a measure of student engagement in the movie project and process.

Attitude to the Project – a measure of student attitudes to the movie project.

Movie Project Outcome – the grade that each student received for the movie project.

Attitude to Teamwork – a measure of student attitude to teamwork.

English Level Outcome - a measure of student English ability at the end of the project.

Data was gathered to test the model from student responses to an online questionnaire. Descriptive analysis, factor analysis and reliability testing were then used to investigate and develop the scales and variables used in the study. All scales had appropriate item loadings and reliabilities as measured by Cronbach's alpha of above 0.8. Analysis of variance (ANOVA) was applied to specific variables to determine their effect on the composite scale variables and multiple linear regression analysis was applied to the data to examine possible relationships.

Path analysis techniques were used in this study to test the proposed model and AMOS 7.0 was used to analyze the data. When regression analysis is carried out on large samples, the chi-square measure should be complemented with other goodness-of-fit measures (Ho, 2006). To test the overall model fit, the following indexes were applied: The chi-squared test, the comparative fit index (CFI), the normed fit index (NFI), and the root mean square error approximation (RMSEA).

Triangulation of the data occurred through the use of the qualitative techniques and this enabled a deeper and richer view of the use of web 2.0 tools to emerge. Data was gathered from a number of sources including: student reflections in blogs, student interviews, and student-created artifacts in the form of storyboards, movie scripts, video files and wiki sites.

Results

All of the groups completed the movie project on time. An English test designed as part of the Smart Choice English Curriculum (Wilson, 2011) was administered to all students at the beginning of the course to determine their English level upon entering the course, and the test was administered again at the end of the course to determine their exit score. Students averaged a score of just slightly above the midpoint on the entrance English test ($\mu=30.1$, $\sigma=11.2$, possible range 0 - 60). By the end of the course their average English ability had increased significantly ($p<0.01$) to an average score of 38.6 ($\sigma=8.5$, possible range 0 - 60), with the effect size (Cohen's d) of the course being 0.85.

Results from the path analysis indicated that the unconstrained model fitted the data well. Although the chi-squared values were significant ($X^2[44, N=1095] = 595$, $p<0.01$) for English Level Outcome, and ($X^2[28, N=1176] = 1756$, $p<0.01$) for Attitude to Teamwork, the incremental fit indices (Normed Fit Index, Incremental Fit Index, Comparative Fit Index), are all above the 0.90 range (range 0.94 – 0.95), and the root mean square error approximation (RMSEA) of 0.70 indicates a good fit of the model (Ho, 2006).

The path model (Figure 2) explained 38% (R^2) of the variance in the students' final English score and 52% (R^2) of the variance in the students' Attitude to Teamwork. Significant relationships are shown within this path model and the size of the standardized regression coefficients give an indication of the strength and nature of these relationships.

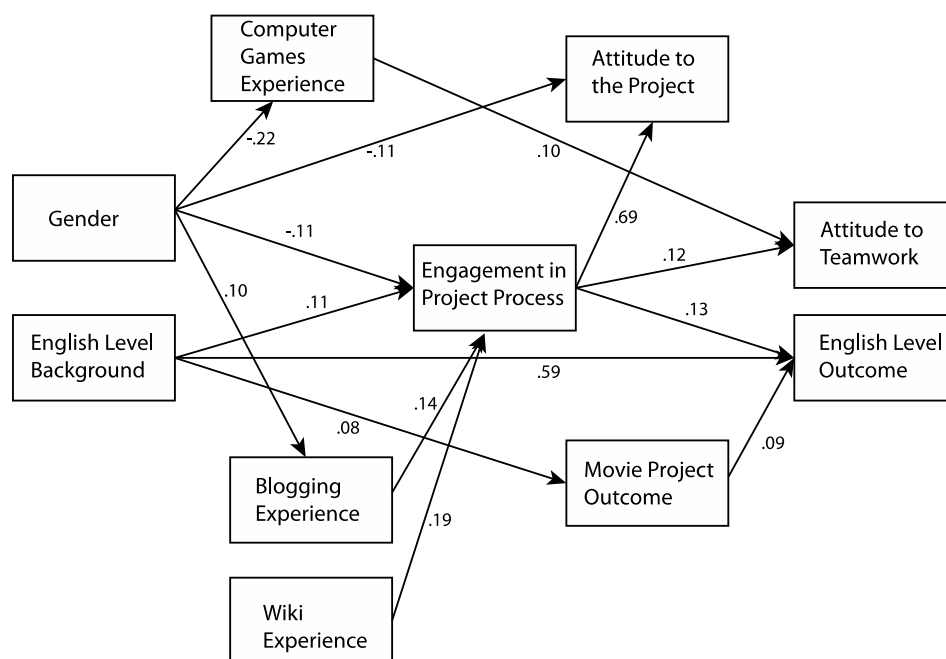


Figure 3. A Path Model for the Movie Project showing significant Paths ($p < 0.05$)

A Closer Look at the Model

Student Background

The students involved in the project came from a low level of use of the web 2.0 tools that the project required. Only 13 per cent of the students had used a Wiki before. Some of the students mentioned that they didn't even know what a Wiki was, and on further questioning, determined that they had not yet used Wikipedia. 21% of the students had made a movie before, but the majority of students indicated a total lack of experience in this area. These two factors combined contributed largely to an initial negative reaction to the project, simply due to the fact that students, could not initially perceive what the project would entail and how the various digital tools would be used to assist them in completing their work.

A majority of students reported using various forms of social media. Facebook was the most common with 87% of students indicating that they had created a Facebook profile, and 54% indicating that they had created a profile on CyWorld. 73% of students indicated that they had used a blog and 62% indicated that they played online computer games. Overall, students' use of social media was not huge as they indicated that they averaged approximately 2 hours a week using social media.

There were gender differences in the students' use of social media. Girls had significantly ($p < 0.01$) more experience on Facebook, Cyworld and the use of Blogs while boys had significantly ($p < 0.01$) more experience in computer gaming than girls.

Engaging with the Project Process

There was a well-defined process for making the movie that was given to students. Student engagement in this process was important as it had the potential to positively influence their attitudes to the project, their attitudes to teamwork and their final English level. The movie project process involved students working in groups and writing a script for a movie in Korean with the help of a wiki, translating it into English, and then acting out and filming the performance. Much of the translation from the Korean script into English was done in a group with various students taking the lead in their groups and the others observing and contributing. Students discussed slang and idioms to be used in the script and from time

to time had to stop and look up words in a dictionary. Once completed, their teacher who identified grammar, spelling and punctuation errors, and discussed the use of some of the English checked this version of the script. Before filming, the group would go over their lines and would model to each other how to pronounce some of the words more naturally. During filming all students got to handle the camera, with advice and ideas coming from the 'tech' leader of the group. The students then shared the editing of the movie.

Overall, students engaged in the project reasonably well with an average level of engagement of 2.73 ($\sigma=0.55$, scale 1-4). It is interesting to see what factors influenced the students' level of engagement in the project. Path analysis (Figure 2) found that initial student levels of English ability positively influenced levels of engagement ($\beta=0.11$), as did their previous experience in using a wiki ($\beta=0.19$), and using a blog ($\beta=0.14$). Interestingly, while there were found to be positive influences between Gender and Blog use ($\beta=0.11$), with girls reporting significantly higher levels of use of blogs than boys ($p<0.01$), and Blog use positively influencing engagement in the project, there was a direct negative influence from Gender to Project engagement ($\beta= -0.11$) indicating that girls were not as engaged in the movie project as boys. This may have been due to the more aggressive style of engagement with ICT projects that boys often apply (Volman, Van Eck, Heemskerk, & Kuiper, 2005).

Student engagement in the project was found to positively influence the students' final English levels ($\beta=0.13$) and their attitudes to the movie project ($\beta=0.69$), and their attitudes to collaborative learning and teamwork ($\beta=0.12$) (Figure 2). The final movies were generally of a good standard with student groups achieving an average grade of 48.99 ($\sigma=6.52$, possible range 0 - 60). Interestingly, there was no significant relationship between levels of student engagement in the movie project and the final grade they received for the project. This may have been due to the fact that the student grade for the movie project was a group score rather than an individual score.

Student Attitudes to Project

Attitudes play a very important role in education. The relationship between attitudes, engagement, and achievement is often a recursive one and has been well documented (Tarantino, McDonough, & Hua, 2013). In the current study attitudes have been considered an important outcome of student involvement in the movie project.

The initial reaction when the project was announced was a negative one, based on the fact that, in general, most students had little to no experience using a Wiki and very few had any movie editing experience. As students started working on the project and started developing their digital skills, attitudes changed, and by the end of the project students displayed a positive attitude, attesting to the fact that they felt a strong sense of accomplishment and pride and reported an average Attitude to the Project of 3.68 ($\sigma=0.78$, possible range 1 - 5). Comments from students included:

I can feel very proud of my movie.

It was good. I feel great, we made a masterpiece.

Students reported positive attitudes towards collaborative learning and teamwork and reported an average Attitude to the Teamwork of 4.08 ($\sigma=0.86$, possible range 1 - 5). Students acknowledged the importance of being able to function well in a team, and as a team. They also acknowledged developing better relationships with their teammates, to the point of bridging the gender divide that often exists between members of the opposite sex within Korean culture. They recognized that functioning optimally in a team was a skill they needed for their studies and for their workplace in the future. The benefits of developing better relationships within a team, spilled over into the classroom as a whole, with students reporting a:

better team spirit amongst all my classmates since doing the project.

The gender of the student influenced attitudes to the movie project ($\beta = -0.11$) with boys having a more positive attitude than girls. This negative influence continued between student attitudes to the movie project and their final English level ($\beta = -0.12$) indicating that boys had more positive attitudes to the

project than girls, however, girls scored significantly better on the final English score than boys ($p < 0.05$).

Discussion

The argument for the use of ICT in schools is twofold. Firstly, schools should prepare students for a productive life in society. Secondly, the use of technology in schools can deliver new ways of teaching and learning, improving student outcomes (Grajek, 2014). There is a substantive research base to support that successful approaches to learning incorporate challenging tasks: e.g. reasoning tasks, not just reproduction tasks, active learning with clear purpose and strong teacher direction, and feedback to the learner, and to the teacher (Hattie, 2012).

The present study sought to immerse students in an authentic, engaging, technically opportunistic, meaningful, creative, and student-minded project that was designed to increase their English knowledge and skills. Initially students were a little wary and apprehensive about the project. This apprehension came from two main areas; the first being a reluctance to participate in group work and the second was a lack of confidence due to being unfamiliar with the technical aspects the project required.

I don't like to work in a group, because as I mentioned some people will not work at all. And secondly, I'm not good at computer, so I have some much stress on how can I edit the movie, or how can I film it, or where should I shoot it and all this kind of stuff.

Some of the students were positive and were particularly looking forward to the authentic nature of the learning task.

Awesome. I really wanted it, because English is too formal, so looked forward to making the movie.

The students' attitude to learning projects is very important. Attitudes have been shown to influence achievement (Michelli, 2013; Tarantino, McDonough, & Hua, 2013; Wasike, 2013) and it is important for students to be positive about learning tasks in which they are asked to participate.

In the present study, despite some initial anxiety, students' attitudes were generally positive by the end of the project. Students' comments at the interviews reflected this:

I really enjoyed it. I watched the movie like ten times.

Really great. Proud. Because we made it. We didn't expect that we made the final version because we don't know about and didn't have any experience before, but we made it. So, we were proud about it.

These positive attitudes were found to in turn have influenced their attitudes to teamwork and their final English levels. In response to the question "What didn't you like about the movie project?" students mentioned insufficient time and lacking in computer skills, specifically with Microsoft Moviemaker.

The authentic nature of the task motivated students to work, and be involved. During the process, the group was aware that they would have to present their movie to the class, and possibly to the whole department. With their language and technical skills being used in a public way, extra care was taken to produce high quality work, even to the point of re-filming some scenes. They reported:

In the group we all knew that we are going to present in front of the class, right? If it wasn't for an audience, we probably would just, you know, shoot it and put subtitles in and submit it for our grade. So, we put a little bit of creativity and art stuff because of the audience.

The project was successful in exposing students to 21st century skills. Students developed and used learning and innovation skills, digital literacy skills, and career and life skills as described by Trilling and Fadel (2009). Triangulating the quantitative data, the interview data and the blog responses revealed that students benefitted from the project through improved relationships both within the group and the class; they had a growing recognition of the importance of teamwork; they improved their English skills; they enjoyed the experience; they learned about the importance of participation; as well as developing their technical skills.

Of particular note is the way students developed their collaboration skills. Group dynamics and challenges had to be met and dealt with, by assuming leadership roles where their skills surpassed those of the rest of the group, demonstrating concepts of leadership and project management. Challenges with group management, technology, filming locations and meeting deadlines required activation of their critical thinking and problem solving skills. At one point a student commented:

If a team member is not willing to do it, it's really awkward for me to have to keep telling team members "Oh, you have to work on this, and you have to work on that; Why do I have to tell you every single step?"

Effective collaboration was demonstrated by the fact that, not only were they extremely proud of the movie, but they achieved a really good score and they remain good friends to this day as several of the students reported an ongoing social interaction with group members after the project was completed.

Within the group students helped, and were helped, by members of the team with new vocabulary, pronunciation, new idioms and colloquialisms. Members of the group did not initially appreciate the value of teamwork, but by the end of the project students had gained an added appreciation of the teamwork aspect and the level at which they could function at through the assistance of a team. In fact, this was one of the main outcomes of the project.

In the interviews, students affirmed the role of teamwork and the part that they played in their team:

So, and especially in Korea, you have to work in a group. You have to be in a group, like to survive, you know. It's so close to each other and you have to do things together, all the time. And, if you do something individually, they'll be like "Oh, what's wrong with her? She's like a loner, or outsider."

I learned the editing skills from Sophie. I didn't know how to use moviemaker at all, so now if someone asked me to make a movie, it will be really awful, but I know how to make it. I can give them a product that I made.

The project did ask both teachers and students to consider new ways of teaching and learning. The authentic, real world nature of the learning task was both challenging and a little daunting to students. Teachers needed to conceptualize their role as they became facilitators of a process rather than content transmitters. The English course did help students to improve their English skills and the movie project made a significant contribution to that outcome.

Conclusion

The movie project described in this paper was successful in increasing students' English knowledge and led to students having a positive attitude to teamwork while facilitating the development of 21st Century skills. Schools need to continue to develop ways to maximize the effective use of ICT in the classroom to engage students in learning. The widespread use of ICTs has moved from institutions to the home (Noss, 2012). With ubiquitous access to technology, students have the tools to build knowledge and skills to set themselves up for a bright and productive future. The results of this project have contributed to the argument that teachers can use ICTs to establish learning environments that benefit students collectively and individually.

The project provided a rich environment with students learning from each other, students learning from the group, and groups learning from other groups. Students should be given opportunities to explore and develop who they are as individuals (Kaufman, 2013). In today's global learning community, ICTs have helped learning to become personal.

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OBSERVING AND ASSESSING CHILDREN'S DIGITAL PLAY IN EARLY CHILDHOOD SETTINGS

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Abstract

In early childhood education children increasingly have access to digital technologies to play on and with. Research often centers on using traditional play theories to understand what is occurring, but some theorists are now using a social-cultural lens to explore digital play in a way that is meaningful for the children and educators involved. In this paper we present a new conceptual framework to understand how children learn to use technologies through play. The framework is called the Digital Play Framework and is informed by the socio-cultural concept of tool mediation (1997) and Hutt's (1966) ideas about explorative and ludic play. The framework is pedagogically useful because it explains the relationship between technology-as-tool and children's play-based behaviours. It is important to understand this relationship in early childhood because play is the basis for curriculum provision. With play as the basis for curriculum provision, educators need a way to assess and plan for children's digital activities. In this paper we illustrate the potential of the Digital Play Framework for achieving this goal.

Introduction

Play has long been argued as the way children learn in early childhood education (Wood, 2013). Using the Early Years Learning Framework (Department of Employment, Education and Workplace Relations (DEEWR), 2009), educators are required to observe and assess children's learning through play. The increased use of digital technologies within early childhood educational settings means that in addition to observing and assessing children's more traditional learning through play, they now also need to observe and assess children's learning to use technologies through play (DEEWR, 2009). Understanding how children learn to use technologies through play is the first step towards educators being able to competently observe and assess young children's digital play. In this paper, we present a new framework called the 'Digital Play Framework' as a new pedagogical tool for helping educators observe and assess how young children learn to use technologies through play (Bird & Edwards, in press). Drawing on data derived from a project involving young children using technologies in a play-based early learning setting (Bird, 2012), we present a case study application of how the 'Digital Play Framework' can be used by educators to support the observation and assessment of young children's learning to use technologies through play.

Assessment in early childhood

While play-based learning has long been argued as the central pedagogical approach in early childhood education, how children learn to use digital technologies through such learning is still being researched. In an era in which accountability for the achievement of children's educational outcomes are 'high' (White, 2007, p. 8), early childhood educators require assessment tools that help them to meet regulatory pressures and recognise the sociocultural context of children's learning and development in terms of the increased role of digital technologies in very young children's lives.

Historically, assessment in early childhood education focused on young children's developmental outcomes (Carr, 2001). A developmental approach to assessment described children's development as a universal process, with each child moving through the developmental process at a given age. Areas of

development that were ‘achieved’ or still ‘developing’ could be readily identified by determining whether or not a child was meeting particular developmental outcomes. Recently, early childhood education has taken on a more sociocultural lens for understanding children's learning and development. This perspective recognises the role of context and culture in young children's learning and development (Robbins, 2005). Approaches to observation and assessment in early childhood education have moved away from using developmental checklists towards a more sociocultural approach because such lists are now recognised as providing educators “with relatively little information to guide service delivery, instructional planning, or progress monitoring” (Snyder, Wixson, Talapatra & Roach, 2008, p. 26). Instead, contemporary approaches to assessment are based on observations of children's play and their interactions with the peers and educators in the context of the early learning setting (McLachlan, Edwards, Margrain & McLean, 2013).

Rather than being largely summative in approach (Swaffield, 2011), assessment in early childhood education is generally formative in nature and represents an ongoing process (Karlsdóttir & Garðarsdóttir, 2010). In Australia, “educators use a variety of strategies to collect, document, organise, synthesise and interpret the information that they gather to assess children's learning” (DEEWR, 2009, p. 17). The use of observations in early childhood education is a valuable strategy for collecting information orientated towards assessing children's learning through play (Rogers & Evans, 2007). The reasons educators complete observational assessments of children's learning through play include: to identify individual strengths and weaknesses; understand children to guide their behaviour; inform work with parents and other professionals; extend shared interests within a group; note individual interests that can extend group learning; reflect on the flow of the day; and evaluate their own teaching (Hatch & Grieshaber, 2002). Educators observe children's play and interpret what they see based on their understandings of children's learning and development in social and cultural contexts (McLachlan et al., 2013). This approach to observational assessment is now well established in early childhood education with respect to children's more traditional play-based learning, such as pretend play, gross motor play and block play. However, a recent problem for educators is how to use observational assessment to understand children's learning to use technologies through play.

We created the ‘Digital Play Framework’ to help educators observe and assess children's learning to use technologies through play. The ‘Digital Play Framework’ understands technologies as cultural ‘tools’ Vygotsky (1997) that children master through two forms of activity, including epistemic and ludic activity (C. Hutt, 1966). Together, epistemic and ludic activity comprises children's play. Behaviours associated with each form of activity are identified in the ‘Digital Play Framework’ as potential indicators for children learning to use technologies through play. The ‘Digital Play Framework’ builds on existing research in the use of early childhood digital technologies that has largely established that young children are regularly users of a range of technologies in their family homes (Plowman, McPake & Stephen, 2012); that children integrate traditional and digital forms of play (Edwards, 2013; Goldstein, 2011; Marsh, 2010); and that further knowledge is needed in the early childhood sector regarding appropriate pedagogical uses of technologies with young children (Aubrey & Dahl, 2014; Marsh et al., 2005).

Theory

The ‘Digital Play Framework’ is based on combination of Vygotsky's (1997) concept of mediated tool use and Hutt's (1966) ideas about epistemic and ludic activity comprising play. Vygotsky's (1997) argued that people use tools derived from their social and cultural contexts to mediate the activities they engage in. The concept of mediated tool use is often illustrated by a triangle with subject (child), object (epistemic or ludic activity) and tool (technology) located at each point of the triangle. As the child masters the tool (technology) the object of activity changes. Hutt (1966) investigated children using play to explore a novel object and categorised their behaviours as either ‘epistemic’ or ‘ludic’. In the ‘epistemic’ play behaviours children explored “what does this object do?” (C. Hutt, 1966, p. 76, italics in the original). The play behaviours changed to ‘ludic’ play as the children began to explore “what can I do with this object?” (C. Hutt, 1966, p. 76, italics in the original). The play range of behaviours identified by S. Hutt, Tyler, Hutt and Christopherson (1989) helped to define the children's activity as either epistemic or ludic. Ludic

activity emerges once children have explored the novel object and mastered epistemic activity. By combining the concept of tool mediated with the epistemic and ludic activity we were able to create a 'Digital Play Framework' (Bird & Edwards, in press) that describes the range of play behaviours associated with each type of activity as children learn to use different technologies as tools (Figure 1).

Digital technologies-as-tool	Object of activity	Behaviours	Indicators	Description
	Epistemic play	Exploration	Seemingly random use of the device	Seemingly random footage, images, pressing the iPad, moving or clicking the mouse.
			Locating the operating functions of the device	Locating the on/off button (video camera), shutter button (still camera), home button (iPad), keyboard (computer) or mouse (computer)
			Exploring the operating functions of the device	Exploring the on/off button (video camera), shutter button (still camera), home button (iPad), keyboard (computer) or mouse (computer)
			Following directions of the device or other people	Following the directions of the device or other people
			Seeking assistance for desired outcome	Asking adults or peers for assistance to use the device
		Problem solving	Relating actions to the response/function	Pressing the on/off button, relating turning the camera to what is in the viewfinder (video camera), pressing the shutter button, relating turning the camera to what is in the viewfinder, pressing the Home button to change Apps, scrolling through Apps (iPad), relating mouse and keyboard to actions on the screen (computer).
			Trying different actions to solve an issue	
			Intentional use of the operating functions	
		Skill acquisition	Intentional and deliberate use of functions for desired outcome	Being able to view taken footage (video camera) or images (still camera), scrolling and tilting (iPad), using mouse to move cursor, click and double click program icons (computer)
			Sharing learned actions with others	Being able to share knowledge of functions of the device with others for the purpose of teaching others (ZPD)
			Intentional and controlled footage of observable people, events and situations or manipulating the App or program for own purpose	
	Ludic play	Symbolic	Deliberate use of device for pretend play	Using the device to record already established pretend play or to record re-enacted play (video and still cameras), selecting an App specifically for pretend play (iPad), selecting a program specifically for pretend play (computer)
			Innovation	Creating a pretend play to record (video or still cameras), selecting an App specifically for pretend play (iPad), selecting a program specifically for pretend play (computer)

Figure 1: The 'Digital Play Framework' (Bird & Edwards, in press).

Methodology

In this paper we use the ‘Digital Play Framework’ as an observational assessment tool. The data presented in this paper is a single case study of Rithik taken from a research project that explored children’s activities on digital devices within a kindergarten classroom. The devices included: digital still and video cameras; iPads and a computer (Bird, 2012). Both parent and child consent was sought from a class of 27 children, with 20 consenting children being part of the research (Dockett & Perry, 2007). The kindergarten served a low-to-middle class suburb of Melbourne, Australia, with families from a range of cultures including from African, Asian and Western-European descent. The educators included a qualified educator and two assistants. The digital technologies were available to the children during the three classes each week, with each class running for approximately five hours. The project ran for five weeks, with data being collected by both the children, through photographs and video recordings (see for example Bird, 2012) and by the educators through photographs, video recordings and written observations (Marshall & Rossman, 2011). The digital technologies were introduced to the children during a group time by the educator (who was also the researcher) with the names of the devices, and safety rules like using the wrist strap were explained.

Data relating to a particular child – Rithik (male, aged 5 years), was identified to form a single case (Stake, 2006). When engaging in a case study, research questions that ask “how” and “why” are employed because they “deal with operational links needing to be traced over time” rather than specific incidents (Yin, 2009, p. 9). The data examined for this paper explores how Rithik was learning to use the digital technologies (digital still and video cameras; iPads and a computer) through play over a five week period. The aim of this paper is to illustrate how the ‘Digital Play Framework’ can be used as observational assessment tool for understanding children’s learning to use digital technologies through play. Accordingly, the data was analysed using a deductive approach in which data are assigned to pre-existing categories (LeCompte, 2012).

Findings

Thirty-seven observational sets of data involving Rithik using the digital technologies were abstracted from the larger data set (Marshall & Rossman, 2011). These observations were categorised according to the play behaviours listed in the ‘Digital Play Framework’ (Figure 2).

Object of activity	Behaviours	All devices	Descriptions of activities	Observations of Rithik
Epistemic play	Exploration	Seemingly random use of the device	Seemingly random footage, images, pressing the iPad, moving or clicking the mouse.	17/10/11 - Rithik filming the ground and someone's legs 17/10/11 - Rithik filming randomly outside 17/10/11 - Rithik filming randomly outside, Joyen and Shaheen run past 17/10/11 - Rithik filming randomly outside, Shamone and Shaheen run past 17/10/11 - Rithik filming tanbark and shadows 17/10/11 - Rithik films a group of children running past 17/10/11 - Rithik filming Shaheen turning around 17/10/11 - Rithik filming random children 17/10/11 - Rithik learns to zoom in and out on the Flip camera and practices
		Locating the operating functions of the device	Locating the on/off button (video camera), shutter button (still camera), home button (iPad), keyboard (computer) or mouse (computer)	
		Exploring the operating functions of the device	Exploring the on/off button (video camera), shutter button (still camera), home button (iPad), keyboard (computer) or mouse (computer)	8/11/11 - Rithik filming and asking an adult questions 8/11/11 - Rithik films Mr Potatohead and zooms in and out
		Following directions of the device or other people	Following the directions of the device or other people	
		Seeking assistance for desired outcome	Asking adults or peers for assistance to use the device	17/10/11 - Rithik asking why the numbers on the Flip camera are changing 8/11/11 - Adult explaining to Rithik how to stop and start the Flip camera 8/11/11 - Rithik asking an adult how to watch his movie 8/11/11 - Rithik asking an adult how to know if the Flip camera is working

Problem solving	Relating actions to the response/function	Pressing the on/off button, relating turning the camera to what is in the viewfinder (video camera), pressing the shutter button, relating turning the camera to what is in the viewfinder, pressing the Home button to change Apps, scrolling through Apps (iPad), relating mouse and keyboard to actions on the screen (computer).	17/10/11 - Rithik asks his educator to show him the letters he needs for his name on the keyboard 20/10/11 - Rithik playing on the iPad pressing the Home button to change Apps
	Trying different actions to solve an issue Intentional use of the operating functions Intentional and deliberate use of functions for desired outcome	Being able to view taken footage (video camera) or images (still camera), scrolling and tilting (iPad), using mouse to move cursor, click and double click program icons (computer)	20/10/11 - Rithik playing Talking Gina on the iPad and he tries different actions to complete the activity 17/10/11 - Rithik zooms in and out at children playing 17/10/11 - Rithik films children eating their snack 17/10/11 - Rithik filming himself telling a story 17/10/11 - Rithik filming an adult filming him 20/10/11 - Rithik playing Ant Smasher on the iPad 20/10/11 - Rithik is playing RF Alphabet on the iPad and manipulates the puzzle pieces 25/10/11 - Rithik playing FaceGoo on the iPad and distorting the image 8/11/11 - Rithik filming Mr Potatohead 8/11/11 - Rithik showing Shaheen the Mr Potatohead movie he made 14/11/11 - Rithik explains to other children how he is making a video 25/10/11 - Rithik playing Reader Rabbit on the computer and deliberately doing the wrong action for the computer's response, laughing each time
Skill acquisition	Sharing learned actions with others	Being able to share knowledge of functions of the device with others for the purpose of teaching others (ZPD)	
	Intentional and controlled footage of observable people, events and situations or manipulating the		

Ludic play	App or program for own purpose		
	Symbolic	Deliberate use of device for pretend play	Using the device to record already established pretend play or to record re-enacted play (video and still cameras), selecting an App specifically for pretend play (iPad), selecting a program specifically for pretend play (computer)
	Innovation	Creating pretend play deliberately for use of the device	Creating a pretend play to record (video or still cameras), selecting an App specifically for pretend play (iPad), selecting a program specifically for pretend play (computer)
			8/11/11 - Rithik filming the children packing up the blocks on the mat 14/11/11 - Rithik films two adults packing up the shed 15/11/11 - Rithik filming an adult reading a book 15/11/11 - Rithik filming himself singing a song 8/11/11 - Rithik films Lara's spaceman movie 8/11/11 - Rithik films as he asks Tiffany questions about her favourite things at kindergarten 8/11/11 - Rithik creates a spaceman story so an adult can film it

Figure 2: The 'Digital Play Framework' used as an observational assessment tool for understanding Rithik learning to use digital technologies through play.

Discussion

Using the 'Digital Play Framework' as an observational assessment tool for Rithik suggests that children's learning to use technologies through play can be observed in the context of the early childhood setting. For example, observations of Rithik are located in the epistemic and ludic aspects of play using different technologies as cultural tools. Rithik's learning is illustrated in terms of how he explored the various functions of the devices through play (e.g. locating the viewfinder of the still camera; learning to zoom in and out on the video camera; using the Home button on the iPad™ for the selection of a new App). Importantly, the extent to which social interactions featured in this learning are identified (e.g. Rithik asking an adult how to watch a movie he has recorded; asking how to use camera; asking how to use the keyboard). The points at which he seemed to master the epistemic play and move into ludic play are also evident (for example: 14/11/11- Rithik films two adults packing up the shed; 15/11/11-Rithik filming an adult reading a book; and 15/11/11- Rithik filming himself singing a song).

Existing approaches to observing and assessing children's learning through play in early childhood education highlight the need to determine contextual aspects of activity (McLachlan, Fler & Edwards, 2010). The 'Digital Play Framework' aligns with these existing approaches by providing space for contextual description. Educators can use observations in relation to the indicators of children's learning to use technologies through play as identified in the 'Digital Play Framework'. This suggests potential for using the 'Digital Play Framework' as assessment tool in early childhood education as it helps educators identify the most appropriate pedagogical response to a child learning to use technologies through play. This addresses a pressing need in early childhood education, as there are very limited options available to early childhood educators wanting to observe and assess children's learning to use technologies through play (Aubrey & Dahl, 2014; Flannery & Bers, 2013). In this case example, the 'Digital Play Framework' provides a basis for an educator to better understand Rithik's learning to use technologies through play - and therefore identify opportunities for planned future learning. For example, if Rithik is observed spending his time in exploration and problem solving it would be counterproductive for an educator to plan experiences for him focussed on the generation of digital content. Instead, more time and opportunity for continued exploration of the functions may be needed. Here, an educator might engage in intentional teaching on how to use a given technology, or even pair the child with a more capable peer in using the technology so that there is continued opportunity for social learning. At the same time, wanting to stretch the child towards a greater understanding of the potential usage of the technology, an educator might provide Rithik with examples of differently generated forms of digital content so that he can become aware of what the functions he is exploring are able to achieve. In this way, the educator can simultaneously plan for current learning to use the technology through play, while promoting awareness of how the technology can be used once the epistemic activity is mastered. Such practices would be orientated towards existing approaches to play-based learning, observation and assessment (Carr & Lee, 2012; Wortham, 1998) and while also fostering a deliberate focus on the use of technologies in early childhood education (McLachlan et al., 2013).

Conclusion

Digital technologies are increasingly accepted as an important aspect of early childhood education. A problem for early childhood educators is to how best observe and assess children's learning to use technologies through play. This is particularly important in early childhood education settings because play-based learning is the accepted pedagogical approach. In addition, current policy initiatives such as the Early Years Learning Framework (DEEWR, 2009) and National Quality Framework (Australian Children's Education and Care Quality Authority [ACECQA], 2013) note that assessment should be orientated towards the achievement of learning outcomes for young children; and include the play-based use of digital technologies. In this paper, we have applied observational data associated Rithik's learning to use technologies through play to the 'Digital Play Framework' to determine the

potential of the framework as an observational assessment tool for understanding children's technology learning in play-based contexts. This early use of the 'Digital Play Framework' indicates that it may be useful for helping educators to identify how children are learning to use technologies through play, and therefore for identifying appropriate avenues of future learning. In this way, early childhood educators can work actively towards achieving the goal of enabling children's technology use in terms of ludic activity. Further research is now needed to evaluate the use of the tool with a broader population of children and educators to determine its efficacy in helping educators observe and assess young children's digital play in the early years.

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PERSONALISING THE PROFESSIONAL LEARNING JOURNEY

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Abstract

Professional development activity is widely accepted as a means of effecting change and as such IT-related professional development has been recognised internationally as a key factor in helping teachers acquire IT proficiency. However, neither mandates for the integration of IT in education, nor the range of professional development activities available to teachers appear to have significantly impacted on the way or frequency with which IT is used in our schools. There is a significant body of literature attesting to low qualitative and quantitative use of IT and evidence suggests many educators are reluctant to embrace the potential afforded by digital technologies. Empirical evidence has already established the significance of beliefs for understanding teachers' behaviour. Given this strong link, it is curious to note that most current forms of professional development neglect to acknowledge the 'mental lives' of participants and remain largely transmissive and impersonal in style. This paper draws on a longitudinal action research study in which participants' 'mental lives' were revealed and explicitly addressed in order to support their IT use and integration into the classroom. An alternative model for professional development that acknowledges and responds to teachers' thoughts and feelings is advocated.

Introduction

There is a silent epidemic in our classrooms... *IT* works in mysterious ways, sometimes undermining teachers' confidence, threatening their sense of self-efficacy and making them feel Dickensian and out of step with twenty-first century learning. *IT* preoccupies their thoughts and renders many frightened to speak up. Others will take little notice of *IT*'s symptoms and carry on as usual. Regardless of their symptoms, few sufferers will talk about *IT*. The classroom epidemic to which I refer is that of teachers' fear of using *IT* in their classrooms. Fortunately, the epidemic isn't life threatening. A treatment option is available, it works and it is needed urgently!

Background

In my work as a researcher, I ask teachers about the ways in which they incorporate IT into their classrooms. Often my question is met with rolling eyes and an awkward, almost apologetic laugh. Some will confess they don't use *IT* much because they don't know how or because *IT* scares them. Others admit to using *IT* for simple tasks like word processing and accessing information. These teachers' anecdotes are supported by a body of literature that attests many educators are reluctant to embrace the potential afforded by digital technologies (Ertmer & Ottenbreit-Leftwich, 2010; Groff & Mouza, 2008; Levin & Wadmany, 2008; Pegg, Reading, & Williams, 2007; Sutherland, Robertson, & John, 2009; Voogt, 2008) or they use it infrequently in low-level ways (Ertmer, 2005; Jamieson-Proctor, Burnett, Finger, & Watson, 2006; Leung, Watters, & Ginns, 2005). This damning claim is despite education department mandates and government policy advocating IT integration and widely accessible IT-related professional development activities. How then can this be?

An education system that embraces new technologies presents a myriad of possibilities, options, dilemmas, and challenges for teachers. Professional development activity is widely accepted as a means of effecting change and a key factor in helping teachers acquire IT proficiency (Phelps, Graham, & Kerr, 2004). However, despite an array of teacher professional development programs over the past 20 years, Jamieson-Proctor & Finger concluded these efforts "have not empowered teachers to have the confidence and skills necessary for them to transform their pedagogy...." (2008, n.p). Ramsey's (2000) observation that IT was "one of the most significant challenges confronting

teachers' education, teachers and schools (p.68) appears still to be very relevant and challenges researchers and professional learning facilitators to remedy the problem.

According to Levin and Wadmany, "teachers are key players in changing the educational world, and in particular the learning and teaching processes in their own classrooms" (2008, p. 234). Ineffective professional development that fails to support teachers' adoption of IT has led to a situation where the extent to which new technologies will be integrated or adopted hinges on teachers' thoughts about, "if, when and how this can be done" (Bate, 2010, p. 1042). Thus, it might be argued that teachers' beliefs about IT are a more powerful predictor of their preparedness to change, rather than policy mandates. Accepting this position implicates those concerned with raising the depth and frequency of IT use to listen to and consider teachers' thinking as an essential part of the professional learning for change equation.

Senge (1992) suggested that failure to appreciate employees' mental models has undermined many efforts of reform because "mental models shape how we act" (p. 5). Blackberry (2012) used the term 'mental lives' to describe the relationship between teachers' thinking (cognition) and affect (feeling). She suggested an individual's 'mental lives' included well-researched constructs like attitudes, beliefs, fears, perceptions, motivation, self-efficacy, confidence, self-esteem and personal knowledge. The link between teachers' 'mental lives' to change is well documented (see Ertmer & Ottenbreit-Leftwich, 2010; Phelps & Graham, 2008; Phelps, Graham, & Kerr, 2004). Luke argued that in the process of acquiring new knowledge and skills, firmly held attitudes and beliefs may be challenged and cause unavoidable dissonance leading to a rejection of the change (as cited in BECTA, 2004). Given the strong empirical links between teachers' beliefs and their IT practices, it seems incongruous that they are rarely acknowledged or considered in IT-related professional learning models.

Diagnosing the 'ailment': professional development

Most professional development initiatives (IT-related or not) remain largely transmissive style workshops focused on skill adoption and 're-tooling' (Jamieson-Proctor & Finger, 2008; John, 2002; Meredyth, Russell, Blackwood, Thomas, & Wise, 1999). Operating from a deficit perspective, this type of professional development treats teachers as passive receivers of knowledge delivered by an "expert" who is often an outsider (Knowles, 1973). There is often little or no differentiation in content or presentation to account for participants existing knowledge and skills. The "working on" model (Tafel & Bertani, 2008) is highly inadequate in the context of rapidly changing technology. It does not give participants the skills to transfer their knowledge to new technologies or situations and it neglects the multidimensional nature of change including the explicit acknowledgement of teachers' attitudes and beliefs that is considered essential by Ertmer (2000, 2005), Ertmer and Ottenbreit-Leftwich (2010), Guskey (2002), Loveless (1995), and Phelps, Graham and Kerr (2004). Only a few IT-related professional learning programs for teachers that consider teachers' attitudes and beliefs are in fact documented in the literature (McNamara, Jones & McLean, 2007; Phelps et al., 2004; Reading, 2010). Difficulties arise when teachers' beliefs about change and the need for change do not align with what they are being asked to do (Guskey, 2002). Consequently, "new insights fail to get put into practice because they conflict with deeply held internal images of how the world works, images that limit us to familiar ways of thinking and acting" (Senge, 1990, p. 174).

Treating the 'ailment'

In contrast to the knowledge-transmission approach, a reforming (Smith, Hofer, Gillespie, Solomon, & Row, 2003) or learner-centred approach to professional learning has been shown to effect change in teachers' practices and is driven by a philosophical orientation about the purpose of professional development as being about teachers changing rather than just adopting new techniques (Smith et al., 2003). Evidence suggests professional learning experiences that are grounded learning that is active, authentic and collaborative are more successful than the transmissive approach (Knowles, 1973; Kagan, 1982; Laferriere, Lamon, & Chan, 2006). The 'deep learning' and transferability of skills

inherent in such grounding enables teachers to develop lifelong learning strategies (Hoffman, 1986). 'Deep learning' comes from "an ecology that grounds teachers' learning experience in their open practice, experience and culture (community)" (Laferriere et al., 2006, p. 78). In addition, Tafel and Bertani (2008) acknowledged the influential nature of beliefs upon teachers' behaviour and advocated professional learning facilitators acquaint themselves with participant's beliefs in order to manage the change process more appropriately and respectfully for them.

Purpose

Three overarching questions guided this inquiry.

- What were our mental lives about IT at the beginning of the inquiry and how did our mental lives impact upon the process of acquiring new knowledge about IT?
- What impact do our mental lives have on our adoption of TPACK and constructivist pedagogies?
- What features of action research facilitate the identification of teachers' mental lives and contribute to their development of TPACK?

Methodology

Five teachers (three from an independent primary school in Brisbane, one kindergarten teacher and myself) formed a professional learning community (PLC) with the intention to develop our knowledge and classroom practice with IT. Each participant (myself included) confessed to reluctantly using or proactively avoiding using IT in the classroom. In addition, I was the PLC mentor. An action research approach framed our professional learning. The constructivist, interpretivist, and non-positivist principles (Cardno & Piggot-Irvine, 1996) underpinning action research supported an approach to the teaching and learning that was personally relevant and meaningful to each of us. Our first action cycle involved planning for and implementing the use of some technology in a unit of work for our classes. Critical reflection occurred simultaneously to teaching the unit and immediately following completion of the unit. Arising from the reflection, modifications to the original plan were made in an attempt to strengthen the work or eliminate problems we had encountered. Two teachers from the primary school left our PLC after the first cycle citing health reasons. The remaining two teachers, Amanda and Dee continued to work through five action cycles with me for a further two and a half years. Both Amanda and Dee were experienced teachers. Amanda had been teaching for over 12 years and Dee for over 40 years at the time we began working together. I had worked intermittently as both a secondary school teacher and a journalist for 20 years.

The data reported in this paper were collected from the last five action cycles. Evidence was drawn from planning meetings and classroom observations together with emails, professional and personal conversations and reflections. The accuracy of data and authenticity of our voices were major considerations, thus member checks with Amanda and Dee formed an important part of the data collection process. The data were transcribed and using NVivo software, coded inductively and analysed for themes.

Findings and discussion

Our findings related to how our mental lives impacted our use of IT were consistent with a voluminous body of literature that has concluded our actions are determined by our thinking. Thus, because we all had reservations about using IT, we tended to use it reluctantly or avoid it altogether. For further discussion of this see Blackberry (2012). An unanticipated outcome from the action research was the evolution of a new model of professional learning that is the focus for the rest of this paper. The model, 'Turning Teachers On to ICT' depicted in Figure 1 evolved from constant comparison analysis of the data. It is a holistic approach to professional learning that makes explicit

the features of action research that supported our IT practice changes whilst simultaneously acknowledging the impact multiple ecologies had on us as we strived for integration.

Microsystem

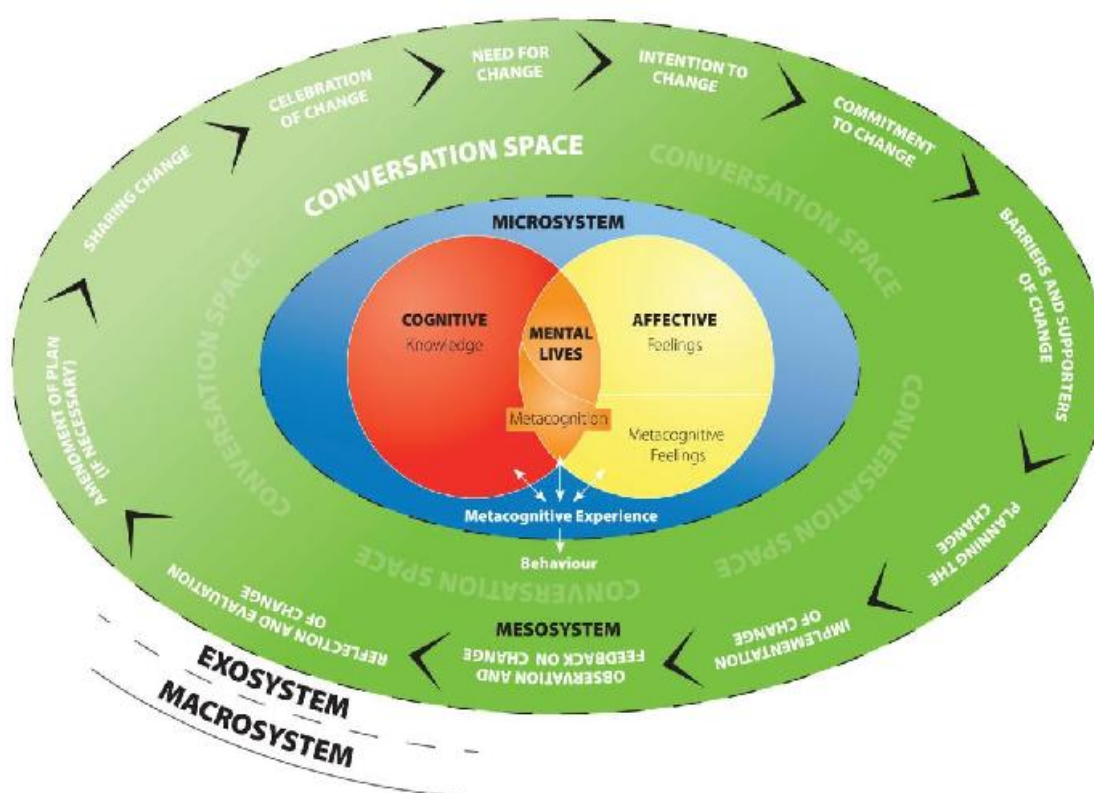
The model suggests the most powerful influence over our actions occurs at the microsystem level. That is, our thoughts and feelings directly impact our actions. While many teachers are able to perceive the need for change and initiate it without the support of other systems, other teachers' thoughts and feelings may function to prevent the adoption of changes in practice (see Pegg et al., 2007; Tafel & Bertani, 2008).

We all fell into this category and needed support to restructure our existing cognitive and affective representations. Although we understood its potential, our thoughts and feeling about IT prevented us from making significant changes to our practice. We were also united by a common fear; how to use IT. Amanda was worried about not knowing how to create an animation and the time it would take while Dee and I were concerned about using IT in educationally sound ways. The model acknowledges the centrality of our mental lives in guiding our action, and in our case, they were powerful determinants of our inaction. In order to be able to change our thoughts and feelings, we needed to acknowledge them, talk about them, identify their origins and reflect on how they prevented us using IT. We did this in our 'conversation space'.

The conversation space and reflection

Our thoughts and feelings often remain tacit and invisible to others unless they are challenged. We

Figure 1. Turning Teachers on to ICT Professional Learning model



utilised the conversation space, a metaphor for the situated, sustained dialogue and reflection that pervaded the action cycles, to challenge our thoughts and feelings. Metacognitive processing and substantive reflection were powerful agents supporting the

change process.

Metacognition has allowed me to see that uncertainty has characterised much of my thinking but that it has been practice and reflection on that practice that has allowed me to replace uncertainty with new knowledge. If we don't challenge our thinking, how can it change and develop. (Gina)

Dee summed up the significance of reflection and conversation for her saying:

To be willing to shift one's thinking, through personal questioning, research and reflection, empowers unfolding growth and development and my ensuing conversations with Gina, as we shared conversations around children's learning, technology and her own studies, began to provoke my thinking about the possibilities of technology as a valuable tool and process for education and for learning. (Dee)

The process by which I was simply allowed to think out loud, to express my fears and concerns and to talk them through until they no longer served as roadblocks, was a great learning experience. I came to realise that I had nothing to fear from technology and that I was as capable as anyone else in playing with it and coming up with meaningful ways to use it to support my teaching and my students' learning. I expressed my frustrations to Gina. And, I have to say, just having someone I could do this with was a blessing in itself. Being able to talk it out gave me the clarity I needed to know I could change things for myself and for my students. (Amanda)

As we worked through the classic action cycle of plan, act, observe, reflect and revise (Zuber-Skerritt, 2001, p. 15) the conversation space also functioned as an information exchange that became the platform for identifying and addressing concerns, negotiation and personalising the learning process. The conversation space also helped us to articulate which steps supported our attempts at change. These concepts, we called 'action steps' emerged during data analysis.

Mesosystem

At the outer edge of the ellipse, the eleven action steps identified in the data as supporting our planned change are indicated. These extend on the five traditional action research steps outlined above. The arrows indicate the movement of our action through various 'action spaces'. While the model suggests these 'action spaces' occurred sequentially, as we moved through cycles we found we sometimes skipped an 'action space'. The ability to move in any direction around the model is suggested by the space above and below the arrows.

Three behaviours, supported by the conversation space, underpinned these action steps and were found to be critical to supporting the change process and restructuring our mental lives in relation to IT. Our data suggested intention/commitment, mentoring/collaboration and observation/reflection pervaded all our work.

Intention/commitment

Policy and school directives suggested we all had a reason to make changes but as this inquiry demonstrated these directives did not translate into action. We found many obstacles that prevented us from initiating IT use and integration independently. These barriers included: time, resources and our mental lives. We were cognisant of the fact that we didn't know how to and this made us feel uncomfortable. It was important for us that we recognised it was in our best interest to make changes and this was accompanied by an intention to make changes.

My own professional growth had led me to consider, wonder about, read and explore the growing relevance of ICT in early childhood classrooms over the span of my professional career. Keen to find a strong foundation on which to rest the use of ICT in my classroom setting to achieve meaningful and credible learning outcomes for children, my

relationship with Gina emerged. When we commenced the process, I was scared... scared of what I thought I couldn't do and needed to be able to do to make the learning rich and interesting. My (natural) fear was also accompanied by an excitement that, here, I had a valuable opportunity to work alongside another professional. (Dee)

Amanda's intention to change was supported by evidence she had that indicated her students were not engaged and motivated. "I've also got to have a reason to do it... there has to be a reason to take on the next challenge."

A commitment to change represents a deep shift in the level of seriousness with which the challenge is taken. When the commitment is explicitly stated, in particular to the mentor, there is a concomitant shift as the participant accepts a degree of accountability for their engagement in and actions during the action cycles.

Having Gina checking in regularly, demonstrating a keen interest in what I was doing and questioning me, challenging me and encouraging me, was what held me accountable. It is one thing to hear of particular programs or websites and tell yourself that one day you will get around to exploring them in more details, but quite another to actually tell someone else you will do it and then have that person check in with you in a week's time to see how it went. That accountability was a key issue for me, particularly in the initial stages. (Amanda)

Mentoring/collaboration

Teachers often work in isolation and are frequently expected to implement change independently or with minimal support. Our action cycles valued mentoring and collaboration as a means of continuous, authentic and contextualised support.

Two heads are better than one. With Gina as my sounding board, cheer squad and mentor, I began investigating other ways in which I could incorporate ICT's into my classroom. Having her checking in regularly, demonstrating a keen interest in what I was doing and questioning me, challenging me and encouraging me, was what held me accountable. (Amanda)

She was a generous, resourceful and enthusiastic mentor. She was willing to listen and was capable of extrapolating our differing capabilities, roles and responsibilities and our need for provocation. She led by example and was aware that each of us would engage as and where we were able, available and interested. (Dee)

Observation/reflection

Watching students work with computers and their seeming enjoyment and comfort in doing so, was a powerful agent of change. Our observations of their capabilities, together with their motivation and enthusiasm provided us with new evidence which directly contradicted Amanda's early claim that, "the students will require a lot of support to do that" (ie. work with computers to create an animation). During cycle two, as a result of using technology-mediated pedagogy, a WebQuest, Amanda observed positive changes in her students' motivation and their ability to work independently.

Today I must admit I'm very excited. I just love not having the kids in my face every five minutes and feeling frustrated. The students responded so positively to doing a WebQuest. I originally thought it might just be the novelty of using the computers but I tell you what, after seven weeks the novelty of using computers has worn off so something else must have been keeping them motivated and on task. I did not expect to have some students where they're at today. And they're excited and you know that's the best thing is that they're loving it. Before the students seemed to lack any sort of engagement with the topic. (Amanda)

These positive perceptions permitted Amanda to revise her beliefs about a range of IT related issues she formerly held and supported her to continue with IT integration.

Exosystem and macrosystem

The exosystem and macrosystem are positioned at the outer edge of the model because for us, they exerted the least influence on our IT practice. Government mandates and educational department policy directives had failed to shift our thinking and increase our IT use.

Conclusion

The nuanced and highly personal lives and contexts within teachers' work deserve a form of professional learning in which the individual is valued, understood, and supported to make change possible. This study has highlighted the need for teachers' mental lives to be made visible and that the interplay of the meso, exo, and macrosystems of their work environment must be investigated and addressed during any ICT-related professional learning experiences. A mesosystem that is able to challenge teachers' mental lives and support them through experiential and situated learning is needed to make teachers' learning personally and professionally relevant and to address the malady of IT integration in our schools.

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DIGITALLY AUGMENTING PHYSICAL SPACES FOR PERSONALISED LEARNING

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Abstract

The ubiquity of mobile computing devices, such as phones and tablets has led to their increased use in education. The ability of these devices to augment physical spaces with additional content shows particular promise to enable the creation of guided and learner driven learning experiences. In this paper, we introduce Trailblazer, a software framework that allows non-programmers to create rich augmented reality experiences. The framework allows for activities that are composed tasks that include a mixture of information transmission and knowledge testing through a multi-modal experience. A case study is presented demonstrating the framework in the cultural heritage space with Year 5 integrated curriculum.

To assist the learning process it can be helpful to journey out of the classroom and into certain places of interest. For example, visiting a heritage site to learn about the past or attending a significant event, such as eruption of a volcano. There are, however, barriers to such excursions. The place of interest could be impractical to get to, dangerous, or the significant event may have already passed. Further, if the site is visitable, expert guidance is needed in taking a group through the site.

A promising solution to the barriers on physical excursions is to augment them with mobile-based augmented reality applications (MAR). In augmented reality (AR), a physical place is transformed by adding virtual content using the mobile device. This is typically implemented by using the camera on the mobile device to capture a view of the environment, presenting it on the screen with the additional virtual content superimposed on the actual scene. The content can include written text, images, video and recorded voiceover through to interactive 3D objects that appear to be a part of the actual scene. This has several applications. For one, an actual place of interest can be augmented with guides and information. This information can be directly matched to meet curriculum objectives so that the experience is both engaging and educationally effective. Further, events from the past and objects no longer present can be recreated through augmented reality. In addition, a space that is not connected to the place of interest, but is easily accessible (such as a school oval), can be transformed with augmented reality to represent the place of interest.

Currently, there is no easy way to create a rich, engaging educational experience using AR. One current solution is to commission custom AR apps, typically a costly, time consuming process, resulting in an app where the content is not easy to change. Another solution is to use one of the existing consumer-accessible authoring tools, such as EveryTrail (2014) or Aurasma (2014). Such tools are currently limited to serving content rather than letting the user take an active part in the experience, or having the ability to scaffold learning tasks to build competence. In our work we address these limitations through an easy to use framework, Trailblazer, where rich experiences can be built from a set of generic task types that promote exploration and actively engage the participant.

The rest of this paper is organised as follows. First, we provide a review of existing work in the augmented reality space, focusing specifically on learning. We then provide an overview of our solution, followed by a case study of applying our solution in the cultural heritage space. This is followed by a discussion of the feedback we have received so far and the conclusion.

Theoretical Framework and Literature review

Innovation in learning with technology depends on individual access to innovative technologies and the pedagogy and infrastructure that support them. Contemporary theories of learning with information communications technology (ICT) emphasise socio-cultural and constructivist theories of learning (Webb & Cox, 2004). Pedagogical approaches to technology integration support student-centred environments that are characterised by their focus on active participation, collaboration, and knowledge production rather than knowledge acquisition (Keengwe & Onchwari, 2011). One of the newest technologies currently being explored for its potential to offer interactive multimodal learning experiences is AR technology (Billinghurst & Dunser, 2012). Physical manipulation of digital content using AR technology is now possible thus opening up a myriad of opportunities for educators to assist learners in exploring abstract spatial and temporal concepts.

How the coexistence of virtual objects and real environments might assist learning is the subject of a rich discourse. Arvanitis et al. (2007) argue that the coexistence of virtual objects and real environments allows learners to visualize complex spatial relationships and abstract concepts. According to Klopfer & Squire (2008), such coexistence enables the learner to experience phenomena that are not possible in the real world and to interact with two and three dimensional synthetic objects in a mixed reality environment. Both create a context for deep learning. Other researchers (Squire & Jan, 2007; Squire & Klopfer, 2007) argue that such environments enable the development of important practices and literacies that cannot be developed and enacted in other technology-enhanced learning environments. In a literature review of research in AR applications in education, Wu et al. (2013) state that such benefits make AR one of the key emerging technologies for education over the next five years.

There is still much to learn regarding how AR can best be used for educational purposes (Folkestead & O'Shae, 2011). Some recent projects suggest the possibility of AR complementing current learning models and tools. AntarcticAR (Lee, Dunser Nassani & Billinghurst, 2013) investigated the application of AR to create a virtual tour of Antarctica where significant portions of the real world (such as a school oval) were replaced with virtual content allowing the user to become immersed in Antarctica's extreme environment. The Handheld Augmented Reality Project (HARP) (O'Shea et al. 2009), investigated the efficacy of AR curricula for engagement and understanding. This collaborative project developed two scenario-based AR curricula, targeted towards Massachusetts state academic standards for middle school math and languages. Prohibitive technological, management and cognitive overload issues were common across these projects; however, overall these projects demonstrated the potential usability of AR technology for engagement and understanding.

Introducing Trailblazer

Our solution in the AR space, Trailblazer, is targeted towards the goal of allowing non-programmers to build engaging augmented reality experiences. In line with this aim, we have opted to develop a graphical user interface (GUI) based system through which such experiences can be created and stored on a server. The content stored on the server is then experienced through a mobile app. The features of Trailblazer were determined using an iterative and incremental methodology using a participatory design process. In this approach, the system is built in increments of functionality with each undergoing several iterations.

Feedback on iterations was sought from a wide range of stakeholders, as detailed in the next section on the case study. Due to the wide range of experience with mobile devices in the potential target audience, it became important to design a simple, intuitive interface. Some general principles used in the interface design of the app include: minimal options on each screen, large meaningful icons and organization of the interface to support one hand interaction. In addition, as it is sometimes useful to situate AR activities outdoors, a colour scheme was chosen to maximise the contrast of user interface elements.

The architecture of the Trailblazer system is shown in Figure 1. From the perspective of a learner (or anyone wishing to partake in the experience), they download a Trailblazer app onto their mobile device from an app store (such as iTunes or Google Play). The app does not come with any AR content when initially downloaded, but provides a means of connecting to the Trailblazer server, which holds a set of experiences that the player can choose from to download and experience through the Trailblazer app. With this approach, the same app can be used for multiple learning experiences, rather than having to download a different app for each. This promotes a consistent experience in terms of the user interface and functionality for various types of learning experiences.

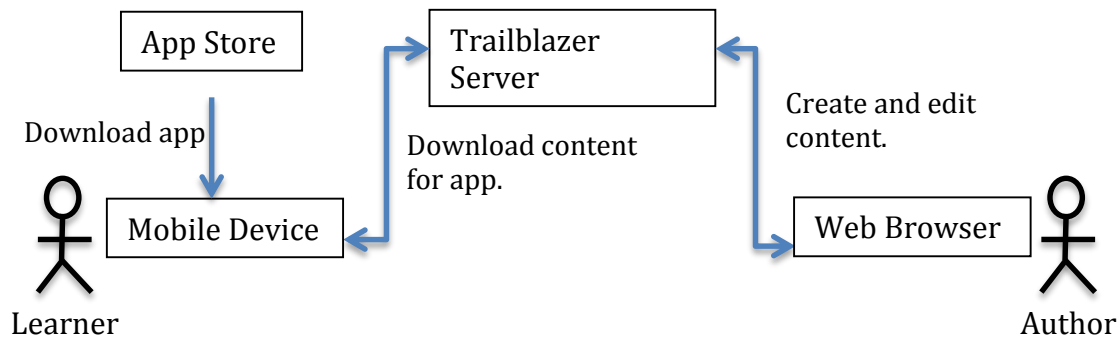


Figure 1: The Trailblazer framework from the perspective of both a learner and the author of the learning experience.

From the perspective of an author, they build a particular experience on the Trailblazer server through a web browser interface. As we envisage Trailblazer to be used to create a wide variety of experiences, encompassing different content across different locations a flexible structure was needed in which generic ‘experience’ elements could be placed. This structure, consisting of five levels, is shown in Figure 2 along with the specific experience built for the case study, described later in this paper and possible extensions.

At the top level is the trail, which consists of one or more physical places of interest (POI). Each POI can have a number of quests, which are intended to be thematic groupings of activities based at that place of interest. An activity is made up of a number of tasks, each task being in a concrete location at the place of interest. These task locations are anchored either by GPS location or visual marker. Multiple sequential tasks at the same visual marker are supported, with the completion of one task causing the next task to appear.

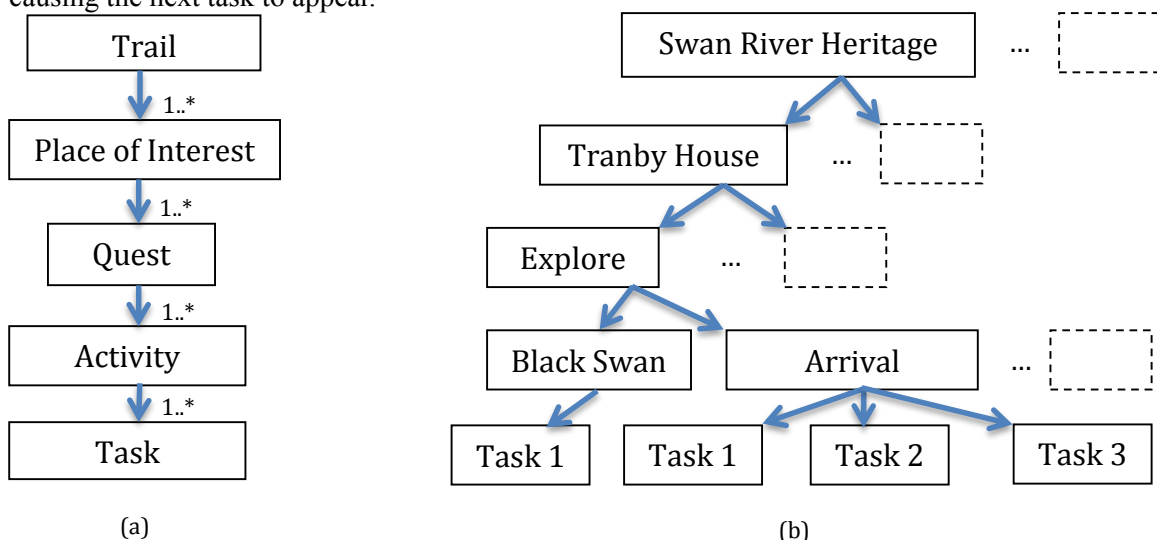


Figure 2: The five levels of content in the Trailblazer framework (a), along with an example instance (b).

Activities in a quest can be attempted in any order, and the author of the experience can create a combination of ordered and unordered tasks within an activity. Several task types have been created to allow the author to create the activity, summarized in Table 1.

Table 1: Types of tasks present in the Trailblazer framework.

Task Type	Learner interaction involved	Role
Information Panel	Presents a panel of text over a visual marker.	Information relevant to the activity can be presented to the learner, such as clues to find the next task or information about the POI.
Video	A video is played over a visual marker. The video pauses when the marker moves off-camera and resumes when the marker is visible again.	A more multi-modal experience than the text-based information panel. The video task type can be used to demonstrate concepts to the learner.
3D Model	A 3D geometric model is shown with position, orientation and scale to match the marker. The learner can manoeuvre around a virtual object as if it was in the physical environment.	The learner can make observations on objects that are not at the physical location. This can be used to engage learners with artifacts that may have once existed at the place of interest, or those too valuable to be on display to the public.
Key	Provides an object that can be collected, anchored to a visual marker. The author can make other tasks unavailable (locked) until a set number of these objects have been collected.	Introduces an ‘explore’ mechanic where the learner needs to investigate their surroundings in order to unlock a particular task.
Multi-Choice Question	The learner is provided with three possible answers to a question, one of which is correct. The learner selects an answer. Points are awarded for selecting the correct answer, with points diminishing with the number of attempts before the correct answer is selected.	Provides a point for reflection, where the learner must make a decision. This decision can be informed by other content at the POI, or the learner can guess. This means the player need not be ‘stuck’ on this task, however subsequent tasks should not assume knowledge of this question.
Written Answer Question	Written text is provided (typically intended to be in the form of a question), with blank spaces that the learner has to fill in with a particular set of words. The author can elect for some of the letters in the answer to be revealed.	A point where the learner can reflect, but harder than the multi-choice questions in that there is limited scope for guessing. The learner must enter the correct response in order to proceed with the activity. Tasks subsequent to this can assume the learner understands the question.

In addition to the information provided directly with the task, each task can have documents attached to it that are added to the Items library on the Trailblazer app. These documents can be in the form of videos, documents (eg. pdf files), or images. Appropriate documents can be selected to help the user complete the activity, or to act as reference points for work done outside the app, such as reflective activities back at school for a school-excursion.

Case study: Trailblazer for the cultural heritage space

Working in partnership with the project sponsor, National Trust of Australia WA (NT), we have created a demonstration of the framework that delivers primary level integrated curriculum at Year 5 level, based around Western Australia's oldest surviving domestic building, Tranby House (TH). Curriculum integration refers to curricula that are aimed at making subject matter more relevant to students' experiences with less focus on discipline boundaries (Gehrke, 1998). Though literature highlights barriers to integrated curriculum, such as teachers' lack of knowledge outside their own discipline and difficulties in fitting established assessment systems (Lam et al., 2013), Trailblazer offers the architecture to embed knowledge from multiple disciplines and guide the students through the AR experience. Toward this end, we have developed two activities, Arrival and The Black Swan, that include content related to: environment, heritage, sustainability, history, literacy, and numeracy set in the context of the TH locality, aligning to meet the outcomes of the Australian History, Geography, Science and Mathematics Curriculum.

Arrival activity

The arrival activity consists of a series of non-linear puzzles associated with the historical artifacts located in the entrance foyer of TH. To encourage students to explore, they are first required to collect a number of AR keys 'hidden' in the foyer, followed by alternating sequences of information panels and questions focused around artefacts with information about the journey the settlers of TH took to arrive in Australia and how TH was started. Challenges include having to calculate the month of arrival, examining the goods that the settlers bought with them against importance for survival and examining the size and shape of land allocated to the settlers. A screenshot from one of the tasks in the Arrival activity is shown in Figure 3 (a).



(a)



(b)

Figure 3: Screenshots from the Trailblazer app with an example of a Written Answer Question task used in the Arrival activity (a) and the 3D model of the swan used in The Black Swan activity (b).

Black Swan activity

This activity was situated outside TH, next to the banks of the adjacent river and positions students in the role of a biologist. A visual marker, given to students outside TH, triggers this AR experience which includes a 3D model of a black swan, screenshot shown in Figure 3 (b), accompanied by an audio narrative detailing the historical context and significance of the black swan as well as instructions for an inquiry task. Working in pairs the students must then orientate the tablet to gain different spatial perspectives of this species so that they may draw its key morphological features on the evidence worksheet. Ultimately this inquiry-based task will challenge students to collect evidence and form an hypothesis related to why so few of these birds exist now in this location. Here we are using AR to amplify the real world environment, as the likelihood of observing this particular indigenous species is very low due to destruction of its natural habitat and the level of watercraft activity on that particular stretch of the river.

Results and Discussion

Prior to testing with Year 5 students, formative feedback on the Trailblazer architecture and the Arrival activity was sought via a think tank of stakeholders, including representatives of the NT, teachers and curriculum experts and representatives of the indigenous community. The think tank was situated on site at TH, giving participants an opportunity to engage in an authentic user experience of the activities. A summary of this formative feedback, along with modifications made in response follows.

Our stakeholders perceived the navigation between the various visual markers used by the arrival activity was not intuitive and would potentially lead to cognitive overload. Consequently the instructional clues were re-written in a simpler and more targeted fashion. Navigational and user hints, including how to hold the tablet to trigger the AR experiences, were also added. Contrary to the evaluative feedback arising from the HARP project (O'Shea et al. 2009), the non-linear nature of the arrival tasks seemed to invoke a sense of confusion. Suggested improvements included numbering the tasks or a screen tool added to indicate how much of the quest had been completed. On the visual presentation of tasks, participants indicated perceptual difficulties as the size of some markers (such as info panels) was scaled with distance away from the visual marker. This necessitated modifications to the presentation of markers, increasing their space to fill the screen and increasing the text font size. A further improvement that was made to the activities was to simplify the readability of the textual information to align more closely with the typical reading age of a Year 5 student.

Further feedback specific to this POI was to feature more historical events or objects no longer present as part of the experience. A more multimodal experience, featuring video and audio was also suggested. The Black Swan activity was created in response to these suggestions. Value was also seen in students being able to capture video and photographic evidence of the completed quests, which then could be used back at school. This feature was seen to be innovative in terms of enabling further opportunities to conduct inquiry based activities with evidence collected on site. Various solutions exist to enable this, such as the use of cloud-based storage that the students could access from anywhere. This will be explored in future work.

After the improvements in response to think tank feedback were made, the next iteration of Trailblazer and the activities were tested with the target audience, 32 Year 5 students from an Independent metropolitan primary school. The students were partnered up to complete both the arrivals and black swan activities. Almost without exception these ten-year-old students intuitively were able to use the swipe features of the tablet and without instruction understood that pressing the home button would return them to the beginning of the quest. High engagement in this activity was observed; however, unexpectedly issues arose with some pairs of students experiencing ownership issues over the single tablet device, which resulted in the NT tour guides and researchers having to strongly reinforce taking turns. The confined nature of the entrance foyer where the arrival activity was located resulted in unanticipated management issues requiring intervention by the NT tour guides and classroom teacher. Almost immediately, the researchers noticed a competitive element arising between pairs of students, with many students seen rushing to locate all the AR keys and solve the challenges.

Once the students had been situated outside of TH next to the banks of the river gasps of delight were heard as the students triggered the appearance of the 3-D model of a black swan. Activating the AR black swan automatically triggered an audio introduction and set of instructions for this task. As these tablets were not purposefully designed for outdoor use, listening to this information was problematic due to the ambient background noise and the excited student chatter. The researchers intervened after noticing this difficulty and offered a verbal explanation for this task instead. Despite being instructed to remain seated during this drawing activity the students stood up in order to orient the tablet to achieve a complete view of this bird. Spatially this was a challenging task requiring the students to simultaneously view the black swan and attempt to draw its features. Without explicitly being instructed, the majority of students collaborated with their partner to successfully draw the black swan's key morphological features on the evidence sheet provided. A number of students were observed to be so deeply engaged with viewing the black swan that they became disoriented and were asked to sit down for fear of tripping or bumping into one another. The issue of glare on the screen was resolved in this particular play testing trial by situating the students in a shaded location, thereby maximizing screen contrast and clarity in this outdoor based activity.

Conclusion and Future Work

Designing curricula specific learning activities that leverage off the affordances of AR is a continuing

topic of research. In this paper, we have described the Trailblazer framework which we have designed to allow non-technical experts to craft such learning activities in order to accelerate research in the field and also to minimise barriers to practical implementation. The framework includes a web-based editor where the authors of experiences construct sequences of tasks, having the ability to interweave text-based information with 3D virtual models, videos as well as questions to encourage the learner to reflect and engage with the material. To demonstrate the framework we have created two demonstration activities and received promising feedback from the Year 5 audience. In future work we are aiming to explore a wider set of activities and also to enhance the framework with a wider array of task types.

Acknowledgements

This work was supported by an Edith Cowan University Industry Collaboration Grant with The National Trust of Australia (WA).

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ACEC2014 - MAKING THE SPACE FOR SPACE: THE EFFECT OF THE CLASSROOM LAYOUT ON TEACHER AND STUDENT USAGE AND PERCEPTION OF ONE-TO-ONE TECHNOLOGY

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Abstract

Today, a significant proportion of Australian secondary school students have some level of access to digital technology through one-to-one or BYOD programs. This ubiquitous access to devices connected through wireless network can create a technology-enabled learning environments (TELE). The teacher-student connectivity of a TELE has the potential to facilitate more collaborative and responsive learning experiences in modalities that may have not been possible before. Despite these significant changes, many students occupy classroom spaces that have changed little in configuration, structure and operation.

This paper reports on the first stage intervention of a three stage quasi-experimental study. The study explored the synergy between technology-enabled and responsive learning spaces and its effects on teaching and learning in a Secondary school setting. The stage one intervention sought to determine if a causal relationship existed between particular layouts and how teachers' and students' perceived the incidence in usage and the influence and effectiveness of one-to-one technology.

A single-subject research design (SSRD) measured the effect of two types of classroom layouts through an explanatory mixed method design. Results from quantitative analyses over a one-year period indicated a more responsive and dynamic physical learning space did have a positive effect on student perceptions of the effectiveness and influence of one-to-one technology on their learning. These quantitative findings were corroborated through thematic analysis of teacher focus groups. Collectively this evidence suggests that the arrangement of the physical learning space can assist teachers to better integrate the affordances of technology into their pedagogical practice.

Introduction

Student access to and usage of digital technology brought about by one-to-one or BYOD programs has the potential to offer many avenues to improve teaching and learning. This ubiquitous access to digital technology through one-to-one devices connected through wireless infrastructure can create technology-enabled learning environments (TELE). The connectivity associated with TELE can support collaborative and more responsive learning experiences by connecting teachers and students in modalities that may have not been possible before (Rosen & Beck-Hill, 2012). The affordances associated with this environment can support contemporary pedagogical practices that are believed to be most powerful in facilitating personalised models of student learning (Bocconi, Kampylis, & Punie, 2012; Ertmer & Ottenbreit-Leftwich, 2010). Despite these significant changes Bautista and Borges (2013) and Chandler (2009) argue that many students operate in a traditional classroom space that has changed little in configuration, structure and operation.

The traditional layout is typical of a classroom where students are arranged in fixed instruction settings, facing the teacher at the front-centre focal or display point (Chandler, 2009; Reynard, 2009). Richards (2006) argues too often the integration of technology into these spaces has been an afterthought, predominantly added-on to existing structures. This approach characteristically leads to the technology supporting existing pedagogical modes (Richards, 2006; Rosen & Beck-Hill, 2012). Fisher (2010) agrees that this lack of alignment between the possible affordances associated with

technology and the common traditional fixed instructional setting points to a *deep spatial silence*. This silence is key to understanding how the salient effects of physical learning environments is enabling or restricting the implementation of technology to support more contemporary pedagogical practices (Fisher, 2004; Lippman, 2010).

This paper seeks to show how the physical arrangement of the space can either hinder or support the effective use of one-to-one technology. It reports on a *Single Subject Research Design* (SSRD) study that measured the quantitative effect of two classroom layouts on how teachers and students perceived the incidence in usage, influence and effectiveness of one-to-one technology. These quantitative findings, further justified by thematic analysis of a teacher focus group, sought to determine if a causal relationship exists between particular layouts and how teachers and students perceived the incidence in usage and the influence and effectiveness of one-to-one technology. This study, whilst small in scale, models an approach with the potential to add dramatically to previously overlooked structures that can support the adoption and effectiveness of one-to-one technology.

Literature Review

The built pedagogical contract of the traditional classroom

The physical layout of the space contains implicit and explicit physical and psychological cues. These cues instinctively and visibly instruct both teachers and students how to behave within the space (Cleveland, 2011; Monahan, 2002). In a classroom that is typical of a traditional layout, these cues are evident in juxtaposition of teachers and students. The teacher's front-centre position, reinforced by a desk and visual display is directly opposed to students arranged in a fixed instructional setting. The teacher's positioning, establishes what Reynard (2009) describes as the *fireplace syndrome*. It sets clear expectations of the role of the teacher and students in the transmission of knowledge (Reynard, 2009). Over time this behaviour establishes a certain script for the teaching and learning transaction between teachers and students (Cleveland, 2011; Dovey & Fisher, 2014).

The establishment of this consistent pedagogical script overtime is best described by the concept of *built pedagogy* developed by Monahan (2002). Built pedagogy describes the ability of the obvious and salient characteristics of the physical space to shape teacher practice and student learning. This is evident in the preservation of the traditional classroom archetype beyond the learning and pedagogical theories that it was initially designed to facilitate (Dovey & Fisher, 2014; Hildebrand, 1999). The result is a hidden *built pedagogical contract* which sets the tone of the teaching and learning relationship between student(s) and teacher(s) (Hildebrand, 1999). Hildebrand (1999) argues that any transgression from the conventions and/or the prevailing norms of this contract, results in resistance from one or both parties. Fullan, Hill, and Crevola (2007) describes how this resistance could be responsible for the classroom innately perpetuating resident pedagogical culture within schools to maintain the status quo.

Rationale for the synergy of space and technology

Brown and Long (2006) and Fisher (2006) argue that learning spaces need to become much more than just tight, static, hierarchical containers of learning. Instead, Oblinger (2005) indicates that spaces should act as a conduit that enable the convergence of technology and pedagogy. This translates to designs that must embody spatial qualities that enable technology to support current and evolving pedagogical practices (Fisher, 2006; Joint Information Systems Committee, 2006). At the same time, the design, configuration and utilisation of spaces must adapt to and in turn be shaped by the users of the space.

Dovey and Fisher (2014) describe how the interaction between the users of the space, the technology (furniture and digital) and the physical layout must enable continual adaptation and flow between various pedagogical and learning modes (teacher-centred, student-centred and informal). This requires spaces to be more than just flexible in design. Instead Kolb (2005) and Lippman (2010)

suggest the emphasis should be on *responsive* design that enables the space to shape the learning context of the inhabitants, and at the same time, enable these inhabitants influence, moulding the space to their pedagogical intent. The result is spaces that are able to adapt to and accommodate emerging modalities, pedagogy and digital technologies.

The Study

Currently there is limited understanding about the interplay between technology-enabled and responsive learning spaces and how this can affect teacher and student usage and perceived value of one-to-one technology. The present study explored how the physical arrangement of the space of different classroom layouts hindered or supported the effective use of digital technology in a secondary school environment. The aim was to determine if a causal relationship existed between particular layouts and how teachers and students perceived the incidence in usage and the influence and effectiveness of one-to-one technology. It was hypothesised that a more responsive and dynamic physical learning space will better support the affordances of one-to-one technology.

The Spaces

The two classroom types existed within buildings constructed between 1940 and 1960. The first type is typical of a classroom that would be described traditional in layout. Desks and chairs are set in a fixed instructional setting, facing a front-centre focal point or teaching position. The second type of classroom is a retrofitted new generation learning space (NGLS). A NGLS combines the flexibility of furniture design and use with the integration of digital and visual technologies to create a dynamic and interactive 360° or polycentric learning space (Lippman, 2013; Monahan, 2002). The aim of this combination was to break down the traditional fixed instruction setting by enabling flow between various pedagogical and learning modes within the existing room.

The polycentric layout was to be created using large TVs on Walls/Wheels, or TOWs, Writeable Walls and multiple teacher data projector inputs (Lippman, 2013; Miller-Cochran & Gierdowski, 2013). This layout has been successfully used in: North Carolina State University's SCALE-UP, Massachusetts Institute of Technology's TEAL and University of Minnesota's ALC projects. Each of these initiatives sought to breakdown the entrenched fireplace syndrome through the de-emphasis on the front-centre focus (Miller-Cochran & Gierdowski, 2013; Reynard, 2009). This supported the shift away from highly teacher-centred, verbal-linguistic learning, to more collaborative, active and student-centred learning approaches.

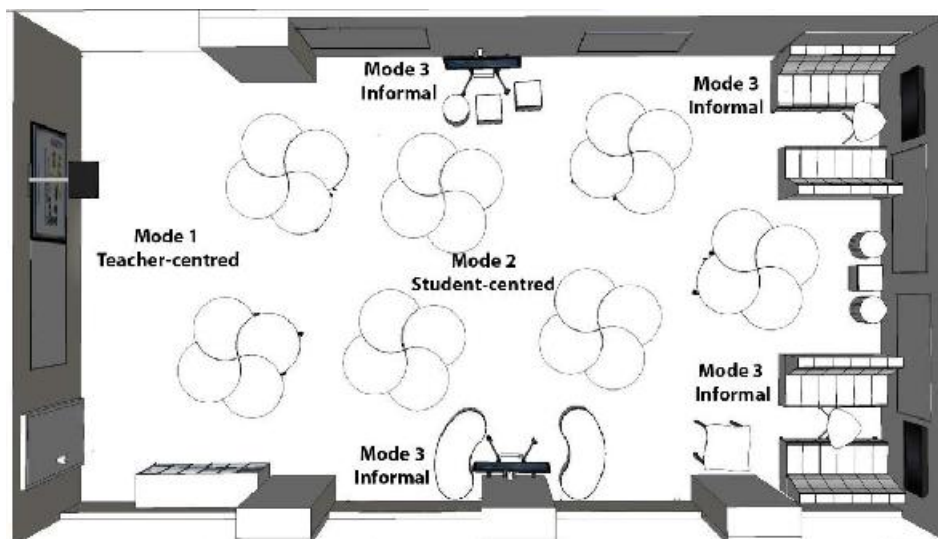


Figure 4. New generation learning space (NGLS) polycentric layout

The Research Design

The aim of the study was to determine if a causal relationship existed between the intervention, the change in classroom type (independent variable), and how students perceived the incidence in usage and the influence and effectiveness of one-to-one technology (dependent variables). The recommendations of Campbell (1957) and Shadish, Cook, and Campbell (2002) around causal inference was employed to ensure the research design had strong focus on moderating the *plausible* threats to internal validity and the spurious effect of confounding variables. However, the nuances of the schooling environment did not support the random assignment and absolute variable control that is a requisite of a randomised experimental study. As a consequence, this study synthesised elements from quasi-experimental and SSRD approaches to moderate these threats and effects.

A quasi-experimental design is a well-established approach to non-randomised intervention studies (Harris et al., 2006). A key facet of quasi-experimental studies is the emphasis on the design, rather than statistics alone, to facilitate causal inference (Shadish & Cook, 1999). This study implemented a design that was able to control a raft of confounding variables, except for the change in classroom type. The confounding causal variables that were controlled included the teacher, student cognitive ability, class composition and subject type. This variable control was facilitated through the application of a SSRD.

Romeiser Logan, Hickman, Harris, and Heriza (2008) and Horner et al. (2005) argue that SSRD is a rigorous and reliable means of moderating the plausible threats to internal validity and variability. It achieves this through establishing a functional relationship between the manipulation of the intervention and the subsequent effect on the dependent variables (Horner et al., 2005). This relationship was facilitated through the study of the six participating classes, who acted as their own control, baseline and unit of analysis (Cakiroglu, 2012; Horner, Swaminathan, & George, 2012). With each class compared and contrasted against themselves, this negated the threat of between-subject variability (Horner et al., 2005). It also mitigated the internal validity threats of selection and testing (Campbell, 1957). The addition of a time-series component to the research design moderated the internal validity threats of maturation and history (Shadish et al., 2002).

A baseline/intervention (A/B) design, collected empirical data through an explanatory mixed method across three baseline (traditional) and four post-intervention (NGLS) points. The aim was to establish a stable baseline for each class, to further strength the validity of the study. This would mitigate the effect of within-subject variability to correlate (Romeiser Logan et al., 2008). In addition, this correlates the causality between the changes in dependent variables to the effect of the particular intervention (Shadish et al., 2002). This collectively seeks to overcome the difficulty to establish singular causality, which is a general criticism of an SSRD.

Data Analysis

Data was collected through a repeated-measures student attitudinal five point Likert scale survey. To improve the generalisability of findings, questions were incorporated from the Shear, Means, Gallagher, House, and Langworthy (2009) *Microsoft Partners in Learning Innovative Teaching and Learning* survey instrument. Questions relating specifically to dependent variables of the influence, effectiveness and incidence use of technology were utilised, but rewritten to be suitable for the research context and age of participants. For example, the question 'This space improves the effectiveness of technology as a learning tool' correlated to the dependent variable of effectiveness.

The survey had high, but not perfect, retention rates (96.7%). To alleviate within-subject variability the statistical power of the sample size ($n = 164$) was maintained by the application of Maximum Likelihood Estimation (ML) to produce a complete data set. ML was chosen because it does not artificially truncate the variance and covariance around the mean (Peugh & Enders, 2004). This truncation would abbreviate the 95% confidence intervals about the mean that would negatively bias the determination of statistical significance that would inform causal inference (Peugh & Enders,

2004). This decision was justified by the data set having Little's Missing Completely at Random (MCAR) score greater than 0.05 (0.94).

A Cronbachs Alpha (0.86) enabled each class's data to be summed and treated as single subject (Ivankova, Creswell, & Stick, 2006). Consequently the visual analysis of class means, with 95% confidence intervals, evaluated the *true effect* of the intervention by indicating the plausible range of values to identify inter- and intra-intervention trends (Baguley, 2009). Bobrovitz and Ottenbacher (1998) claim that this process is equitable for *t*-test calculations.

To mitigate the *subjective* nature of visual analysis and Type 1 errors, additional quantitative analysis and thematic analysis of teacher focus groups occurred (Kinugasa, Cerin, & Hooper, 2004). Cohen's *d* effect size calculations, were calculated using the method suggested by Beeson and Robey (2006). This circumvented distributional issues of inferential statistics to justify the determination of statistical significance (Beeson & Robey, 2006). Finally thematic analysis of a follow-up teacher focus group provided a more detailed and context-specific picture that explained to some degree particular statistical results and outcomes.

Analysis of Student Attitudinal Survey

The visual analysis process outlined by Horner et al. (2012) was utilised to determine *significant* and *non-significant* statistical difference (Figure 2). This process incorporated the criterion of changes in level, trend and variability of both means and confidence intervals. The shift from a traditional to NGLS classroom resulted in a clear statistical difference in twelve out of the eighteen questions (Table 1). Figure 2 indicates the reliability of visual analysis in moderating both the trend and variability to determine statistical significance. The stable baseline set of class 8.2, along with non-overlapping confidence intervals of a stable intervention phase, indicates a statistically significant change, attributable to the NGLS intervention. Whereas, the unstable and positive trending baseline data set of class 7.2 and overlapping confidence interval indicates a positive, but not statistically significant change.

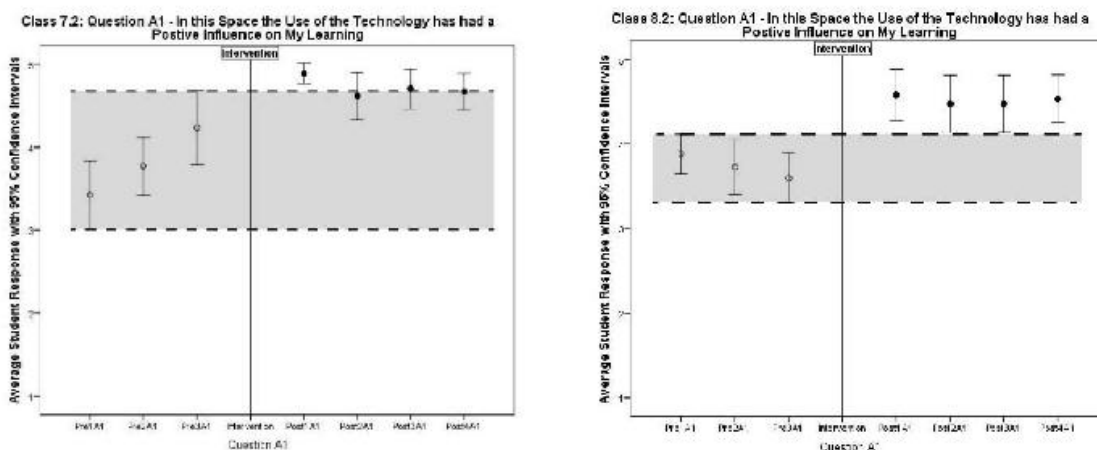


Figure 2. Visual analysis through summative means, with 95% confidence intervals, of attitudinal data in a traditional and NGLS classroom

Cohen's *d* effect sizes (Table 1) were calculated using the process outlined by Beeson and Robey (2006). All pre- and post-measures were utilised in the effect size calculation, to ensure a more reliable representation than a single measure. Using the thresholds suggested by Cohen (1998), the conclusions made from the visual analysis are justified through large (0.8 to 1.3) to very large (greater than 1.3) effect sizes. Interestingly, class 7.2 achieved a slightly larger effect size for Question A1 than class 8.2, even though the visual analysis process identified a statistically significant effect in

class 8.2. This supports the robustness of visual analysis, as it distinguishes not only a change in level, but also the variation and trends throughout both phases.

Table 2

Summary table of visual analysis and effect size calculations for the positive influence, effectiveness, and flexibility of one-to-one technology

Class	<u>Positive influence</u>		<u>Effectiveness</u>		<u>Flexibility</u>	
	Visual analysis	Cohen's d effect size	Visual analysis	Cohen's d effect size	Visual analysis	Cohen's d effect size
7.1	Significant	1.291	Significant	2.016	Significant	1.203
7.2	Non-significant	1.131	Significant	1.527	Non-significant	0.737
8.1	Non-significant	0.931	Significant	1.37	Non-significant	0.793
8.2	Significant	1.055	Significant	1.57	Significant	1.114
8.3	Non-significant	0.721	Significant	1.81	Non-significant	0.665
8.4	Significant	1.634	Significant	2.495	Significant	1.211

Thematic Analysis of Teacher Focus Group

Thematic analysis of a teacher focus group followed the quantitative analysis. All teachers noted that the change from a traditional classroom to NGLS layout coincided with a change in both teacher and student perception of the value of technology. Teacher B noted that “I think there’s a bit of a myth out there that, the one-to-one program is invalid, that technology gets in the way, it doesn’t actually help deliver the curriculum”. There was agreement that teachers’ perceptions and beliefs had a significant effect on how they viewed the relevance of technology. Furthermore that the application of the one-to-one Tablet PC program is limited more by the teachers and that the students are ready for change. This is corroborated by the student data indicating that all classes identified that they perceived the technology was a more effective learning tool in a NGLS compared to a traditional classroom.

The teachers noted that one of these reasons for the change in both perception and usage was due to the flexibility and collaborative nature of the NGLS. This was supported by various comments that highlighted how the flexibility of the room enabled them to use a wider range of software applications. Teacher A noted by the “end of the survey period I was actually doing a lot more with the technology... and using it quite extensively”. This increase usage of a range of software applications in an NGLS was verified by medium to large effect sizes in the student data associated with the intervention.

This use of a wider variety of software applications, along with the flexibility of an NGLS, had a significant effect of the pedagogical activities that the technology supported. For example, Teacher C noted that they “deliberately tried to get the boys to use technology in different ways within the new rooms”. Rather than just using the technology to disseminate information and content, a significant number used applications that connect students into various sized groupings to facilitate collaboration. For example Teacher A noted that across Year 7 “changes were made to various activities and assessment to incorporate a higher degree of student collaboration”. This collaboration initially took place face-to-face in the NGLS, but was extended outside the classroom through the key applications of Shared OneNotes and Web 2.0 tools.

Conclusion

In summary, the study found sound quantitative evidence that the arrangement of the physical learning space does have an effect on how teachers and students perceive the influence, effectiveness, and teacher usage of one-to-one. This was determined through a combination of visual analysis and effect-size calculations of SSRD data as a suitable and robust mechanism in the determination of a statistically significant effect of an intervention. In all instances, a statistically significant result determined through visual analysis, was justified by a large to very large effect size. Thematic analysis of the teacher focus group provided an additional layer of context-specific and reliable detail. The corroborating nature of the teacher voice did support the statistical analysis and subsequent conclusion derived from the student data. Both the student and teacher data does suggest that when the layout of the classroom aligns with and supports the affordances and flexibility associated with technology, its perceived influence, effectiveness, and flexibility improves. Therefore, this lack of alignment between the arrangement of the physical learning space and the affordances of one-to-one technology appears to be a potential barrier, not widely acknowledged, for teachers in the effective and efficient use of technology.

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REDEFINING THE DEVELOPMENT OF PRE-SERVICE TEACHERS' INTERCULTURAL COMPETENCE THROUGH AN ONLINE TEACHING ENVIRONMENT

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Abstract

Teacher educators are faced with the dual challenge of preparing teachers for an increasingly globalized world and a digitally enriched world. Building pre-service teachers intercultural and digital competences are therefore priorities. This paper reports on pre-service teachers' perceptions of their intercultural competence after participating in an online teaching and learning environment, eTutor, that partnered them with culturally diverse children from local and international primary and secondary schools. Analysis of pre-service teacher reflections shows that the experience of tutoring culturally diverse children online does contribute to the development of intercultural competence and that online spaces can redefine how intercultural competence can be developed in pre-service teachers.

Introduction

Teacher educators today are faced with the challenge of preparing teachers for an increasingly globalised world, where teachers need to understand and accommodate the needs of more culturally diverse classrooms (Porto, 2010; Santoro, 2013), that is, to develop their intercultural competence. The imperative to teach in more culturally responsive ways is embedded in teacher professional standards (Australian Institute for Teaching and School Leadership, 2012) and in curriculum priorities such as Asia and Australia's role in Asia (Australian Curriculum Assessment and Reporting Authority, 2013). At the same time, teacher educators are expected to prepare pre-service teachers to teach in digitally enriched learning environments. This paper explores the outcomes of a project designed to improve pre-service teachers' intercultural competence through interactions with culturally diverse children in an online learning environment.

Intercultural competence

Intercultural competence is taken to mean the ability to interact effectively and appropriately in intercultural situations, based on specific attitudes, intercultural knowledge, skills and reflection (Deardorff, 2006), to achieve mutually successful outcomes (Stone, 2006). Intercultural competence occurs when people no longer assume that their culture's way of looking at things is the best way or the only way, and when people therefore begin to evaluate other cultural perspectives (Yassine, 2006 as cited in Kourova & Modianos, 2013), that is, when they move from ethno-centric to ethno-relative perspectives.

Models and frameworks that attempt to explain how intercultural competence is developed and arrived at (Byram, 1997; Deardorff, 2006; Stone 2006;) focus on the multidimensional aspect of intercultural competence. Attitudes play a foundational role in the development of intercultural competence (Byram, 1997; Deardorff, 2006). To be interculturally competent, one needs to have the requisite attitudes of respect for other cultures and cultural diversity; openness to people from other cultures and to intercultural learning; as well as a sense of curiosity and the ability to tolerate uncertainty and ambiguity in intercultural exchanges, in other words, an ability to see oneself in relation to others and to withhold judgement about other cultures. Intercultural competence also requires cultural self-awareness, or knowledge about one's own culture, as a crucial starting point for beginning to understand other cultures. A deep understanding and knowledge of other cultures is also considered key, including knowledge about the role of culture on behaviour and communication.

Further, being interculturally competent requires the development of skills for acquiring and processing knowledge about cultures including discovery and interaction through listening, observing and interpreting cultures, as well as skills of analysing, interpreting and relating to other cultures (Byram, 1997; Deardorff, 2006),

Intercultural competence emerges when there is a shift in a person's internal frame of reference to bring about a more ethno-relative rather than ethno-centric view (an internal or individual outcome) and, importantly, when one is able to behave and communicate effectively and appropriately to achieve one's goals through interaction with other cultures (external outcome) (Deardorff, 2006). Stone (2006) expanded on this concept to argue that intercultural competence is achieved when both parties achieve their communication goals. The development of intercultural competence is seen by Deardorff (2006) as an ongoing and iterative process, rather than a linear one and that in developing intercultural competence a person moves in and out and between the personal and interpersonal domains. Deardorff believes that, whilst it is possible for someone to achieve the external outcome of behaving and communicating effectively in intercultural situations without having made internal shifts in frames of reference, the degree of appropriateness and effectiveness of the outcome may not be as high "without having fully achieved the internal outcome of a shift in the frame of reference" (2006, p.257).

Role of online environments in building intercultural competence

Teacher education institutions provide theoretical knowledge about other cultures and about being more culturally responsive. However, abstract knowledge alone is not sufficient for the development of intercultural competence (Bennett, 2009; Perry & Southwell, 2011). The development of intercultural competence is a process that develops through interactions with cultural 'others' (Deardorff, 2006). Opportunities for authentic and persuasive personal encounters with people from different cultures enhance intercultural competence (Scarino & Liddiecoat, 2009). International field experiences, that is, opportunities to teach in culturally different location, have been a traditional way to provide more direct contact with culturally diverse 'others' (Walters, Garii, & Walters, 2009), however, such programs are generally expensive and available to a limited number of students. Increasingly, online environments are seen as a way to generate 'persuasive personal encounters' between students of different cultures (Lawrence, 2013), with a growing number of projects that integrate online environments with aspects of intercultural learning, (Deed, Edwards, & Gomez, 2013; Garcia-Sanches & Rojas-Lizana, 2013; Lawrence, 2013; Magos, Tsilimeni, & Spanopoulou, 2013). Online environments that foster a sense of community through discussion, collaboration and sharing of ideas can foster cultural awareness, and offer of new view of participants' own culture as well as the culture of other participants (Magos et al., 2013). Well known examples of online projects for schools that aim to foster global connections include I*EARN, ePals and within Victoria, Global2.

At the same time as being asked to develop their intercultural competence, pre-service teachers need to be prepared to teach in digitally enriched learning environments, in both online and face-to-face settings. The development of an online environment that brings together pre-service teachers and students from different cultures thus offers a space where teacher educators can attempt to, metaphorically, kill two birds with one stone – foster the development of intercultural competence amongst pre-service teachers through authentic encounters with children from different cultures, whilst, at the same time, providing opportunities for pre-service teachers to experience first-hand what it is like to teach in an online space. The key question, for the purpose of this paper, is to what extent did participation in the online environment foster increased intercultural competence amongst the pre-service teachers.

The research context – eTutor

The eTutor project trialed the use of an online environment to facilitate authentic, rich, personal encounters between Australian pre-service teachers and school students from Australian and Asian primary and secondary schools. Through the use of social media tools including blogs, chat, messages and wall posts (Fig.1), eTutor participants learned about each other and their cultures by exchanging information and working on curriculum projects, tutored by pre-service teachers.

Figure 2: eTutor Home page



Over 150 pre-service teachers and 303 school students from eight schools in four countries interacted with each other in the eTutor environment for approximately 14 weeks in the second half of 2013. Pre-service teachers in their first year of an undergraduate primary teaching qualification undertook a core course, which was based on participation in eTutor. Whilst participation itself was not assessed, pre-service teachers were required to draw on their own and others' participation in eTutor to complete a major assessment task. Key aims of the course included increasing the pre-service teachers' understanding about the characteristics of effective educational environments, both face-to-face and online, as well as introducing students to concepts of cultural diversity and intercultural competence.

Schools that participated in eTutor in 2013 included government schools in small, remote rural villages in Nepal; government schools servicing largely middle class students in north-east India; a private boys school in eastern Malaysia; government primary schools in outer Melbourne suburbs catering to both middle class and socio-economically disadvantaged areas, and a private secondary school in a middle class suburb of Melbourne.

On eTutor, each participant had a profile page, containing a brief biography, and from where they could create blog posts and upload images and videos. Blog posts, images and videos were able to be viewed by everyone who belonged to eTutor. Participants could also exchange private messages and engage in live chat sessions with other eTutor participants.

The majority of communications however, took place within eTutor groups. Students and pre-service teachers were placed into small groups of approximately eight to ten people. Each group had its own space within eTutor, where students could post comments on the group wall, or to other group members' personal wall. Group members could also post comments on each other's blogs.

Method

The outcomes being reported in this paper are part of a broader mixed method study that is investigating a range of outcomes and aspects of the eTutor project in 2013. The focus of this paper is on the undergraduate students' perceptions of their development of intercultural competence.

The process of developing intercultural competence is one that involves self-reflection and negotiation such that one's attitudes are gradually transformed. Ideas of intercultural competence are therefore subjective, rather than objective, dealing with such concepts as attitude, and ideas of openness and respect. Many who study intercultural competence recognise that more introspective, qualitative approaches to investigate the development of intercultural competence are required (Jackson, 2006). This study therefore takes a qualitative approach, grounded in interpretive paradigms where understanding the subjective world of human experience (Cohen, Manion & Morrison, 2007) is the focus. Gathering pre-service teachers' perceptions of their experiences provides insights into the efficacy of an online environment such as eTutor in fostering increased intercultural competence.

All 152 pre-service teachers who took the course and participated in eTutor were required, as part of their assessment tasks, to develop a portfolio of interactions from eTutor that illustrated their intercultural competence. Portfolios can represent the complexity of the intercultural experience capturing aspects of intercultural learning that and can encourage students to reflect on their experiences and learning (Perry & Southwell, 2011). In their portfolios, pre-service teachers reflected on the extent to which participation in the eTutor project fostered their intercultural competence. Following the completion of the course, pre-service teachers' portfolios were collected and analysed qualitatively using NVivo. Data were analysed using coding frameworks based on Deardorff's (2006) process model of intercultural competence – attitudes, knowledge, skills, internal frame of reference, external outcomes. Reflections were stripped of any identifying data prior to analysis, to maintain pre-service teacher confidentiality.

Findings

Overall, participation in eTutor fostered a perception amongst the majority of pre-service teachers that their intercultural competence increased, particularly in changing attitudes and cultural knowledge, specifically cultural self-awareness. This section begins by presenting findings relating to the pre-service teachers' intercultural competence, drawing on Deardorff's (2006) Process Model of Intercultural Competence described above as a conceptual framework. Two other key findings relating to reciprocity and vicarious learning are also presented.

Improvement in intercultural competence

Attitudes

In keeping with Deardorff's model this analysis commenced with attitudes. Did participation in eTutor have an impact on the intercultural attitudes of the pre-service teachers, including openness, respect, as well as a sense of curiosity and discovery? Many of the reflections contained explicit references to being more open to other cultures and more open to changing outlooks, as exemplified in these excerpts:

It's clear that if I want to be an intercultural teacher I need to be open to making changes. I believe that as a result of eTutor this has been made clear to me.

This whole experience has made me a more open and accepting person and taught me to be more open about everything.

Attitudes of respecting and valuing other cultures are also a key feature of intercultural competence. Pre-service teachers frequently made reference to the need for respect to be demonstrated, as in this example

Not only do we need to understand other cultures, we need to be respectful and accepting of them, willing to learn from them and able to engage with them.

This course challenged me to think about how to teach students of different cultures about different cultures, and to keep in mind that this is a person's identity so it should be treated with more than sensitivity, but also respect.

Cultural knowledge

For the majority of pre-service teachers, one of the most significant outcomes of their participation in eTutor was a heightened awareness and understanding of their own culture and of the role culture plays in shaping an individual's identity, for example:

Being involved within eTutor, I was able to assess, reflect and break down my understanding of my own culture and identity.

Before their eTutor experience, many of the students interpreted someone's culture to be defined only by the location of their birth and the colour of their skin. The following two examples encapsulate the shift in thinking most pre-service teachers displayed about what culture is:

I have also learnt about the many layers of culture, and by that I mean that it is not just religion and festivals, which is the answer I would have given when this unit commenced. Through eTutor I have a richer understanding of culture

Previously, I thought it [culture] was about what country you come from, what language you speak and what colour your skin is. I now think culture is different for every individual and is not dependent on ancestry or country of birth.

Prior to participation in eTutor, some pre-service teachers did not believe they had a culture, for example:

Before participating in this course I held the belief that I didn't really have a culture, I was 'just Australian'.

This suggests that for these pre-service teachers, one's own culture is largely invisible, as illustrated by this student:

Participating in the eTutor environment has caused me to critically reflect on my own cultural identity. Why is it that I can so easily identify elements of the cultures of others, but not my own? How does my culture affect me on a daily basis?

Pre-service teachers became more knowledgeable about limited aspects of the cultures of the children who participated in eTutor. For example, some pre-service teachers had not been aware of Ramadan and the Eid festival. This was being celebrated by students in India, Malaysia and at one of the Australian primary schools involved in the eTutor project. Pre-service teachers also learned much about the various religious festivals held in India, Nepal and Malaysia and the importance such celebrations represented in these cultures and a little about the daily lives of some of their eTutor children. However, most of the pre-service teachers did not develop more than a superficial knowledge of the specific cultures of the children with whom they interacted in the eTutor environment.

Intercultural skills

As a result of analysing their interactions in eTutor, many of the pre-service teachers were able to articulate a more critical view of an Australian culture. For example, the different cultural attitudes towards education provided a lens for the pre-service teachers to analyse and interpret their own culture and that of their partner students. Pre-service teachers identified the high value placed on education in all three partner countries and were able to compare this with their perceptions of the values and educational practices in the Australian partner schools:

The Indian students were always respectful and courteous when writing to us. It reflects the way their culture and society is and how they see teachers. They also seem to value their education more so than the Australian students

This [high number of posts] shows the discipline that Malaysian culture puts on students to complete their work and to not disappoint their teachers and tutors.

For example, in many Asian cultures, education is often held in high regard with an emphasis placed on achieving high academic testing results, and the primary role of the teacher is to direct, rather than guide. In contrast, as evident in my professional placement

experience, Australian culture and teaching practices often revolve around discussion, collaboration, and hands-on learning.

Pre-service teachers extrapolated from their eTutor experience to make general interpretations of what they believed their own culture to be – one that was generally more casual than Asian cultures, for example *I realized just how laid back we are as Australians*, less focused on religious celebrations, more focused on sporting achievements, less aware of the privilege the majority of Australians experience, but more accepting of cultural diversity. Importantly, the pre-service teachers were able to identify similarities as well as differences between their own and other cultures, including the importance of family, of similar values, of hobbies and of music, as this example illustrates:

It was incredible to think that a boy from another walk of life would be interested in the same hobbies as I am. It's been great to find these similarities as well as learning about our differences.

Internal frame of reference

It is clear from the data that the majority, although not all, the pre-service teachers made substantial shifts in their internal cultural frame of reference, informed by their experiences interacting with culturally diverse children within the eTutor environment. Many pre-service teachers reflected on what impact their participation in eTutor had on their views about the role of culture and cultural diversity in their own teaching. Most pre-service teachers' reflections contained reflections that suggest a more ethno-relative stance, such as typified in the following responses:

From the eTutor experience I have learnt that it is important not to have a cultural bias where reflections are from my own cultural experience and assumptions.

Through eTutor I have learnt the importance of acknowledging different worldviews and applying this knowledge and attitude to my developing pedagogy. It is also important getting to know the students individually without applying bias or fixed ideas of culture.

A small number of pre-service teachers commented on the difficulty of enacting, rather than simply espousing, a more empathic and open intercultural stance:

Being open to accepting people for their own beliefs can sometimes be more difficult than we think.

External outcomes

The final stage in Deardorff's process model of developing intercultural competence is when people take effective and appropriate behaviour and communication in an intercultural situation. Pre-service teachers provided examples of where they believed they had acted in culturally appropriate ways within eTutor. Examples typically included adopting a different tone with local students to that adopted with the international students; of acknowledging obvious cultural differences and asking questions about the students' lives and interests; by being very careful with choice and quantity of words when giving feedback; by uploading culturally appropriate images; and by avoiding the use of colloquialisms and references to culturally specific information. The following response illustrates how many pre-service teachers became increasingly aware of the need to adapt their own practices to accommodate cultural differences so that all participants in eTutor achieved their desired outcomes:

There were different cultural initiations for our Broadmeadows and Indian students. We used humour to draw in our Broadmeadows kids and established a formal, superior relationship to our Indian students in order to get highest success from both.

A small number of pre-service teachers also gave examples of how their practices in a face-to-face setting also shifted as a result of their participation in eTutor, for example:

On my second placement after participating in eTutor, I was able to talk to her [student in classroom] about the country that she came from and link some cultural differences to those I came across when travelling in Europe. By using this experience she opened up to me and became more open to talking about her country and was understanding of the

differences she experiences here. I felt that eTutor was a direct influence in my actions to help and communicate with this student.

Whilst not common, this type of response suggests that eTutor could be instrumental in shifting pre-service teachers' practices with respect to diverse cultures.

Reciprocity

Despite the affordance of online communication tools to facilitate frequent exchanges between participants, such as the social media-based tools within eTutor, communication between pre-service teachers and the school children was not always seamless. At times, there was a lack of reciprocity of posts. Whilst there was consistent communication in many eTutor groups, in some eTutor groups communication was frequently interrupted because of:

- technical difficulties experienced at schools, most commonly associated with lack of access to the internet, particularly in Nepal, where electricity and internet are only intermittent, and at one Australian school, where restrictions on internet access effectively blocked eTutor at the school.
- incongruence between school/university and school/school calendars. Examination periods, festivals, professional placement blocks and school/university holidays frequently fell at different times throughout the 14 week period, which reduced the amount mutual availability for participation in eTutor. This effectively reduced the number of times eTutor participants were able to post and to reply to each others' posts.

Pre-service teachers found it difficult to re-capture engagement from the children in eTutor when conversations were interrupted. Delays in responding to posts meant that conversations lost momentum, and, in some cases, were lost altogether:

Interactions were not always reciprocated from the students, which made it a challenging task to engage with them.

Some pre-service teachers expressed frustration at the lack of response, or the time it took to get a response from the children in eTutor. The effect of the delays between online interactions was to limit the volume of information that could be exchanged, including cultural-specific information and the extent to which the pre-service teachers could implement all the online activities they had planned, as illustrated in this common response:

The students online were less responsive and we didn't get to cover as much as we planned.

Learning vicariously

Because of the architecture of eTutor, it was possible for everyone in eTutor to see each others' posts and comments, even if they were unable to respond to them outside their own group. So, despite the lack of reciprocity in some eTutor groups and from some eTutor participants, it was possible to view all the interactions that took place. This enabled those pre-service teachers who had limited opportunity for their own interactions to view others' interactions and to learn from these. Pre-service teachers were able to analyse other groups and to detect patterns across groups, from which to form a view. Discussions in the associated face-to-face classes where groups presented on their online activities helped to make sense of the online communications. However, those pre-service teachers were envious of the first-hand communication in which the majority of their peers were able to participate and would have preferred to experience online communications with the eTutor students first-hand, rather than from second-hand viewing.

Discussion & Conclusions

The data clearly shows that pre-service teachers believed they demonstrated competence in the majority of the components of intercultural competence as defined in Deadroff's (2006) model. Attitudes of respect, openness and a sense of discovery of other cultures were evident, as were positive shifts in cultural knowledge, particularly about their own culture. The experience of interacting with children from multiple cultures in an online environment contributed positively to a shift, for the majority of pre-service teachers, in their internal frame of reference away from an ethnocentric view to amore ethno-relative view, showing greater empathy towards children from different cultures. For many, this translated from the online environment of eTutor to their face-to-face placement, where their experiences in eTutor gave them a new perspective on the cultural diversity they face in their classrooms.

However, it is also clear that lack of reciprocity, even if the unintentional result of technical or calendar-related issues, can inhibit or limit the development of intercultural competence. In the case of eTutor, lack of reciprocity in some groups at some stages of the project, limited the extent of conversations that, in turn, limited the depth of cultural specific knowledge the pre-service teachers were able to garner from first hand experience. It would seem prudent if using online environments for this, or indeed, any educational purpose, to take whatever measures are necessary to promote higher levels of reciprocity, that is, more frequent and timely interactions. Attention needs to be paid to coordinating timetables and institutional calendars as much as possible to minimise the occurrence of extended delays in responses to posts, although this is challenging when dealing with eight schools and a university across four countries. Participating institutions also need to minimise disruptions caused by inadequate Internet connectivity and remove technical barriers. Whilst these are both important barriers to effective online interactions, other factors may also lead to reduced levels of interaction. Timeliness of response is not always a technical or calendar issue, though beyond the scope of this paper to discuss, and identifying other factors that act on engagement in an online environment such as eTutor is clearly worthy of investigation.

Despite this limitation, the open nature of the eTutor environment, whereby all participants could view, if not respond to all posts, enabled those pre-service teachers whose first-hand interactions were limited to learn vicariously. The eTutor experience reinforces the benefits of making such online environments open to view to all within the online community, even if not open to comment to all participants.

Reliance on self-perceptions is potentially limiting. Findings in this study need to be examined against the actual performance of intercultural competence, the next planned stage of analysis. Whilst students may have felt a shift in their internal frame, did this extend to enacting intercultural competence in the online eTutor environment? Further analysis of the actual posts and replies made by the pre-service teachers is required to validate the self-reported perceptions.

What is clear from the analysis of the data from the eTutor 2013 project to date is that online environments clearly have the potential to contribute positively and significantly to the development of pre-service teachers' intercultural competence. The eTutor project demonstrates that using online environments can be an effective way of giving large numbers of pre-service teachers opportunities to engage in authentic personal encounters with children from a variety of cultures, either in schools in other countries or in local schools that are more culturally diverse than some schools in which pre-service teachers undertake practicum placements. In an era when expectations of intercultural competence and digital literacies are only set to increase, the eTutor model may offer a viable solution to some of the challenges faced by teacher educators.

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THE IMPACT OF LONG-TERM ICT PROJECTS ON STUDENT ATTITUDES AND CAPABILITIES

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Abstract

This study draws on pre- and post-surveys of 574 upper primary students who engaged in intensive work over two school terms to produce a multimodal narrative using desktop animation software. It was thought that factors such as general ability with computers, interest in composing stories and persistence with long-term projects might be influences of successful completion or higher quality products. Over the course of the project, there is evidence of student growth in the ICT-related skills as well as enjoyment and capacity with story composition. However, concerns remain over the pedagogy of extended project work and the impact of this on student learning in the affective domain. The impact of these findings for classroom teaching and the planning of long-term ICT projects are discussed.

Introduction

Over a period of three years (2009-2011), the 3D multimodal authoring pedagogy (3DMAP) project¹ engaged over 1200 students from 48 level five and six classes across five Australian states in the construction of a 3D multimodal narratives – a sort of desktop-equivalent to live-action filmmaking. Students undertook two units of work, each with a minimum of 20 hours of engagement, using the software *Kahootz* (Maggs, 2008). Details of the program have been described elsewhere (Chandler, O'Brien, & Unsworth, 2009, 2010; Chandler, 2014/forthcoming), but notably whilst it was clearly located as a literacy project for the students (and multimodal semiotics in particular), it would not have been possible except for intensive engagement with Information and Communications Technology (ICT). The departure point for the present investigation occurred as the researchers reflected on the second year of the project, as the engagement with classes in the final year was being planned. Throughout the first years, there were some difficulties with students presenting completed work. Some of that was attributable to intrinsic difficulties with the software (resulting in 'lost' or corrupted files), but to what extent such problems were partly or wholly a manifestation of a broader problem (i.e., students' work habits or file management practices) was unclear. Certainly, a 20 hour unit of work will reveal chinks in the armour of work practices that a one or two hour task would not, and most likely cause greater distress to the student concerned. But equally we wondered about students' familiarity with extended project work (whether involving ICT or not) – is, for instance, maintaining focus and application to projects something that they are used to doing? And furthermore, do students actually like writing stories or enjoy using computers to be creative: could it be that some of the problems were motivational? Broadly, the concerns, then, are the extent to which affective dimensions of student learning and allied areas of knowledge are impacted by, and themselves impact on, student performance in 3D multimodal authoring tasks.

This concern sets the background for the present investigation and which have broader implications. Across the world, literacy is being reconceptualised in response to our increasingly digital, multimodal information and communication world (Australian Curriculum Assessment and

¹ The Australian Research Council Linkage Project "Teaching effective 3D authoring in the middle school years: multimedia grammatical design and multimedia authoring pedagogy" (LP0883563) was funded for 2009-2011. The Chief Investigators were Prof. L. Unsworth (Australian Catholic University) and Dr A. Thomas (University of Tasmania), in partnership with, and also funded by, the Australian Children's Television Foundation.

Reporting Authority, 2013; England Qualifications and Curriculum Authority, 1999; Singapore Ministry of Education, 2010). The 3DMAP project is but one instance of cutting-edge literacy projects which require intensive engagement with ICT in Australia alone (e.g., Ryan, Scott, & Walsh, 2010; Walsh, 2011). Within the use of the term by Grant (2011), the 3DMAP project was also an example of project-based learning (PBL), increasingly a feature of classrooms both within Australia and internationally. Jones and Issroff (2005) have pointed out that affective issues have been viewed as somewhat problematic in studying learning and so they have often been excluded from the frame of research, or studied separately from cognitive learning. Grant (2011), too, has observed that there has been limited attention to the student perspective, including the affective domain, in research into PBL. Attending to those is an important component of advancing the development of 'new literacy' projects and 'project-based learning' practices and pedagogies.

This paper reports on (a) the variation between schools and (b) the impact of engagement with a long-term ICT project on student self-reports which are indicative of:

- i. Interest and ability with story writing
- ii. Perception of computers as a creative tool
- iii. Competence and capability with computer use
- iv. Work practice and ethic in relation to long-term project work

We firstly consider connections to the broader literature, and proceed to describe the research methodology used in this study. A detailed and exacting instrument to investigate these features is not presented, but rather a relatively coarse one, which was designed to give a general sense of any issues. Results are then discussed and conclusions, quite positive in relation to ICT use, but less so in relation to the pedagogy of extended project work, are outlined.

Connections to the broader literature

Despite Jones and Issroff's (2005) complaint about the lack of attention to the affective domain in the application of learning technologies, a few relevant studies can be identified. None were found, however, specifically in the context of cutting edge literacy work, but rather in the field of PBL more generally. Hernández-Ramos and De La Paz (2009), in a quantitative study of 170 students, found evidence that students' attitudes toward the subject under consideration, and toward working with others, were significantly positively affected by the PBL experience, which is consistent with reports on PBL made elsewhere (p. 167). Hung, Hwang and Huang (2012), also in quantitative work with a similar number of students, found that extended engagement with ICT and PBL enhanced learning motivation, problem-solving competence, and learning achievement. The detailed case study of a small number of eighth-grade students engaging in PBL by Grant (2011) provides the most detailed discussion of relevant issues, however.

Several of the themes identified by Grant (2011) are relevant in relation to extended literacies-orientated projects such as 3DMAP. The first is "internal influences", embracing the issues of persistence, motivation, and self-management skills. His informants (students) explained that, in the context of PBL, the personal relevance of the project/investigation is important, along with the presentation of the project as having an emotional anchor; the students made choices about the topic, its development and the technologies used in its development based on perceptions of that they were "good at". At these points, Grant's PBL project is rather different to the 3DMAP project: 3DMAP provided no choice of technology, did not go out of its way to engender emotional ownership in the process, and provided no alternate trajectories through the material. Whether PBL and 3DMAP are just different in these respects, or whether these are some of the necessary conditions for effective persistence, motivation and self-management is at the heart of the present investigation. It was interesting to read of students in Grant's study who found that the length of the project was too long to sustain motivation – some even expressed a concern of being 'burnt out' by the topic; carefully constructing the length of project to maximise both learning and motivation is probably a challenge for extended multimodal authoring projects.

Two further themes from Grant's informants are also important. One is "beliefs about project work": that they should be fun, engaging, providing freedom and autonomy in work. And yet his informants said that their beliefs in this respect had been 'sobered' by previous and current teacher expectations. The role of the teacher was an important "external influence", in particular a lack of teacher engagement as a key negative impact on project work. The students, in other words, want their teachers to be engaged and supportive and to help them find an enriching experience. Grant's informants also confessed to relying heavily on their prior knowledge and experience in developing their PBL work: finding ways to actually enlarge the knowledge base of students through PBL in ways that are readily welcomed by them, may not always be a straightforward task. The 3DMAP project sought to teach new concepts of multimodal authoring, and given the low knowledge base of students at the commencement of the project (Chandler, 2012) relying on prior knowledge was never going to be sufficient. The role of the teacher in fostering multimodal authoring has been emphasised elsewhere (e.g. Chandler, 2013) and through Grant's study the centrality of effective teacher/student engagement to foster affective development is further highlighted.

Focus for investigation

The investigation reported in this paper is restricted to the impact of extended multimodal authoring project work on affective dimensions of student learning and allied areas of knowledge. The investigation sought to identify if there are differences between classes in these areas, and in which there can be said to be a positive or negative impact as a result of the project. With relatively thin background available, specific hypotheses were not developed, but rather the defensibility of an impact was explored using post-hoc comparison techniques, as described below.

Method

Design

The design was a quasi-experimental study using a pre-test/post-test design (Campbell & Stanley, 1963, p. 7), as we could not randomly assign students or teachers to schools (conditions) and could not alter the teaching arrangement for the comparison. It is represented as $O_1 \quad X \quad O_2$ where X represents an intervention (i.e., engaging in the units of work) and O_1 and O_2 are observations. As Campbell and Stanley stress, this design is an inherently weak approach and so conclusions as to whether any significant change can be attributed to engaging in these units of work will need to be made very cautiously.

Participants

Participants in the 3DMAP project were students in their last two years of primary school. In total, data were collected from 574 students, but not all students completed either or both of the questionnaires. From the pre-test survey, data were collected from 523 students from 14 schools (26 classes) in both years 5 and 6 (including both single year level and composite classes) who participated in the study. The schools were varied in relation to geographic location and socioeconomic status, but were mainly government schools. The majority of respondents were Victorian: 9 schools with 80% of total respondents, with smaller numbers from Tasmania (2 schools, 10% of respondents), New South Wales (2 schools, 9% of respondents) and Queensland (1 school, 1% of respondents). 304 students completed the post-test survey, with 266 of them having completed both; there was a diminished return rate for the post-test data from all schools, and in addition 2 Victorian, 1 New South Wales and the Queensland school had withdrawn from the project during the year.

Questionnaire

Ten questionnaire items were used to gather data in relation to the investigative foci, which were

presented as a five-point scale, as illustrated in Figure 1. This is not a fine-grained, detailed and highly calibrated instrument, but the data discussed below shows that even this relatively coarse instrument sheds light on some important issues.

1. I enjoy writing stories
2. Others think I am good at writing stories
3. I enjoy using computers to be creative, tell stories, or make movies
4. How confident are you with using *Kahootz* for telling multimedia stories?
5. I experience frustrations when working at a computer
6. I manage my computer files and know where things are stored
7. Others think I am good at using computers
8. Others think I am an organised and efficient worker
9. I enjoy working on long projects and like to do a good job to get my work finished
10. When I meet challenges in my work I don't give up easily

Figure 1: Sample item

I enjoy writing stories						
	1	2	3	4	5	
This is not at all true for me	☐	☐	☐	☐	☐	This is very true for me

Data collection

The questionnaire was made available online (google docs). The pre-test was completed in the first third of the school year, prior to each class commencing the program of multimodal authoring. All teachers allocated class time for the completion of the questionnaire, leading to a return rate of over 80%. The post-test was completed at the very end of the school year, when each class had completed the project work. One suspects that the busyness of the school year in the weeks prior to the Christmas holidays was the main reason for a diminished return rate for the post-test.

Data analysis

Three statistical investigations were employed for the data analysis:

1. Considering the dataset as a whole, a comparison of pre- and post-test means for each item using a standard *t*-test, was conducted, followed by a calculation of effect size. Following the recommendation of Dunlop, Cortina, Vaslow & Burke (1996) not to use paired tests of significance to determine effect size, a paired *t*-test was not used. The statistical package *R* (R Development Core Team, 2012) was used to perform the calculations.
2. The *t*-test investigation was repeated for each class individually
3. The means for each class on each item were compared using the visual Gabriel comparison interval approach (Gabriel, 1978) advocated by McDonald (2009, pp. 132-136), as is illustrated in Figure 2 (see later in this paper).

Results and Discussion

Changes over the duration of the project

The overall mean for each item before and after engagement with the 3DMAP project is shown in Table 1. These are presented in order of effect size (Cohen's *d*). An effect size of 0.2 or above is conventionally regarded as "small", of 0.3 or above as "medium" and 0.5 or above as "large". So it can be readily seen from the table that the engagement with the long-term project work provided by

the 3DMAP project appears to have at least a “medium” impact in most, except for confidence with the software, where the effect is clearly “high”, and the effect for the enjoyment of long-term projects is negligible.

Table 1: Means and effect sizes for all items, showing changes over the duration of the project
Presented in order of effect size

Item	Mean Before	Mean After	Unpaired t test (n ₁ =523, n ₂ =304)
4: Confidence with <i>Kahootz</i>	2.914	3.622	t=-8.7633, df=709.432 p<0.001, d=0.65
2: Good at writing stories	3.069	3.536	t=-6.9481, df=695.551 p<0.001, d=0.52
6: Good file management	3.630	4.109	t=-6.9136, df=745.074 p<0.001, d=0.52
5: Frustrations with computer use	2.576	3.089	t=-6.0828, df=577.237 p<0.001, d=0.52
8: Organised and Efficient	3.307	3.760	t=-6.2678, df=661.435 p<0.001, d=0.50
7: Good at using computers	3.340	3.776	t=-6.2365, df=707.258 p<0.001, d=0.47
1: Enjoyment with writing stories	3.508	3.911	t=-5.7215, df=726.353 p<0.001, d=.43
10: Persistence	3.702	3.931	t=-3.4699, df=692.025 p<0.01, r=0.26
3: Enjoyment of using computers to be creative	3.635	3.901	t=-3.4114, df=702.376 p<0.001, r=0.26
9: Enjoyment of long term projects	3.773	3.855	t=-0.9913, df=653.309 p>0.1

There are two further refinements to the above initial interpretation of the data. Firstly, the effects were not uniform across classes. Investigating the data on a class-by-class basis show that the only item for which there was a significant difference between means for all classes was “others think I am good at using computers” (item 7). This is consistent with Hyun’s (2005) work, for instance, who demonstrated that competence with computers increased for kindergarten children due to a longitudinal engagement with project work supported by ICT. An increase in professed confidence with the software (item 4) was noted ($p<0.01$) for 7 out of 15 classes, which is further discussed below. For all other items, there was no significant difference between means ($p>0.1$) for any particular class.

The second refinement to the argument is by comparison with Hattie’s (2009) use of effect size. In his work on student achievement, Hattie described an effect size of 0.4 as being consistent with ‘teacher effects’ – that is, the best teachers without using any special strategies achieve an effect size of 0.4. Also, he describes effect sizes of around 0.15 as ‘developmental effects’ – a student who drops out of school and grows a year older will achieve an overall effect size of up to 0.15; so it is argued that an effect size of less than 0.15 is doing harm to students; anything higher than 0.4 is accomplishing more than the best teacher possibly could without using the particular strategy being investigated. Certainly, the data presented here is attitudinal rather than that of achievement, but it does suggest that engagement with an extended multimodal authoring project is:

- highly effective for developing confidence with the software being used
- quite effective for improving student attitude towards story writing, their proficiency with computer use, and their self-organisation
- better than maturation alone for developing persistence with tasks and fostering enjoyment in the use of computers for being creative; but
- in real terms, adversely effected the enjoyment of long-term project work, and the experience

was actually highly effective for promoting frustrations with computer use.

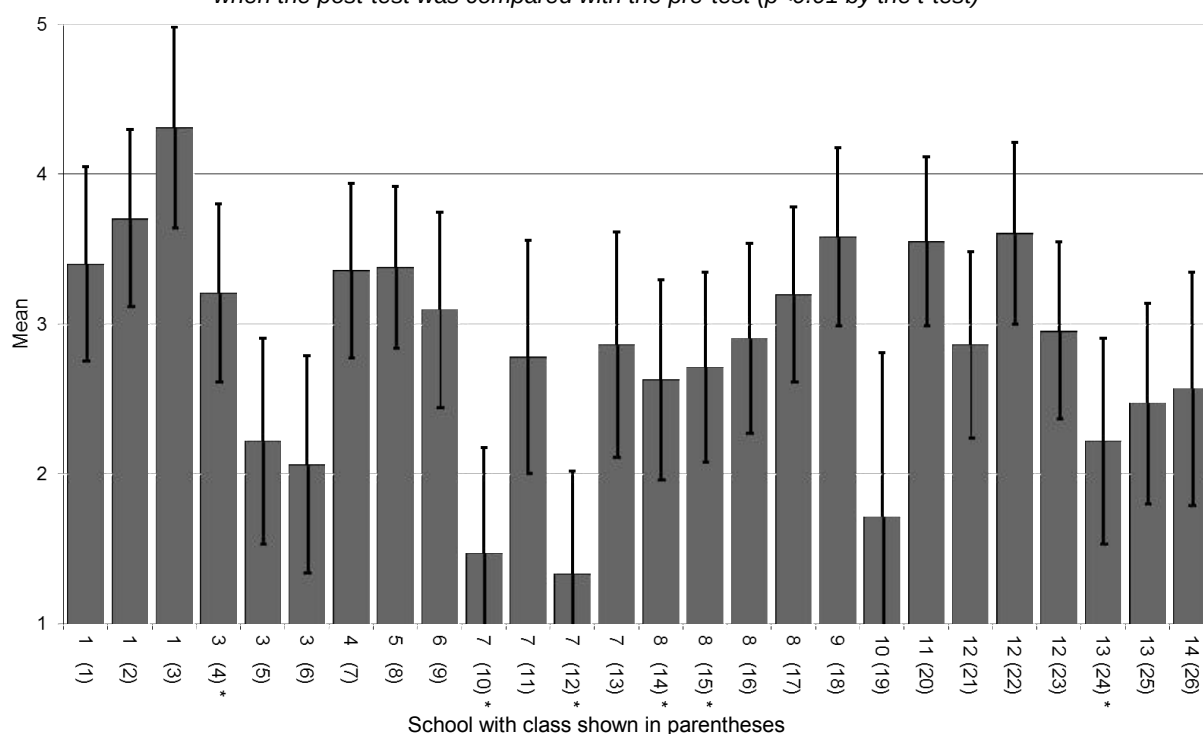
These types of results have been in the published literature for some time, though these are probably stronger results. For instance, Proctor and Burnett (1996) studied attitude to computers in the context of extended project work in Australian classrooms. In their study, attitude was considered to have 3 components: 'importance', 'confidence' and 'liking'. The extended project work: had no effect on 'importance', no effect on 'confidence' and there was a decline in 'liking'. Slightly surprised by the lack of apparent impact, Proctor and Burnett refer to even earlier research which indicated that game playing, when appropriated for a school purpose, was not rated as enjoyable by students. Insofar as multimodal authoring is a task which frequently uses software which is either exactly what students use for out-of-school game-play (e.g. *Minecraft*, *Second Life*) or is very similar to it (e.g. *Kahootz*, *Alice*, *Scratch*), it is reasonable to suggest that this same concern is echoed in the present research. What this study achieves is to confirm and reiterate the findings related to the complexity of attitudinal studies so that each generation of teachers understand that integrating computers in extended project work requires careful planning and may result in many affective and cognitive effects that were not initially anticipated.

Variations between classes

The analysis which compares the means between classes at the commencement of the study begins by considering item 4, 'confidence with the software', which is the most interesting case. The means for each class are shown in Figure 2. Primarily, this reveals considerable variation between classes. A large proportion of this probably arises from certain classes having used *Kahootz* previously (either earlier in the year of the study, or in previous years). Broadly speaking, the means for each class in the same school are not dissimilar. The classes where the mean for item 4 was significantly higher at the post-test are shown with an asterisk. This tends to be one or two classes at a school which are lower than the others at the start and are in effect 'catching up' to others in the same school as the study proceeded. There was no class where a decline in the mean for this item (let alone a statistically significant one) was noted, so it is reasonable to suggest that confidence with the software is either maintained or increased by prolonged engagement. The larger effect size for this item overall may well be due to a 'catching up' effect.

Figure 2: Comparison of pre-test means for each class on 'confidence with Kahootz' (item 4)

Means are shown with Gabriel comparison intervals (Gabriel 1978);
pairs of means whose comparison intervals do not overlap are significantly different ($p < 0.05$).
Asterixes indicate classes for which the mean had increased significantly
when the post-test was compared with the pre-test ($p < 0.01$ by the t-test)



Charts such as Figure 2 were produced to compare classes for all ten items in the pre-test. . These are not presented individually as the results are not especially startling. No statistically significant difference between pairs of means for classes could be identified for items 1 (enjoyment of writing stories), 2 (being perceived as good at writing stories), 3 (using computers to be creative) and 6 (managing files). The significant differences which are identified do not point to any systematic trend, but were: class 6 stands out as being statistically different to some others (lower ratings) in terms of being good at computers, personal organisation, liking long-term projects and persistence; one class at school 13 (25) also has a lower rating of liking project work; the other class at the same school (24) has a lower rating of being good at computers; and one class at school 12 (23) also has a lower rating for persistence. There is, really, a good deal of similarity on most of the measures amongst the schools and classes in this study at the pre-test.

There are significant differences in the study data, though, and these are identified between classes in the same school. It is possible that, under the oversight of one teacher compared with another, some classes responded differently to the survey compared with their peers. This may not be the only explanation. One cannot help but think of Grant's (2011) students who were 'sobered' by the reality of teacher expectations and who valued strong, informed engagement by teachers. Class-to-class differences in liking project work, being persistent and perceiving themselves as being good with computers by different ways in which teachers interact with their students – particularly when ratings of other matters which may well be more intrinsic to each teacher (such as 'enjoyment of story writing') are mainly invariant from class to class. One needs to be careful that the manner of the teacher and the nature of the work is not dampening down student perceptions of extended project work as fun and engaging, and having an adverse effect on persistence, perception of ability and ultimate success and enjoyment in the prescribed task.

Reliability and Validity

It is important to consider issues of reliability (can it produce similar results if used again in similar circumstances) and validity (whether it examines what it claims to examine) in relation to this investigation, and within that the matter of the instrument being a self-report. The advantage of a self-report approach is that it gives the respondents' own views directly – their perceptions of themselves and their world which are unobtainable in any other way. The main disadvantage of self-report is that there are a number of potential validity problems associated with it because each respondent's understanding of the items may be idiosyncratic, so the responses may bear little relationship to "reality", as seen by the researcher or others. Self-reported answers may be exaggerated (one way or the other), with a tendency to provide 'socially desirable' responses.

There is evidence within the data presented for the reliability and validity of the general indication that this study has considered (and these briefly stated 10 items are no more than that). Principal among this evidence is the considerable consistency between classes on items which are likely to be intrinsic to each student: enjoyment of writing stories, using computers to be creative, and so forth – no matter which class is considered, the results are much the same (i.e., reliability). If students have rated their knowledge of the software or their degree of persistence as low – and they have – then that speaks more to an honest response than a socially-acceptable response. If anything, it is likely that students have under-estimated their capacities with the items presented, and a more nuanced understanding of the affective domain in relation to long-term ICT projects will require a more carefully constructed and well-calibrated instrument. Nevertheless, this relatively coarse instrument has provided some important insights.

Conclusion and Recommendations

The specific findings are that, in a long-term project which involved intensive engagement with ICT, for upper primary school students:

- a perception of being good with computers, and being confident with the software tool both show a strong increase over the course of the study;
- potentially positive allied outcomes such as being good at 'file management' and being generally 'organised and efficient' are positively regarded, and improve modestly over the course of the study;
- Students perceive themselves positively in regard to the competence at writing stories' and having enjoyment with writing stories, and this perception shows a modest to strong increase over the course of the study;
- The perception of the computer as frustrating tool increased substantially; in addition, a sense of enjoyment to use computer to be creative, a persistence with difficulties, and enjoyment of long-term project work were in real terms probably adversely effected.

There are some individual classes where the indicators on several of these measures are concerning, but the results from classes are very similar for each of the 10 items.

From an ICT point of view, it is quite good news: more exposure to computers leads to greater confidence and an elevated perception of competence, and this seems to be unaffected by genuine challenges or frustrations encountered in the process.

From a literacy point of view, the news is also good, but the effect not quite as strong as for the ICT items. The capability with, and enjoyment of, writing stories are both enhanced by engagement in a longitudinal multimodal authoring project. Also, there is no basis for suggesting that classes with a greater sense of being good, or enjoying, story writing will perform any better than classes that don't: the data for these measures is quite similar, and yet considerable variability in the quality of multimodal work between classes has been described elsewhere (Chandler, Unsworth, & O'Brien, 2012).

Yet despite all of that, the students are not likely to have come out of the 3DMAP program singing the praises of extended project work: their desire to be persistent has not been enhanced and their urge to be creative with the technology has possibly been diminished. That is hardly good for the child, the teacher nor a good advertisement for the approach. It resonates, though, with other studies in which student enthusiasm has been ‘sobered’ by teacher expectation and engagement – and places the spotlight clearly on the teacher to develop the student affectively as well as cognitively. We note, though, the finding of Jamieson-Proctor and Burnett (2002) who found that ‘purposeful integration’ of computer technology positively affected the personal creativity characteristics of students. In relating findings about extended project work and ICT to a next-generation of teachers, one of the important issues is about organizing the teaching and learning of multimodal authoring such that it is, and is seen to be, highly purposeful.

The study, by its nature, does not give any insight into the impact of various affective or allied areas of knowledge on the quality of student outcomes in their multimodal authoring work. It is possible that the initial speculation that capacity with factors such as file management, personal organization and persistence were nevertheless important. One therefore wonders what the quality of the product would be if the teachers deliberately taught these allied areas alongside the main agenda of a multimodal authoring product. It may be simply providing a context in which these aspects might develop is insufficient – that teachers need to be more deliberate about teaching the teachable, allied areas of knowledge and attitude which are associated with certain units of work. Further investigation is required to investigate these interactions.

In the current era, when multimodal authoring is an increasingly important component of literacies curricula, most frequently implemented through extended project work which includes intensive use of ICT, recommendations from this investigation are directed to both the teacher and the curriculum designer. To the teacher: it is important not to be over-committed to the destination at the expense of the journey. Persistence, motivation, self-management skills, personal relevance of the work, an emotional anchor, and choice are reasonable expectations that students have of extended project work, and may interact in important ways with the quality of the end product and students’ long-term motivation for engaging in such projects. Affective and allied content knowledge should be not only valued wherever possible, but actively taught as necessary. Curriculum designers (and researchers), too, need to be conscious of the journey as well as the destination. For instance, design of project work which is of optimal length which maximizes learning and motivation and avoids students being ‘burnt out’ by the topic is important. It cannot be assumed that certain allied learnings will be naturally emergent through such work, and matters such as file management, personal organisation and persistence will need to be explicitly planned for.

In conclusion, we might ask ‘was the 3DMAP project a success?’ The answer has to be ‘yes’. Other data from the project (Chandler, 2013) clearly indicated that students commenced with a very limited prior knowledge of *Kahootz* or related software – they learned the basic tool required for construction of multimodal texts because of what they were taught in class, and report an increased confidence in using and with computers in general. In the face of this overhead, indicators of competence and confidence with both ICT and story composition suggest strongly positive growth. We know that keys to further enhancing the impact of such work involve minimizing frustration with the software and maximizing persistence and enjoyment of long-term project work.

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REDEFINING EDUCATION?

1:1 COMPUTING STRATEGIES IN VICTORIAN SCHOOLS

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Abstract

This paper focuses on three schools in Victoria (Australia) that introduced 1:1 mobile computing devices for students' use in learning. Each began their roll out of devices in 2013. It was a time when an interest in Bring Your Own Device (BYOD) strategies was beginning to appear in popular media (Topsfield 2013) as a response to the cessation of various Federal government funding programs for buildings and 1:1 computing in Australian schools. Although each school had an interest in BYOD each chose to introduce a programme that mandated a specific device be purchased or leased. The decision to go to a specific device was based on simplifying the management of the restrictions placed on student uses of the device. The schools individually adopted different forms of student ownership of the devices extending from full purchase to leasing arrangements with different levels of school and personal responsibility for the device. It is not possible to attribute changes in how learning occurred to the introduction of the devices alone. It is of note that the shift to 1:1 computing largely reflected or amplified changes to teaching and learning that surrounded and pre-dated the introduction of the devices.

Introduction

Mobile, portable and hand held computing in Australian schools were being reported as part of some schools' programmes as early as 1992 (see for example: Gifford, 1992; Albion, 1999; Stradling, Sims, & Jamison, 1994). In the intervening period there have been various programmes to move to some model of 1:1 computing in individual schools (e.g. Fluck 2011). In 2008 the Federal Government provided over AUD\$2billion, through a programme called the Digital Education Revolution (DER), for each student in Years 9 to 12 across state system schools to have a computer or laptop device allocated to them (Department of Education, Employment and Workplace Relations, 2008). In 2013 this funding was coming to an end. At the same time two other sources of funds were also winding down: one for school infrastructure, called the *Building the Education Revolution* (BER); the other was the last stages of the *National Secondary School Computer Fund* (NSSCF). During that year it was reported in the media that some Victorian schools were considering Bring Your Own Device (BYOD) programmes, as a way to respond to the loss of funding from federal government programmes for 1:1 computing and school building programmes, such as the *DER* and the *BER*.

The \$2.4 billion "digital education revolution" was a key plank of Labor's 2007 election pitch. However the funding agreement ends on June 30, creating headaches for schools when ageing computers need replacement... The report by the Digital Education Advisory Group – which was asked to identify future strategies – said a move to a bring your own device policy would result in a shift away from the expenditure needed to continually replace computers in schools. (Topsfield 2013).

BYOD (Bring Your Own Device) is a model in which student bring in their own devices,

which can be registered with the school and connected to the school network. Lee and Levins (2012) identified a shift from BYOD to BYOT (Bring Your Own Technology), which they described as a shift in power from the school to the home. The Queensland Department of Education, Training and Employment (2013) coined the term BYOx to refer to Bring Your Own (BYO) models in which the school specifies which devices can be brought into school.

Aligned with many earlier claims for how digital technology will transform education (for example: BECTA 2005; Garrison & Anderson 2002; Graves 2001), BYO approaches are heralded as transforming of school practice by some educational literature. For example Ackerman and Krupp (2012:p 6) posit:

Through the use of Bring Your Own Technology (BYOT), teachers and students can change the focus of the classroom and become more student-centered... This research depicts how BYOT will revolutionize education and create a new prototype of learning both inside and outside of the school setting.

In the general context of such claims, a series of 22 case studies carried out in England in 2012 looked at the impacts that digital technology strategies such as 1:1 computing and BYO were having. Meta-analysis of these 22 ‘Vital Studies’ (as they are known) resulted in 11 dimensions of practice related to changes in schools (Twining 2013; Twining 2014). These included dimensions related to: the model of technology provision; who pays for the digital technology used in school; the role of the teacher; the role of the students; the impact on the curriculum and/or pedagogy. The Provision dimension, which is illustrated in Figure 1, distinguishes between 1:1 computing strategies and BYO approaches. A 1:1 approach assumes that every student will have a particular model/specification of device. In a BYO model some students may not have a device. BYOD and BYOT, unlike BYOx, does not specify what devices are acceptable, so students may have a wide range of different devices.

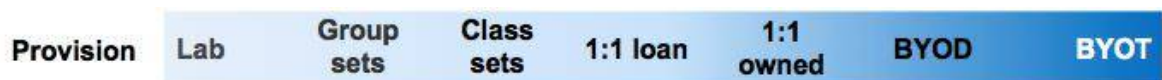


Figure 1 Provision Trend: how digital technology is organised (Twining 2014)

This paper reports on three case studies, which explicitly built upon the Vital Studies, utilising a similar methodology and being informed by the dimensions of practice identified in that project. A particular focus in these three studies was the extent to which implementing 1:1 strategies had led to changes in the schools’ provision or practices.

Methodology

The three studies reported here were the Victorian component of a series of 13 studies carried out in Australia between September and December 2013, which are referred to as the Snapshot Studies (see http://edfutures.net/Technology_Strategy_Case_Studies#The_Snapshot_Studies). The Snapshot Study schools were selected based on the researchers’ local knowledge of schools that were engaged in the implementation of mobile device strategies. Table 1 provides a summary of these three Snapshot Study schools.

Table 1 Summary of the Snapshot Study schools reported here

	<i>School X</i>	<i>School Y</i>	<i>School Z</i>
<i>Type</i>	State	State	Catholic
<i>Phase</i>	Secondary	Primary	Primary
<i>No. students on roll</i>	1800	440	466
<i>Digital technology strategy</i>	1:1 iPad	1:1 iPad Years 5 & 6	1:1 laptop Years 5 & 6

The Snapshot Studies used a cut down version of the methodology used in the Vital Studies (see http://edfutures.net/Research_Strategy). They involved data collection during one day spent in the school by the researchers. As one might expect given the practicalities of doing research in schools, there were minor variations from the standard methodology in each of the Snapshot Study schools. These are summarized in Table 2.

Table 2 Variations in the methodology

	<i>School X</i>	<i>School Y</i>	<i>School Z</i>
<i>Questionnaire</i>	None	Principal ICT Coordinator Yr 6 teacher 2 parents	Principal ICT coordinator / Yr 5/6 teacher (same person) 2 parents
<i>Interview</i>	Principal ICT coordinator Teacher of Japanese Parent	Principal ICT coordinator Yr 6 teacher Parent	Principal ICT coordinator / Yr 5/6 teacher (same person) Parent
<i>Focus group</i>	4 Yr 8 students	1 Yr 6 & 3 Yr 5 students	5 Yr 5/6 students
<i>Observation</i>	Yr 8 Humanities	Yr 5/6 Humanities	Yr 5/6 Literacy

Overview of the three schools

School X

School X was a state funded secondary school, which had been moving towards team teaching in flexible (open plan) areas, with time divided equally between direct teaching, independent study and collaborative work. They trialed iPads, initially in Japanese, and concluded that they fitted well with their pedagogical vision. They therefore decided to roll out a 1:1 iPad programme from January 2013 in Years 7 and 8.

School Y

School Y was a high performing state funded primary school. Each classroom was provided with an interactive whiteboard, six laptops and six iPads. In addition, parents of students in Years 5 and 6 were expected to provide their children with iPads with a set of 'school apps' for use in school. 90% of Year 5 and 6 students did bring in their own iPad from the beginning

of January 2013. The principal saw digital technology as an important tool in society and thought it should also be a tool to support learning.

School Z

School Z was a Catholic primary school whose vision was about contemporary learning. Key elements of this included collegiate teaching teams working in open plan spaces, in which learning was shared and visible. In January 2013 the school moved from having 1 laptop between 2 students to 1:1 provision of Windows laptops in Years 5 & 6. Part of the motivation for moving to a 1:1 scheme was to address equity issues by ensuring that every student had a device that they could use at home (as well as in school).

Discussion of the data

Funding and types of 1:1 programs

In Schools X and Y parents were expected to provide the devices for their children. For the very small number of students for whom this was a problem School X subsidised the cost in association with local organisations, whilst School Y provided iPads in each classroom which could be used by students who did not have their own device. Thus Schools X and Y align with the ‘Home’ category on the Funding dimension from the Vital Studies (Figure 2). In School Z parents were expected to make a financial contribution towards the cost of the devices, which remained the property of the school. This aligns with the ‘Subsidised’ category in Figure 2.



Figure 2 The Funding Dimension (Twining 2014)

The funding models had been carefully thought through in each of the schools. Parents interviewed for this study mentioned consultations with parents as part of the 1:1 implementations. Paying for devices appeared not to have been the main issue for parents in any of the three schools. Where parental concerns were reported these related to other features of the proposed strategies. For example, School Y’s principal explained how one parent had reacted:

... so he wasn’t against the 1:1 device program he just wanted to know ‘why Apple?’
(School Y, Principal Interview)

A very small number of families who were not able to meet the cost were supported by being provided with a device that they did not have to pay towards.

Device Use and Changes to Practices Data

The data collection and analysis had an intention of exploring the extent to which introducing 1:1 strategies in these three schools led to changes in practices. Even with the different implementations based on the types of ownership and funding models outlined above, the shifts in school practice were not that great. In what follows we first draw attention to similarities in observations made across the three schools in terms of practice. These

similarities tend to blend or overlap with considerations of classroom layout and BYO use, such as classroom management issues, and shifts in student and teacher roles that were already commenced. Device use was observed to enhance both traditional practice and changes already occurring.

Similarity 1: More access but apps do not change practices

Across all three schools a feature of the 1:1 devices was the facilitation of teaching tasks and student access to digital information and digital activities undertaken with the help of “apps” (computer applications) available through the devices used. Comments at interview were that individual students benefited from independent work using different easily accessible apps on their own device. These apps could be easily referenced by the teacher, often to do work similar to that done without apps. Quizzing apps were an example of such. A difference was that some allowed the student to gain instant feedback by benchmarking work against other students. For example, the language teacher at the School X enthused about their iPad programme:

Quizlet is just the bomb, I love it ... You don't have to create the lists {Yeah} other teachers have gone there and there's free access {there's thousands of them aren't there} and the kids love it and it gives them a chance to benchmark themselves, to get a time and to beat it and for individual practice

(School X, Teacher Interview)

Similarly, a teacher interviewed at School Y saw advantages for students in that they were able to independently access a range of content and various levels of class and home work since the introduction of the 1:1 iPad programme:

You would see a lot more independent learning. You would see more student engagement. You would see more motivated students. You'd see students thinking outside the box. You would also see the students working collaboratively together, a lot more efficiently as well. You'd see them extending their learning so they're taking it home and doing things. They're coming back to class and they've completed what they're meant to do already. They're going on and extending themselves. For example at the moment we're doing algebra in maths and when we jump onto this wonderful algebra site we've got some kids doing quadratic equations and Fibonacci sequences and they're 10 years old, you've got other kids just filling in a blank box – so it really differentiated the learning

(School Y, Teacher Interview)

These sorts of uses were popular and apps provided useful ways of tracking diverse student work and progress. However, it did not necessarily follow that new or innovative learning pedagogies were implemented. Traditional approaches were made more efficient. The expanded choices on tasks, access and levels of task were not necessarily innovations in pedagogy.

Similarity 2: Diverse activity in class but teacher still centre

In both the above observations of similarities in expanded access to traditional tasks, the perception of change was based on an expansion of choice and centering teacher ability to manage this. The teacher at School Y went on to say:

I think it has changed the way we teach as in we're placing a lot more responsibility on

the shoulders of the kids. ... I might have previously come in with 3 levels of worksheets ... now we don't do that we come in and say 'here's the mini lesson, ... you may decide that you're this level this level this level off you go' and we have 31 kids doing basically 31 different things. So it's completely changed the way we research, we teach.

(School Y, Teacher Interview)

However, the same teacher was clear that the teacher's role was still crucial in setting a "brief" for the task or activity, facilitating the work, and providing feedback. He acknowledged that part of letting the "kids decide their level" was letting them decide not to always use the iPads for the task. This was corroborated by observations, in which students were seen working in small groups or pairs planning presentations or posters on 'disasters and how they are dealt with'. Some were using iPads to access the web, and just as many were transcribing text by hand from illustrated textbooks. Many were using pencils to draw images into workbooks.

The student focus group from School Y verified that they choose to use different media at different times in response to being given some direction by the teacher, but also in response to being given a choice as to which media to use.

S4 Normally they say make a presentation so we have like a

S2 They want us to use our imaginations

S3 To be creative

S1 So they don't like tell you to do a specific presentation like they tell you what topic you need but they don't tell you what how you're meant to do it so you have a variety of what you can do

(School Y, Student Focus Group)

Similarity 3: Enhanced ability and enablement of already strived for practices

The principal of School Y pointed out that the whole school followed a particular way of structuring lessons that hadn't been changed by the 1:1 programme, though he expected that tasks within that overarching framework would change over time:

Now they might do it on the iPad, so it's a sort of Substitute ... Now because we use the SAMR model [see <http://edfutures.net/SAMR>: substitution, augmentation, modification and redefinition] and we're still developing in that area obviously, but we're really trying to take that to a higher level so rather than just substituting we're trying to replace the task with technology as best we can. It's a journey.

(School Y, Principal Interview)

What the principal saw as differences were devices replacing older methods. The potential shifts of note were access to information "at their fingertips", the ability to create, record, photograph, film and present information, and to be able to actively involve parents, grandparents, and students who are away from school in their classroom activities. A teacher at the same school illustrated this facilitated enablement:

... one of the great things about having a 1:1 device is that it enables the parents to come into the room as well, but virtually. So, for example, let's say that your daughter is giving a presentation about <pause> I don't know <pause> about micro-organisms well we organise a time with you when she's going to be presenting, you swipe in on Facetime or

Skype, the iPads up, you're watching her live give her presentation to the class ...

(School Y, Teacher Interview)

He went on to provide a range of other examples. Whilst much of what was described might have been possible with older or desktop technologies, Traxler (2010 p.5) argues that these earlier desktop technologies were too restrictive because the learning there:

...takes place in a bubble, and in dedicated times and places where the user has his or her back to the rest of the world for a substantial and probably premeditated episode

Whilst, in this case, providing access into the classroom from outside was attributed to the 1:1 programme, it was clear that the overarching pedagogical framework, the desire to involve parents and family and bring the outside world into the classroom, pre-dated the 1:1 programme. The availability of mobile devices made their goals easier to achieve, rather than having caused a change in the school's approach or pedagogy.

The Principal at School Z saw differences in the way students were working particularly in the way students accessed documents and information but when asked about what she had not noticed in the ways teaching had changed with the BYOD responded that:

Probably not a lot in type of teaching, but the difference in how students could access information that they couldn't before – in maths particularly teachers started to upload lessons and resources so children had constant access to that, at home and at school. The other element was teachers setting up collaborative documents on group projects where students add pieces in – they're able to work collaboratively. We're starting off being able to access learning anytime anywhere, but what they were doing in teaching probably wouldn't change significantly.

(School Z, Principal Interview)

Similarity 4: Concerns about clarity

The number of different media the teacher used to make sure students had an idea of what was to be done emphasised the need for clear teacher direction of tasks. There were sometimes three versions of the same guidelines available for students to check: on a whiteboard, on worksheets, and sent as digital instructions as either emails or uploaded to websites.

Just as it was up to the student often to choose to use the device or not for a particular task, the students at School X reported that they often transcribed to workbooks the instructions or timetables, even though they were available digitally, because it made it clear what they were going to do.

Similarity 5: Devices, team teaching, student team work and already open plan spaces.

The physical layout in all the classrooms visited in both the secondary and primary schools supported group and individual work, rather than having desks in rows facing the front. This allowed group work and/or team teaching approaches. The devices were not a central or determining factor in these classrooms. They were used as a resource in much the same way desktop computers may have been used in the past. However, the tablets were clearly less intrusive than a bank of desktop computers would be. In all the classes observed it was evident that one, or more than one teacher, was responsible for the open plan room and the

way learning was organised in that space.

Choosing to use or not to use the device for a particular task was not always the way every teacher chose to manage 1:1 use. It was pointed out by one of the teachers at secondary school X that they liked to be in control of device use:

I like to I guess I like to keep control over when they use it and when they don't. If I had a student using an iPad when I hadn't specifically said, 'Ok iPads out' I'd be immediately saying 'iPad away' if I suspected they weren't using it appropriately I'd be asking them to bring it up to me and show me their iPad. Do a double click, see what's open or I'd simply if I felt it was the wrong time I might hold on to their iPad for the end of the lesson. If I have proof they're on a game as a coordinator I'd we hold on to it till the end of the day and they'd come and collect it.

(School X, Teacher Interview)

The earlier observation that team teaching and student team project work were not necessarily due to the introduction of 1:1, similarly applied to classroom management. One of the teachers interviewed at X, the secondary school, noted there had been a substantial change to classroom management in the open plan classrooms and that the team teaching aspects made this easier, but iPads were undermining this:

Before the iPads and we already saw a change in the type of distraction we were getting and misbehaviour in classroom we had a lot less, just a massive drop and that's largely attributed to having more than one teacher in a space and that passive supervision, so more sets of eyes equals less trouble. ... if I'd of said maybe two years ago 'Open your textbook' if they were quiet and had their heads down looking at their work I could be pretty confident they were doing that. Now if they are quite with their heads down looking at their work I still have to double check that there's not that temptation they haven't just click click slide and they're sending an email or they're looking at something that someone sent and so that's a bit of an unknown for us still.

(School X, Teacher Interview)

At primary school Z, classroom management and individual scheduling of when each student did literacy tasks were both facilitated enormously by each student having access to their own laptop device. The coordination or classroom management was based on student accessing an online timetable and self-selecting what they would be rotating through in 20 minute blocks. Student self-selected activities based on guidance from teachers and on their own preference for the order in which tasks were done. Whilst this might have been possible to do on paper or on a whiteboard, keeping track of updates and weekly changes was made more manageable, for both the teacher and the students, through the online timetable. This timetabling arrangement was facilitated by student having access to a laptop so they could regularly check and update their schedules. However, as before, whilst the laptops enabled this sort of approach, they had not caused the change in pedagogy.

Similarity 6: Devices and already shifting pupil roles

The changes noted in all three schools involved the 1:1 programmes supporting or amplifying

moves that the schools were already making toward student centred learning. These involved changing the role of the pupils as illustrated in Figure 3, which shows the Pupil Role dimension from the Vital Studies.



Figure 3 The Pupil role dimension (Twining 2014)

Although there was a move in all schools to a more student centred choice and work, the choice was very much limited to clear directions and the specification of limits by the teachers.

Similarity 7: Devices and Teacher Roles as Managers not Co-learners

1:1 programmes in these three schools were at early stages, but changes in teacher roles, with a shift towards becoming facilitators and learning managers were evident alongside shifts to more student centred pedagogies. These correspond with changes identified on the Teacher Role dimension from the Vital Studies. However, there was little evidence in these three schools of teachers taking on the role of co-learners alongside the students. Once again existing roles were emphasized rather than 1:1 shifting roles.



Figure 4 The Teacher role dimension (Twining 2014)

The principal in School Z saw 1:1 as enabling better distribution and more ongoing access to resources that teachers were guiding students to (as evidenced by earlier quotes). The difference pointed to, is one where students are expected to find out, rather than relying only on the teacher telling (Wiemer 2013).

Conclusions

The observed implementation of 1:1 programmes were not by themselves identified as transforming of teaching and learning in any of the schools. 1:1 became a part of pre-existing pedagogical approaches, which in some cases had already led to other significant changes in the school, such as in classroom layout. Thus, for example, the ICT coordinator in School Z characterized their school's 1:1 programme as part of an overall "vision" that was reflected in the open plan established thanks to the BER school buildings fund:

And in the last 7 years or so [pause] we've come to fruition I suppose a vision of [pause] shared learning, learning that is visible, learning that happens in communities and so that's reflected in the open plan that's been established in the last couple of years thanks to BER funding.

(School Z, ICT Coordinator Interview)

1:1 and BYO programmes were a good fit with these new spaces and new more open team teaching practices and shared learning approaches. It seems probable that the pedagogic foundation predated the new buildings. The contribution of a new device programme overlays these development and appears to be complementary. Thus the 1:1 programme was

not the ultimate causal agent it was more of an amplification of a range of processes. However, there is no doubt things were changing in these schools, and the 1:1 programmes were embedded and working in combination with various other arrangements, including room layouts, new timetables, acceptable use policies, strong Wi-Fi networks, consultations with parents, and more. Some of these, like consultations with parents were directly related to the 1:1 initiatives, but most arrangements were already in place before the 1:1 programmes. Others, for example extending WiFi networks, although basic networks were already in place, were identified as requiring upgrades to increase capacity to enable the 1:1 programme to work.

1:1 was found to be more of an amplifier of pedagogic and physical adjustments already underway. Some significant changes were observed along the dimensions identified by the Vital Studies, such as Model of provision, Funding, Pupil role, and Teacher role. The first two of these changes reflected changes to funding and the last two were changes in directions that the schools were already focusing on. The 1:1 programmes aligned with these changes, they facilitated the changes and were reciprocally facilitated by them. The three 1:1 programmes were in early stages and were advancing and maintaining changes in ways compatible with what had already commenced.

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IS THE 21ST CENTURY LEARNER STILL RELEVANT IN 2014?

Jill Colton

Abstract

The term 21st century learner may be seen as outdated by some, but it seems to persist in texts used by teachers to inform their perspectives on teaching and learning. In this paper I consider how the figure of the 21st century learner, travels into a school. I do this by reporting on the discussion of 8 teachers at a South Australian secondary school who were asked 'how do you understand the 21st century learner?' While their answers to this question commenced with claims about the way that students (and teachers) use digital technology, it developed into a discussion about knowledge – how it is accessed, filtered, organized and created by contemporary students. In this research I asked the teachers to identify some of the texts that informed this understanding of the 21st century learner and this paper will present an analysis of one of these texts in order to trace the way that knowledge about learners and learning is transported into and around a school. I argue that it is important to analyze the way that this figure of the 21st century learner is taken up in the school because of the way that it informs teachers' knowledge about (innovative) pedagogy.

Introduction

The 21st century learner is a term that has emerged to represent students as different from the past, mostly due to their use of digital and media technologies. Inherent in the notion of 21st century learner is a projection of the future and the 21st century learner can be seen as a way of imagining what students and learning practices will be like in a future time. But now that we are in the 21st century some people have said to me comments along the line of, 'why are we still using this term? We are over a decade into the 21st century so why are we still talking about 21st century learners?' These comments might be used to illustrate how the figure of the 21st century learner works within a futurist discourse and may also invite us to consider the work that the 21st century learner does in a contemporary context. How do teachers understand this term and how is it taken up in their thinking about contemporary students?

When I began thinking about my topic for research in 2009 I felt that the term 21st century learner was difficult to define and in my own attempts to understand this term I found a video on Youtube titled 'A Vision of K-12 Learners' (Nesbitt 2007)



Figure 1. Still from 'A Vision of K-12 learners'

This video got me thinking about what this term 21st century learner meant. It also got me thinking about how teachers were responding to the ideas behind the words 21st century learner and also about who was constructing these 'truths' about students.

While I found that the idea of 21st century learners was vague and difficult to define, I also noticed that these terms were being used widely in my workplace and in my professional circles of communication. I saw it as a concept that would allow me to investigate a phenomenon that is happening ‘out there’ and to think about what that means for what is happening in a school, on a local level. In their policy genealogy, Williams, Gannon and Sawyer (2013) trace the figure of the 21st century learner through policy networks including the Melbourne Declaration on Educational Goals for Young Australians Melbourne Declaration on Educational Goals for Young Australians (Ministerial Council on Education, Employment, Training and Youth Affairs [MCEETYA] 2008) and the Australian Curriculum (ACARA 2012). They also present a discourse analysis of a recent book on 21st century learning that is available commercially to teachers. I share their interest in “the extent to which policy mobility has implications for how the most fundamental aspects of education, such as curriculum, are inflected in local contexts” (page 2). This is why I have positioned the 21st century learner as a travelling construct in my research – as I consider how it interacts with both traditional and innovative pedagogies and the use of digital technologies in a local school.

In the Youtube clip mentioned above “A Vision of K-12 Learners”, 21st century learners are represented as young people who use digital texts and digital literacy practices in ways that are liberating, empowering, engaging and also different from traditional school practices. How does this view of learners fit in with research in the field in the last 20 years? A review of the literature shows that there have been many studies of young people and their use of digital technologies and digital text (Green and Bigum 1993; Selwyn 2003; Buckingham 2007; Knobel and Lankshear 2008; Rosen 2010; Kupiainen 2013). In addition there have been various typologies used to describe young people as users of digital technologies – digital natives (Prensky, 2001), the wired generation (Hanman 2005), the i-generation (Rosen 2010) and the digital generation (Schwartz 2013). Green and Bigum (1993) used the phrase “aliens in the classroom” (page 119) to highlight the significant way that they saw digital technologies changing culture and knowledge while Kress (2008) used the term “transitional generation” (page 253) to focus on a move from predominantly print and written word based text to screen and visual and media based text. In all of this literature, there is a focus on the use of digital technologies and digital literacies and there is also a focus on educational change.

The Data Collection

The focus group data collected here forms part of a larger single school ethnography in which I aim to trace the discursive construct of the 21st century learner into the school. The methodology can be described as a critical ethnography in the way that qualitative data is collected from a local site through focus groups, interviews, classroom observation and collection of artefacts, and analysed using a discourse analysis approach which questions claims of truth in terms of power and identity (Carspecken, 2001). In this first project, I invited teachers at the school in which I work, to be involved in focus groups where I asked the question what do you understand by the 21st century learner? Eight teachers replied to my invitation and I organised mutually convenient times for them to meet with me in groups during Term 3 and 4 2013. Upon request, participants also forwarded links and details about texts they had read or viewed that had informed their views.

From these focus groups I have identified three themes:

- 1. Defining the term 21st century learner**
- 2. Digital technology and the 21st century learner**
- 3. Knowledge and the 21st century learner**

In the last section of this paper I briefly discuss a TED talk given by Sugata Mitra that was referred to by three of the teachers in this project.

1. Defining the term 21st century learner

In the focus groups I asked the question, ‘what do you understand by the term 21st century learner?’. In the first focus group, this was a problematic phrase and the term ‘contemporary learner’ was favoured by one person who said that, *“I’m probably the worst person to have in the room because I hate the term with a passion”*. His argument was that he preferred the term contemporary learner because ‘contemporary’ is about our day and age – so it is about learning about and for our day and age whereas the term 21st century learner was part of a futurist discourse from 10 or so years ago and so was not relevant anymore because we are now in that future. He also noted that the term seemed to be used by the (commercial) vendors at a recent education and technology (EduTECH) conference.

And that’s why I’m worried about it (the term 21st century learners) because we’re actually almost at the next year’s EduTECH, its’ pretty much banned. And the only people who use it are the vendors who were trying to impress the educators,. And we were going, ‘Yeah, move on.’ (Tim, English Teacher)

A concern with the commercialisation and mediatisation of the term is also alluded to in this comment by one of the other teachers involved. She said that:

I have suspected for a long time, that it’s a term that’s been bandied about in the press, in schools, and that it’s possibly been overused by people who really are not absolutely sure about what it actually means. And I suspect that there isn’t just one meaning and that, you know, 21st century learning can be described in numbers of ways by numbers of different people. (Anna, English Teacher)

The 21st century learner can be seen as *“in some ways a catch-all phrase that tends to stand in for a collection of ideas that may vary from site to site”* and this may be where confusion about its meaning comes from (Williams, Gannon and Sawyer, 2013, page 3). Williams, Gannon and Sawyer also mention that *“the ‘21st century learner’ is also associated quite literally with a particular ‘brand’ in many of its recent articulations.”* This supports what some of the teachers said in regards to their concern with the corporatisation and commercialisation of the term and with the difficulty in defining it.

2. 21st century learners and digital technology

In this project, teachers at a particular site were asked what they understood by the term 21st century learners and in their responses some themes emerged which reflect how students were being constructed. In this section of the paper I will focus on **one** of these themes - the connections made between contemporary students and digital technologies. All of the eight participants in the focus groups talked about technology as integral to ideas about 21st century learners. Students were clearly positioned as users of digital technology and in some cases the teachers also identified themselves as users of technology. Technology was referred to by all of the teachers as a tool which allowed for a range of teaching and learning behaviours such as engagement, access to information, authenticity, immersion, high order thinking and differentiation. The use of digital technology to access information was a key point in the focus group discussion.

The way that digital technology allows for access to information was referred to by 7 of the 8 teachers in this project. Year 7 teacher, Jack, said that students have easy access to information at home. He said: *“...for 21st century learners I think we need to recognise that we are dealing with families, with students, who outside of school have **access to information** at their fingertips.”*

Anna compared old ways of accessing information with new ways. She said that instead of *“tracking*

to the library, working through call cards, going to the, you know, pulling out, finding the right page number” which would be a “20 minute process” - students and teachers can use technology as a tool to get information, which she qualified by saying: “That is a one-minute process.”

Another teacher said that:

“...what we’re doing now with kids is we’re actually saying, “You know what, I know some things, so point me in some good directions, and guess what, you are lucky enough through technology to have access to a whole range of information I’d beg to know about. But we’re going to go in here and my job is to help you make sense of that where I can, and your job is to help me make sense of some of that as well because I don’t know it either.” (Tim, English Teacher)

In these three examples, students are described in relation to the way that they can access information through digital technology. But, the teachers’ comments also work to construct the teacher – Jack said that the teacher needs to recognise these (21st century) students in a way that is perhaps different from the past; Anna’s comments compare the way that we (as teachers) accessed information with the changing practices of today. In Tim’s comment, we (the teacher) are constructed as a guide but also as a co-learner.

Jenny, the Year 11/12 Geography Teacher stated that she loved using technology in her teaching work because of its tool-like qualities.

I mean, obviously I love technology. I love using it. But I love it because it makes these things easier for us to, you know, get the information, easier for us to organise things and so, yes, very much technology is the tool. (Jenny, Geography teacher)

For her, technology was something that allows students, and herself, to access information – and in the comment below she refers to the way that access to information (such as Google Earth) enables her to bring the real world in to her classroom.

If we’re talking about contemporary: as a geography teacher, so cool, I get magnitude of earthquake updates, you know, on the minute that you would never have got before, so you can constantly be bringing in, for me, the real world that we live in on a daily or hourly basis if you really want to. (Jenny)

Twenty first century learners were clearly being positioned as users of digital technology to do ‘school things’ – but there was further discussion on the impact of the students’ preferences on what is valued as learning or, in other words, the acknowledgement or power of what young people see as being worthwhile learning. Anna said that “for me it’s more about what 21st-century learners value” and what students value “is the knowledge and understanding of things or elements that are critical to them”. Anna’s point is that there is some knowledge that is more critical to today’s learners – this is about the way that learners can access a broad range of knowledge so what students see as valuable or worthwhile to them is what they will learn.

In each of these comments can be seen the positioning of the student in relation to technology, information and knowledge. In the construction of students as 21st century learners who are closely aligned to digital technology, can also be seen the construction of teachers who, as shown in the comments above, are responding to these ‘new’ students, ‘new’ technologies and changing roles.

3. Knowledge and the 21st century learner

I now move onto my third theme and in this section I highlight some of the ways that the teachers in this project talked about knowledge in relation to contemporary students. My purpose here is to shed some light on the way that students are being constructed as 21st century learners. I will start with Julie's comment about the implications of being able to access a large amount of information easily and quickly. Julie said:

It's what you do with that, that information, and how you value it and how you order it; so, you know, recognising or being discerning, I suppose, with data and information.
(Julie, Science Teacher)

There was a lot of discussion about what students do with information – how they select, order and evaluate it, such as this comment by Jenny.

Now that contemporary learning in a contemporary world for me means not knowing, the need to have to know this amount of information and that amount of information; so content is present but not the emphasis for me. So I think it's the skills in thinking, in evaluation, in problem-solving. That's far more central, I think, to that learning, to 21st-century learning. (Jenny, Geography Teacher)

In this comment there are a couple of things going on. First she uses the concept of 'not knowing' which links to the way that information can be easily accessed through the internet on a needs basis. Then she moves into a list of skills - "thinking, in evaluation, in problem solving" which is about how information is interpreted and used.

Jack described how he had used a problem solving approach with his year7 Maths class. He had shown his students an advertisement from a local petrol station for discount petrol – the deal involved spending money in the shop in order to gain a discount on the petrol price. He invited the students to find out 'who wins' in the discount petrol deal. Jack explained how one student worked through the problem. Initially, she asked the teacher, 'what car is it?' and he said 'I don't know':

"...that was my response to every question she asked I said 'no idea', 'I don't know'..."
(Yr 7 Maths teacher)

The student then decided to use her family car as the example, because that was relevant to her. From there she used web based resources to look up the fuel capacity of her car and to find out how to convert gallons to litres.

She worked out how much she could fill her car up with the fuel and worked out that there was no way that she could save more money than what he was spending by driving that vehicle and in fact she then went on and calculated how many litres you would need to spend in order to make a saving based on current fuel prices as an average and then she realised that the clause in the voucher explains that it can't be over a certain amount.

...So straight away she said 'well the company wins'... but then she stopped herself and said 'well wait a second, if I needed to buy bread and milk anyway and I was going to buy it from another shop and it was a similar price to the service station then buying it from the service station and then getting a discount means I do actually win because I wouldn't've got this discount otherwise'. (Jack, Yr 7 Maths Teacher)

In this example, the teacher has created a learning activity where information is accessed as needed by the student in order to solve a problem, involving critical thinking and in this way the student is seen to be constructing her knowledge. This teacher described this scenario as a response to the 21st century learner – he made the point that this approach differed in many ways to his usual approach – the key points of difference begin that he did not provide the information and his response to her questions was ‘I don’t know’. One way that we can analyse this approach to using information to construct knowledge is with Kress.

Kress (2009) says that the distinction between knowledge and information is not as clear as it once was. But the nature of the problems, he says, is different now in some ways – problems are less predictable and less structured than they used to be and so new knowledge must be produced to use as a tool to solve these types of ‘new’ problems. As for information, Kress says that *“Information is the material from which individuals fashion the knowledge they need”* (2009, page 25). This means that rather than an established body of knowledge there is information available that can be shaped by individuals to solve these unpredictable problems. This is why the accessibility of information is significant – as discussed in the focus groups – information is easily accessible through digital technology, but applying this as knowledge becomes a process of thinking and also about solving problems.

The example given by the year 7 teacher of the use of a problem solving approach in his Maths class illustrates this way of gaining knowledge through accessing information as needed to solve a problem. The information was sought by the student as she needed it to produce the knowledge about the situation through a problem solving approach. We could say that knowledge is seen as a tool which is shaped in specific contexts and related to the process of transforming information (Kress, 2009). What does it take to do this? The student would need to be able to understand the relevant information and also have the capacity to apply it to the situation. Thus there is a need for a learner to be able to be a curator - find and organise relevant information – and be a problem solver - apply appropriate knowledge. Jack concluded that, *“She (the student) was suddenly thinking much more openly about it and to achieve... and I don’t know if I could have achieved that learning through some of the traditional methods that we use in the classroom...”*

Textual representations of 21st century learners – Sugata Mitra TED talk

When I asked teachers at my school about 21st century learners they spoke at length about accessing information and constructing knowledge. What was significant in the context of 21st century learning was the use of web based resources to access the information and how the information was used to solve problems or connect with things that the students valued and were interested in. I also asked the teachers to identify websites, videos, books, documents or presentations that had informed their views. Not surprisingly the resulting list was large but one text that was cited by three of the 8 teachers which I will refer to here was the 2013 TED talk by Sugata Mitra ‘School in the Cloud’. In the brief analysis of this text I have focussed on beliefs about 21st century learners as users of digital technology to access information and construct knowledge through applying information to problems.



Figure 2. Still from Sugata Mitra – School in the Cloud

Mitra spends some time in this presentation making a case for change in education. He begins his talk with a brief history of education as a mechanism of British rule. He describes school as a machine which produces people who are able to work in the Empire's bureaucracy, where people had to have identical skills – to be able to do arithmetic in their head, use a standard form of handwriting and read. He accompanies this description of traditional education with an image from the past of students sitting in identical poses in order to emphasise the notion of uniformity. He then contrasts this image of education with a question about what schools should be like now that the empire has gone and now that computers can do much of the work of the bureaucratic 'machine' – what is to be the future of learning?



Figure 3. Still from Sugata Mitra – School in the Cloud

Most of the presentation concerns Mitra's model of collaborative learning called SOLE (Self Organised Learning Environment). This system rests on the interest of the learner and Mitra says that curiosity and interest is essential. From that, the learner asks questions and seeks answers through the vast information source accessed through computer or device. Learners do this together so that they can talk about it and solve problems together. When they need to know more then they go and find out more. In this presentation, children are represented as curious, eager to learn and be collaborative and also highly engaged by digital technology. They are presented as able to teach themselves and able to teach each other, with a natural ability to work together and a natural sense of wonder. When we place these representations against other ideas about 21st century learners we can see the idea of 21st century learners working in this text to create a certain view of students. The SOLE system cannot work without learners acting in these ways – it rests on a certain vision of children or young people – I would argue a vision that rests on the ideas of 21st century learners.

Mitra can be seen as somewhat of a policy entrepreneur (Ball 2012). He has identified an educational need and offers an innovative way to satisfy it. He has invested financially in the innovation and, through mechanisms such as this TED talk, has developed networks in order to move the idea around

on a national or global scale. What is interesting is that several of the teachers in my school have picked up on Mitra's ideas and applied them to their own context and in the context of my question about 21st century learners have mentioned his talk as an influential text. The way that students and teachers are positioned in this text can be traced into the way that these particular teachers talked about students as 21st century learners and about themselves as teachers. And in the example given by Jack, the Year 7 teacher we can see how Mitra's ideas about teaching and learning, are being adopted in the site under study. We can see how representations of students as independent learners, users of technology, curious problem solvers are informing the pedagogical choices made by this teacher.

Conclusion

The teachers in my school seem to understand the 21st century learner as a user of digital technology to access information and create knowledge by applying information to contexts that they value and are interested in. There was some resistance to use the term, 21st century learners because it was seen as outdated by some - something used in the past to describe a future subject. Perhaps what we are seeing here is part of a wider trend where "educators are increasingly being asked to take the future into account" (Facer, 2013, p142). Certainly in Mitra's TED talk we can see a focus on the future of learning. However, in the teachers description of 21st century learners can be found their versions of the present – consider for example the way that some teachers preferred the term contemporary learners and the way that they referred to contemporary uses of digital technology. In these versions of the present, we can see how stories about the future are being applied to the present in powerful ways. It was interesting to see how the ideas about the future of learning in the TED talk, 'School In The Cloud', can be traced into what the teachers said about contemporary students and education. The next step in this project is to find out how these ways of representing students as 21st century learners affect pedagogies adopted by these teachers in their classes – how do these ideas travel into their practice?

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DOI:10.1080/02680939.2013.776117

STUDENTS ONLINE DURING MATHEMATICS CLASS

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Abstract

Effective teaching occurs when teachers know their students and design for learning stems from this knowledge. Some of this knowledge is available from the students themselves.

This study was undertaken by a secondary teacher, Maria Mojica-Casey, who recognized that Year 8 students are very capable of communicating, in particular, their understanding about their learning and their classroom environments. The study was designed to give voice to this understanding with regard to the use of ICT in the mathematics classroom. A primary focus of the research was to capture the dimensions of learning by encouraging students to tap into their feelings and ideas about going online during mathematics class.

Seven constructs were generated from the words and phrases used by the students, namely, usefulness, empowerment, sociability, differentiated learning, visual aspects, student communication, and teacher role.

The findings in the research inform contemporary practices to engage students generally and specifically, to deepen engagement of students in learning mathematics. This paper provides an opportunity for teachers to consider that which guides students' choices to engage or participate, reflections about and connections with ICT in learning.

Of importance in the thoughts of most teachers in western societies is the challenge of using Information Communication Technology (ICT) to the benefit of learners and learning. This challenge changes in nature as the technology develops continuously and quickly. It is a most tiring challenge, especially for those teachers who have confronted the challenge since its infancy in Queensland in the 1980s. Most importantly in this challenge is the use of ICT for the benefit of youth and learning, as opposed to simply using ICT to appear to engage with contemporary practices. Specifically, the contemporary challenge is the online environment.

Crucial to discussions of this nature is the realization that much of the ICT used in classrooms is developed for business or by companies, outside of education, seeking to introduce their products in schools. Therein, the challenges for teachers have developed:

1. How can ICT be adapted to education for the benefit of learning?
2. How beneficial to education are those ICT developed for education?

Answers to both questions revolve around the motivations of teachers to:

1. use their knowledge of students and learning
2. critically view ICT
3. be creative in their design of learning environments that incorporate ICT.

Despite a teacher's perspective on ICT for learning, she/he still engages with these challenges; some with a positive lens and others with a negative or dismissive lens. The perspectives of teachers have been researched extensively. A search of the literature suggests that the perspectives of students have not received as much attention.

Therein lies the purpose of this paper, to explore the role of ICT in learning from students' perspectives. Often, teachers evaluate ICT or the role of ICT in learning from their professional perspective. This paper considers ICT use from a student perspective as advocated by a number of researchers. (Mishra & Koehler, 2006; Lynch & Smith, 2006) Furthermore, the terms, class and classroom are used interchangeably with the term learning environment, on the assumption that the classroom needs to be a learning environment in which pedagogy assures learning for all students.

In an endeavour to confront the challenge of ICT in learning in a contemporary context, this Queensland mathematics teacher researched use of ICT in the mathematics classroom using the perspectives of her middle-years students. The findings presented here are part of a larger doctoral study into the online environment.

In this paper, the views of students on using online environments in their learning are examined. The study is explained briefly, to provide the context for the capture of the views of students. Student responses to blogs and focus group discussions are then analysed and implications outlined.

Background to the Study

Professional dialogue with colleagues provided the stimulus for the study. The result was the inspiration to the main author of this paper to dig deeply into the benefits of her classroom practices within the online environment. As a mathematics teacher of some years, blogs and reusable learning objects frequently form part of the design of the learning environment for middle years students in her mathematics classrooms. The study investigated perceptions of and attitudes to using ICT. It was her goal to identify feedback for her own practices and contribute to dialogue for teachers.

The design of the study focused in the importance of students' views. The study developed a *students about students* and *students about learning and teaching* approach. Observations of students before and after class and in the playground identified their fluent use of some technology such as their phones. From this, the study was designed on the assumption that students in the early years of secondary school know about themselves, and their expectations of and the outcomes of using ICT-based environments.

The Study

The research reported here is a component of a doctoral thesis that sought to study students' perspectives on the use of ICTs in a mathematics class as designed by their teacher, using analysis of only some data from the data collected for the purposes of a doctoral candidature. It sought to describe or characterise ICT use in mathematics learning environments. In striving to do this, students and student voice and particular ICT were identified as key aspects of design for the research.

The following research questions frame the research of which part is being reported in this paper:
Research question 1: What particular aspects dominate student online experiences during maths class?

Research question 2: How do students perceive relationships amongst themselves and with teachers when online during maths class?

Central to the study's intent was the use of ICT. In this case, the ICT considered had to be available to most teachers; both readily available and easy for teachers to use and manage. Consequently the study focused on teaching practices already in use at the school where the study took place and therefore, included online environments such as blogs, reusable learning objects and online textbooks. These are readily available ICT artefacts, identifiable in many Australian secondary schools and also available to students.

A further aspect of the learning environment was the students. As the users of the online environments, students and their interactions in this environment needed to be at the heart of the study. This is the insight being sought. Teachers need to know how the stimulus for engagement is provided by ICT and how engagement with mathematics through ICT happens in ways that enable learning. This paper reports on the perspectives of students of their experiences using ICT and their engagement. Consequently, the study was designed to hear the student voice. It is posited that Year 8 students are capable of clearly representing their ideas and view both orally and in writing such that credible data is available. (Appleton, Heldsinger, Hunt, & Thrupp, 2005, Attard, 2010, Thrupp, 2008) To this end, data were collected from seventy-nine Year 8 students using blog comments, open-ended questions and opinionnaires and from small focus group interviews.

Given these aspects as critical points identified by the researcher, a search of the literature identified limited research considering ICT use in mathematics learning and in hearing student perspectives. Most of that which is available reflected the teacher perspective (Goos & Bennison, 2008; Guerrero, 2010). Research of mathematics practices using ICTs can be categorised as follows:

- the characteristics and effectiveness of specific ICT applications and their capacity for enhancing student mathematical understanding (Akpinar, 2010).
- student usability and critiques of reusable learning objects (Freebody, Freebody, McRae & Muspratt, 2006; Haughey, 2005; McGehee & Griffith, 2004).
- the design of interactive student and mathematics class learning environments (Ilomaki, Lakkala & Paavola, 2006).
- the use of blogs for learning mathematics (Pyon, 2008).

These studies are of importance to this study in that while there is similarity in aspects of the content of these studies, these studies took a teacher perspective. This study views similar topics to these studies but chose to follow the direction of Freebody, Freebody, McRae and Muspratt (2006, p. 14) who suggested that, “students’ comments have significance for developers and for teachers using digital learning objects (LOs) in their classrooms.” The position taken here and by Loong, Doig and Groves (2010) is that these comments have the potential to impact upon effective learning with ICT.

Consequently, this study combines the perspectives of the latter researchers with the work completed by the earlier categories of research to provide a different perspective on ICT in the classroom. Furthermore, it is posited that, though this study was completed in the context of mathematics due to the teaching role of the researcher, that findings may be considered in the light of other subject areas.

Analysis

The purpose of the analysis was to identify the characteristics of online environments according to students. Data used for the purposes of this paper consisted of posts to blogs and text from focus group discussions. See Table 1. Posts to blogs designed by the teacher, captured discussion about maths between students and between student and teacher, captured student's perceptions and opinions of mathematics. All pages were archived and analysed for descriptions, identifications of trends and interrelationships as they relate to each of the research questions. Blog data was used to obtain details as well as real life samples of what and how students communicate and interact whilst online in a maths lesson. Focus group data provided the opportunity for students to share their ideas, experiences, and attitudes as well as consider those of their peers about going online to do mathematics during class time. It was intended that students discuss perceptions about experiences during mathematics class in an online context, the roles of mathematics learning objects, blogs, textbooks and other digital mathematics related media. In addition consideration in the discussion was to be given to how their usage of computers during class time affects the student-student and student-teacher relationship.

Table 1: Summary of data collections

RQs addressed	Data source/ method	Data collected
RQ 1 & RQ 2	Student Maths Opinionnaires (Qualitative)	Open-ended comments about student opinion of: their online experiences using maths-blogs, maths reusable learning objects and textbooks online.
RQ1 & RQ2	Student Maths Opinionnaires (Quantitative)	Opinionnaires using Likert scales to explore student use of maths-blogs, maths reusable learning objects and textbooks online.
RQ1 & RQ2	Posts to maths blogs	Samples of communication by students amongst themselves and with their teacher whilst posting comments on pages of the maths blogs.
RQ1 & RQ2	Focus groups	Student reflections about: • data uncovered in the opinionnaires • their experiences using maths blogs, maths reusable • learning objects and textbooks online • their interaction with their teacher during class.

Posts and interview comments were analysed to identify trends and interrelationships to identify themes, from which constructs were established. NVivo, computer software for analysing text, was a key tool in the process of analysis to which labels were added by the researcher. The constructs are ordered according to prevalence in the analysis as follows: *usefulness*, *empowerment*, *sociability*, *teacher interaction*, *differentiated learning* and *youth culture*. There is a clear distinction between the first two constructs and the latter five constructs.

The first two constructs (*usefulness* and *empowerment*) were identified from 56% of the data. The most significant aspect dominating student online experiences during mathematics class was the construct of *usefulness*, comprising over 36% of the data coded. The constructs are defined from the comments. A selection of comments from each data set is included to demonstrate the basis from which the construct was identified. Constructs are constructed from positive and negative perspectives. Comments in italics are those of students.

Usefulness is defined as convenience and practicality in the use of computers during mathematics lessons online. ICT were considered useful when actions and events were repeatable, for example, being able to repeat the reusable learning objects (RLOs), knowing *you are right or wrong straight away* and having *no books to carry*. Aspects of usefulness were further elaborated in comments such as *This link is loading too slow. I think the blog is a waste of time because it gives you the questions but doesn't really tell you how to answer anything*. These indicate that ICT are not always useful when consideration is given to functional difficulties. For example, concerns were expressed about usefulness being influenced by slow connection speeds, flat batteries and bad keyboards and loading times.

Empowerment refers to a feeling of control or of freedom to work and experiences of independence and self-confidence with ICT during class. The words control, independence and freedom were the words of the students as in evidence in the following examples. *We are more in control of our learning. When you do things independently you get more confidence to do it by yourself*. The concept of control was further elaborated in this example, *You can forget what the teacher says but on the computer it is always there for you. The idea of independence was embedded in this example: You can work it out yourself instead of having to ask a question in the first place*. The idea of self-confidence is further elaborated within this data; *Through the school year you can learn a lot more and do a lot more*.

These dominant constructs show students as thinking critically about ICT, their usefulness and their role. Students compare both negative and positive aspects. However, it is evident that students readily associate the online environment with opportunity for learning and wasting time. Students balance some of the irritating characteristics within the usefulness construct with the extended learning made available by the online environment, for example, *you can work it out yourself*. The student perceptions outline a role for the student as the person responsible for learning. The ability to initiate and direct learning from a variety of sources is recognised as a characteristic of the online environment.

Furthermore, there is evidence of constructing an identity as a learner. Comments such as *you can forget what the teacher says but on the computer it is always there for you* indicates a level of metalearning. Students learn the ways by which they learn to facilitate future access to information when needed. They perceive that information is no longer limited by the words of the teacher but can be enriched and extended by online access and access to peers. The role of motivation is evident in comments such as *through the school year you can learn a lot more and do a lot more*; the identity of students who want to learn.

Both constructs are aspects of knowing the contemporary student as the basis for designing learning in the classroom. (Lynch & Smith, 2006) Teachers establish an understanding of their students by talking to them about how they view the usefulness of ICT in the classroom and view ways in which ICT can be useful in engagement and participation (Freebody, Freebody, McRae & Muspratt, 2006). In this way, teacher decision-making about ICT in learning is further informed to manage learning in ways that align with their students.

The latter five constructs were identified with far less frequency than the first two, in particular the last two constructs, visual aspects and youth culture. The perception of students is that the teacher continues to play a vital role within a classroom environment in association with an online component. The role of the teacher is evident in the constructs, namely, teacher interaction, sociability and differentiated learning. Students identified a role of less direct, whole class instruction and more interactive, side-by-side, one-on-one focused learning. There is a clear perspective that the online environment enables teachers to vary both type and quantity of interaction dependent on student requirements. Students are defining an environment in which all students are working and the teacher focuses attention on identified students when necessary, with the intent of specifically scaffolding learning for that student. The input of the teacher is necessary in supporting learning and understanding of mathematics during online lessons.

Teacher interaction describes teacher presence to assist learning, offer support and or add input during online mathematics lessons. The following comments identify both the role and worth of teacher presence and the way in which that teacher presence is useful: *We want the teacher around so they can come to you when you want them. It is a bit easier if you have the teacher right there beside you. Teachers act different in lessons using ICT because the focus is off of them. The teachers are more lenient they are more relaxed.*

Sociability was defined as greater autonomy with fellow students to communicate with one another, friendliness of their teacher and having fun or emphasising camaraderie when using computers to learn mathematics. This data identifies a range of ways in which social practices differ in a classroom where an online learning environment is being used, including student-student interaction, student-direction, and positive attitude. *While we were on the computer I said, Let's do our homework and we did it. Using computers in the mathematics lessons helps us learn in a fun way. Time passes quicker. The lesson is interesting. The lesson is cool.* However, for some students there is an aspect of anti-sociability; *When you're on the computer you're kind of locked into it without socialising with anyone.*

That students respond differently to online environments and have different needs when engaging in online environments is evident in these comments. *I'm a visual person and doing mathematics online*

is a lot of visual. I find I work better on computers. I can concentrate better on the computer. Computers extend my understanding. More of a variety. Using the computer is more fun than just copying what the teacher tells us to write. I do better work now. It is too hard by myself. On computers you are going as fast or slow as you want to. When the teacher is going slower/faster than you, you can learn however you need. If some people are slow in your class it gets annoying and you look out the windows. These comments formed the basis of the construct: Differentiated learning. This construct identifies the opportunity provided by ICTs to work at a pace or in ways consistent with their mathematical abilities. Combined with the next construct, visual aspects, there is cause to consider how the information about students is used; to design learning that is the same for all students at one time or the need to design different approaches to the same learning for different students.

Though the following data are not as strong as for other constructs, the range of data readily identifies the 'look' as an aspect of motivation for engagement. (Freebody, Freebody, McRae & Muspratt, 2006) Visual aspects refers to the 'look' of online learning during mathematics class. *It is better than a teacher doing it all on the board. I like the bright colours. Our textbook colours are faded. You can read the instruction over again. The pictures and diagrams are more clear. I like the zoom. Diagrams on the computer are easier to follow than the textbook. My textbook is full of graffiti and is worn out. It is easier to follow the pronumerals when they are the same colour. The computer holds my focus. You're locked into the computer screen better than when looking at a hard copy of the textbook.* These comments on visual aspects are particularly pertinent to inform the teacher and designers that students are clear on the range of elements makes them comfortable and more likely to learn. (Freebody, Freebody, McRae & Muspratt, 2006; Loong, Doig & Groves, 2010)

The last construct, student culture, speaks most directly of contemporary times. (Gee, 2000) Students see ICT as an aspect of the second decade of the twenty-first century. In so doing, the data suggests student culture as the adoption of ICT for and by young people or when participants critiqued adult usage or participation. *We get to learn how we want. Lets student use something they know how to use. We get to do what we enjoy and are used to doing. Teachers have their own way and if you don't understand their way you kind of suck. They (adults) don't use it as much. We learn how to do it easier. Computers make it a less old- fashioned classroom. We try more stuff and new stuff on computers. Computers belong to young people. We are like the technology age so we like it.* Once again, however, the strength of this construct is limited due to the quantity of data to support it.

In conclusion, the regularity with which words such as learn are used, indicates that students recognise that the purpose of the online environment in the classroom is for learning. There is evidence that students know about learning, barriers to learning and factors that enhance learning. In addition, there are some ideas that attempt to define learning. In these cases, learning is defined as *figuring things out* for oneself, going to a range of sources, reviewing many times and sometimes *taking time* to go more slowly. This view of learning was elaborated upon with learning being viewed as more than regurgitating or *just copying what the teacher tells you to write*. From the findings, it is possible to posit that online learning is seen by students as an appropriate environment for learning and learning is seen as an activity that is their own and happens differently for different people. (Lynch & Smith, 2006) Students have shown that they can talk about learning in ways familiar to teachers. (Mishra & Koehler, 2010)

Both the roles of the learner and the teacher in an online environment were evident. Perceptions of interactions of students with ICT, students with students, students with the teacher and teachers with ICT were evident in the data. There is a perception that the roles of learner and teacher interact actively and that an online environment influences the nature of the interactions. Some students expressed a view on how the online environment best functions to facilitate learning. Furthermore, some perception of the difference between classrooms without ICT and classrooms with ICT exists.

Students identified many aspects of the learning environment that involve online learning. In so doing, it is clear that there are negative and positive aspects. Furthermore, aspects defined by the constructs are not of equal importance to them; usefulness being very important and the fact that it is an aspect

of contemporary culture being of minimal importance. The findings must now be considered in the context of and the structure of the learning environment.

Conclusions

Though these data represent only partial data collection for the study, this section of the data provides much that is worthwhile to teachers in the contemporary classroom. While the data represented here only partially answers the two research questions, it does go some way to doing so. In identifying the aspects that dominate student online experiences during maths class from the data, it becomes clear that students value usefulness and empowerment when judging the worth of ICT in their online learning. Furthermore, they perceive the teacher-student and student-student relationships integral to working online during maths class though different to learning without ICT. The constructs of teacher interaction, sociability, differentiation, and student culture, though of far less consequence than usefulness and empowerment, demonstrate that students consider the socio-cultural aspects of the online learning environment as elements of the learning environment. Visual aspects of the learning environment are a construct seen as an element of online experiences, but not of much consequence.

The constructs do not fall neatly into answering the research questions. Rather, it can be seen that usefulness and empowerment are closely related to aspects that dominate the experience. Constructs such as teacher interaction, sociability, differentiation and student culture provide insight into both questions while visual aspects relates more closely to online experiences. These contributions form two categories: firstly, aspects that impact on student online experiences during mathematics class and secondly, perceived relationships amongst students and with teachers when online during mathematics class.

These two categories are used to organise statements that capture the key understandings that have their origins in the findings:

- A. aspects that impact on student online experiences during mathematics class
 - 1. Students value control in their learning environment and that the learning environment has connections with that with which they are familiar. (Construct: empowerment)
 - 2. Students identify learning as the purpose of using online learning environments. (Construct: usefulness)
 - 3. Students are pragmatic about ICT usage in classroom learning. (Construct: usefulness. They readily weigh up the negative and the positive of using ICT.)
- B. perceived relationships amongst students and with teachers when online during mathematics class:
 - 1. Students value the integration of human interactions and online environments in a learning environment and recognize the contribution of both to the learning of mathematics.
 - 2. Students outline the difference in the nature of teacher-student interactions in an online environment and the capacity for teachers to interact with different students in different ways.

Implications

The findings of the research suggest that students are able to enunciate clearly their perceptions about learning, learning environments and ICT. (Appleton, Heldsinger, Hunt & Thrupp, 2005, Attard, 2010, Thrupp, 2008) The way students explain the use of online learning environments corresponds with those aspects of the learning environment of importance to teachers; a place where learning occurs for as many students as possible and a context in which students are motivated to learn. The results demonstrate that middle years students want to learn with their teachers but in online environments where it is useful and worthwhile. Consequently, collaborative discussion between teacher and

students can provide input to future planning. Students and teachers work together to design useful online learning environments. This design process has two components: the ICT and the teacher role. Students want to use ICT when its use is designed in a way that promotes learning; suggesting that if the use of ICT that does not align with what needs to be learned, it will be viewed of little value by students. Teachers need to design their role as a key component of any online environment; interacting and supporting use of the online artefact. Students expect that these interactions will differ in nature with the teacher moving from student to student, interacting in ways that match with the student's needs, both with the software and with mathematics. Finally, though of least importance, students view learning embedded with ICT to be consistent with their times. Students may consider mathematics learning environments without ICT as not contemporary, thereby affecting attitudes to learning.

From the foregoing, a key classroom practice is identifiable from this study, namely, the practice of teachers and students working together to define and construct learning environments that effectively make the most of the benefits of ICT.

It is possible to envisage teachers and students in two-way conversation that informs the design of the learning environment for the next unit of work. For example, in co-planning, students and teachers discuss what learning needs to occur and together identify ways by which this can happen effectively for as many students as possible. Another approach is student and teachers reflecting together on the effectiveness of a learning environment in a past unit of work; thus providing the teacher with student ideas and opinions that may be useful for planning in the next unit of work.

Conclusion

This paper provides an opportunity to consider that which guides students' choices about engagement and participation and reflections about connecting with mathematics learning by using ICT. This study provides directions for teachers to adapt ICT to education in ways that promote learning and provides ways by which teachers can make decisions about the benefits to education of those ICT developed for education. It provides for an understanding that co-planning with students for learning has potential as an approach to learning design appropriate for contemporary learners. It is this co-planning that provides for critical viewing of particular ICT artefacts as to their worth and for design of use of ICT artefacts in ways that are useful to learning. Knowing students through dialogue about learning in an online environment has the potential to take the guess-work out of the design for the use of these environments. In so doing, it informs teacher decisions about design of learning environments for mathematics learning.

In essence, this study has provided two models. Firstly, it has modelled an approach for students and teachers working together to design learning environments that suit the learning requirements of both curriculum and students. It demonstrates that students do have perspectives about their learning, how it best happens and that they are ready and able to discuss it. Secondly, it provides a set of constructs to support teacher design of the use of ICT for learning. In using these constructs, teachers can make informed decisions about the learning environment they create when designing for learning, with ICT. Now, learning is personal.

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INVESTIGATING 3-5 YEAR-OLD'S PARENTS' ATTITUDES TOWARDS USE OF IPAD

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Abstract:

This paper investigated 3 – 5 year old children's parents' attitudes towards use of iPad in Child Care Centres. A survey was used and eighty parents participated in this study. The major findings include most of the parents agreed that Apps designed for preschool educational purposes was indeed assistive of children's learning, and the most participating parents thought that use of educational media could be used to teach literacy, numeracy, science, and art. However, they did not agree that educational media could be used to teach physical education. Moreover, it shows that the most parents thought that use of educational media could be used for children's cognitive development, fine motor skills development and language development. However, they did not agree that educational media could be used for children's social development and gross motor skills development. Early childhood educators and parents may find this paper useful about the use of iPad in early childhood settings.

Parents and Use of iPad

The role of educational media, such as use of iPad, in the current early childhood educational environment is becoming more prevalent and accepted in terms of being a mainstream pedagogical tool. In their book, *Born digital: Understanding the first generation of digital natives*, Palfrey and Gasser (2008) describe that currently we are undergoing the most rapid technological transformation in terms of information. Children are being born into a digital age where by how they gather and interpret information will be different to previous generations, including their parents. In order to effectively educate the 'digital child' parents need to address their own attitudes towards use of iPad and how the technological advancements fit within their comprehension of children and the concept of early childhood (Palfrey & Gasser, 2008).

Within the new digital age, parents have access to and are allowing children to be exposed to a wider variety of educational media alternatives, such as iPad, to enhance and build on children's experiences and develop their own pedagogical practices (Colker, 2011). Historically used educational media devices such as television and standard desktop/laptop computers still have a prevalent place in children's homes and educational settings (Blackwell, Lauricella, Wartella, Robb & Schomburg, 2013). However there are multiple issues when using such devices with preschool aged children; television is a passive/one way communication device (Rosen & Jaruszewicz, 2009) which is opposite to the play based active learning promoted by early childhood educators (Fleer, 2013). Desktop computers are problematic in terms of children's fine motor control when using a standard mouse/keyboard setup. Therefore a device that uses a gestural interface such as that of an iPad suits the developmental characteristics of active engagement coupled with developmentally appropriate fine motor controls (Siegle, 2013).

With growing curricula expectations that educational media, such as iPad, become a part of mainstream pedagogy, combined with the fall in price of technological products, has led to a proliferation of educational media alternatives being brought to the attention of children (Fleer, 2011). According to Jay Blanchard (2010) and Scooter et al. (2001), cited in Shoukry (2013), there are a perceived number of benefits of educational media for children, this includes improved: cognitive and social development; self-concept and attitudes to learning; spoken communication and cooperation; leadership skills and interactional opportunities; visual attention and processing speed.

But not all parents are welcoming of the integration of educational media and the ensuing technologies into early childhood settings. Furthermore, there is an undercurrent that educational media, particularly technological products are drastically altering the landscape of early childhood to its detriment (Plowman, McPake & Stephen, 2010).

There are a variety of reasons that parents, children's first educators, will have differing views about the role and value of screen based media in early childhood education. The Unified Theory of Acceptance and Use of Technology (UTAUT) (as cited in Blackwell et al., 2013) explains that four major constructs influence people's use with technology: performance expectancy (will the technology achieve what I want it to achieve), effort expectancy (how easy is it to use the technology), social influence (how do other people in the same situation use technology) and facilitating conditions (will I get help to use and access the technology). In this case it is the parent who is deciding whether the technology is suitable for use with their children. Hence, before parents allow their children to be exposed to new forms of technology need to decide if the technology will assist the child's learning (performance expectancy), be easily useable given the developmental characteristics of the child and my own understanding of the technology (effort expectancy), gauge how and why other parents/educators use technology (social influence), and if they will be supported in terms of access and understanding of how to use the technology (facilitating conditions).

Therefore, this paper investigated 3-5 year old children's parents' opinions about the use of iPad in early childhood education from the following areas: (a) parents' knowledge about Apps, (b) *Attitudes towards Apps designed for preschool educational purposes are indeed assistive of children's learning*, (c) Attitudes towards the use of touch screen devices for pre-schoolers, (d) Attitudes towards the use of educational media for teaching literacy, numeracy, science, art and physical education, and (e) Attitudes towards the use of educational media for children's development in the domains of cognitive development, gross motor skills development, fine motor skills development, language development, and social development.

Method

A survey was used and eighty parents participated in this study. As Gay and Airasian (2003) and Leedy and Ormrod (2005) stated that survey research involved acquiring information about one people or a group of people. Their characteristics, options, attitudes, or previous experiences were asked through questions and their answers were analysed. The purpose of a survey research was to learn about a population by surveying a sample of the population. The intention of the surveys for the present study was to investigate the attitudes from parents. The research instrument for the survey for parents was developed after analysing the responses from the parents from the pilot study. Out of the 80 parents, 59 (73.8%) were female, and 21 (26.3%) were males. The age range was from 26 to 50 years old, with 7.5% being 26-30 years old, 28.8% being 31-35 years old, 51.3% being 36-40 years old, 10% being above 41 years old. Forty parents were from South Australia and forty parents were from Northern Territory.

The questionnaire survey was administrated with the assistance from the child care centres. The survey was conducted from May to September, 2012. Survey instruments, in hard copy, were handed out to the participants and collected from the participants later with the assistance from the child care centres.

Data were transcribed, entered and the researcher took approximately 4 weeks to enter all the written answers into the Statistical Package for Social Science (SPSS), and spent another week to confirm all the data were entered correctly. Data were analysed using the Statistical Package for Social Science (SPSS) and alpha was set at 0.05 for purpose of the present study.

Results

Parents' skills of using technology

All the parents used technology at home, and their skills of using technology were presented, using a 5-point scale (1 = novice user, and 5 = expert user).

According to their self-reports, 3 parents (3.8%) rated themselves 2, 42 (52.5%) parents rated themselves 3, 20 parents (25.0%) rated themselves 4, and 15 parents (18.8%) rated themselves 5 (see Figure 5.2). The mean of the 80 parents was 3.49 (see Table 1). This variable was referred as parents' skills of using technology.

Table 1
Means and SD of parents' skills of using technology

	Mean	SD	N
Parents' self-rated skills of using technology	3.49	.84	80

Knowledge about Apps

Parents' confidence of knowing Apps was also rated on a 3 point scale : 1= I don't know what an App is, 2 = I have heard what an App is, but I'm not totally sure, and 3 = I am very confident that I know what an App is. It was found all the participating parents knew Apps to a degree, with 87.5% choosing they were very confident about what an App was.

Attitudes towards Apps designed for preschool educational purposes are indeed assistive of children's learning

The participating parents were asked to rate their agreement level towards whether apps designed for preschool educational purposes is indeed assistive of children's learning, on a 5 point scale: 1= strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree.

It was found that most of the parents agreed that Apps designed for preschool educational purposes was indeed assistive of children's learning, $\mu = 3.79$, $\sigma = 0.87$ (see Figure 1).

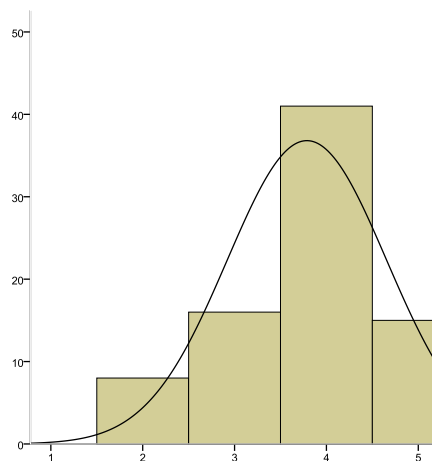
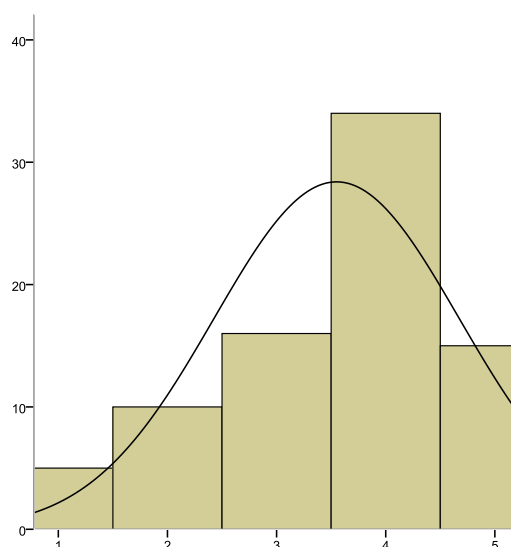


Figure 1. Parents' attitudes towards Apps designed for preschool educational purposes are indeed assistive of children's learning devices (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree).

Attitudes towards the use of touch screen devices for pre-schoolers

This section firstly reports the parents' opinions towards the use of touch screen devices, then it presents their knowledge about Apps and the usefulness of Apps designed for preschool educational purposes. Detailed reasons of their opinions are also reported.

It was found that most of parents thought use of touch screen devices were appropriate for preschool age children, $\mu = 3.55$, $\sigma = 1.12$ (see Figure 2).



Figur 2. Parents' attitudes towards Use of touch screen devices (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree).

Twenty-seven (27) out of the 80 parents also presented reasons for their attitudes towards the use of touch screen devices. The reasons were categorised as following, and the number in brackets represents the frequencies of the factors.

- Reason 1: children's age (3)
- Reason 2: being unfamiliar with technology (2)
- Reason 3: children's daily use (3)
- Reason 4: children's communication and interaction (3)
- Reason 5: easy use of screen (8)
- Reason 6: children's enjoyment (4)
- Reason 7: educational use (5)
- Reason 8: use as a reward (1)
- Reason 9: useful for children's development (2)
- Reason 10: life-long learning for children (3)

Table 1 shows an example of the parent's response to the question "Do you agree that touch screen devices, such as Apple's iPad, Sony's Tablet S or Samsung's Galaxy Tab are appropriate for use by children aged 3 to 4 years of age? Please explain your reasons why?". The parent's response "Young children... " was categorised into Reason 1, as "Young" matched the classification. Moreover, "...find direct contact easier to control. Get frustrated with conventional screen" was categorised into Reason 8, as "easier to control" and "screen" was categorised into Reason 8.

Table 1

An example of parent's response "Do you agree that touch screen devices, such as Apple's iPad, Sony's Tablet S or Samsung's Galaxy Tab are appropriate for use by children aged 3 to 4 years of age? Please explain your reasons why?"

Question: Do you agree that touch screen devices, such as Apple's iPad, Sony's Tablet S or Samsung's Galaxy Tab are appropriate for use by children aged 3 to 4 years of age? Please explain your reasons why

Parent #4: Young children (Reason 1) find direct contact easier to control (Reason 8). Get frustrated with conventional screen (Reason 8).

Interpretation: This table illustrates categorises Reasons 1, and 8.

Attitudes towards the use of educational media for teaching literacy, numeracy, science, art and physical education

This section reports the participants' parents' attitudes towards the use of educational media for teaching literacy, numeracy, science, art and physical education.

Table 2 shows that the most parents thought that use of educational media could be used to teach literacy, numeracy, science, and art. However, they did not agree that educational media could be used to teach physical education.

Table 2 Parents' opinions about the use of educational media teaching literacy, numeracy, science, art and physical education (Means)

	Mean	SD	N
• numeracy/mathematics	4.19	0.73	80
• literacy/language	4.13	0.64	80
• science	3.60	0.84	80
• art	3.45	1.03	80
• physical education	2.30	1.00	80

Note: (a) The means were presented in order, from highest to lowest using a 5 point scale anchored (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree). (b) A repeated measures ANOVA on the above means revealed a significant effect, $F(4, 316) = 112.06, p < .01$.

Table 3 presents the percentages of parents' opinions attitudes towards the use of educational media for teaching literacy, numeracy, science, art and physical education. It was found that more than half of the parents agree that use of educational media could be used to teach numeracy/mathematics (86.3%), literacy/language (87.6%), science (63.8%), and art (57.6%). It was also noted that most the parents (57.5%) did not think use of educational media could be used in teaching physical education.

Table 3

Parents' opinions about the use of educational media teaching literacy, numeracy, science, art and physical education (percentages)

	1	2	3	4	5
• numeracy/mathematics	0	2.5	11.3	51.3	35.0
• literacy/language	0	1.3	11.3	61.3	26.3
• science	1.3	11.0	25.0	55.0	8.8
• art	5.0	13.8	23.8	46.3	11.3
• physical education	25.0	32.5	31.3	10.0	1.3

Note: (a) All above figures represents percentages within each item.

(b) 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree

Attitudes towards the use of educational media for children's development in the domains of cognitive development, gross motor skills development, fine motor skills development, language development, and social development

This section reports the participants' parents' attitudes towards the use of educational media for children's development in the domains of cognitive development, gross motor skills development, fine motor skills development, language development, and social development.

Table 4 shows that the most parents thought that use of educational media could be used for children's cognitive development, fine motor skills development and language development. However, they did not agree that educational media could be used for children's social development and gross motor skills development.

Table 4

Parents' opinions about the use of educational media for children's development in the domains of cognitive development, gross motor skills development, fine motor skills development, language development, and social development (Means)

	Mean	SD	N
• cognitive development	4.21	0.88	80
• fine motor skills development	3.93	0.90	80
• language development	3.46	0.90	80
• social development	2.45	0.94	80
• gross motor skills development	2.01	0.96	80

Note: (a) The means were presented in order, from highest to lowest using a 5 point scale anchored (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree). (b) A repeated measures ANOVA on the above means revealed a significant effect, $F(4, 316) = 142.33, p < .01$.

Table 5 presents the percentages of parents' attitudes towards the use of educational media for children's development in the domains of cognitive development, gross motor skills development, fine motor skills development, language development, and social development. It was found that more than half of the parents agree that use of educational media could be used in the domains of cognitive development (83.8%), fine motor skills development (76.3%), and language development

(58.8%). It was also noted that most the parents did not think use of educational media could be used in the domain of children's gross motor skills development (73.8%) and social development (57.6%).

Table 5 *Parents' opinions about the use of educational media for children's development in the domains of cognitive development, gross motor skills development, fine motor skills development, language development, and social development (percentages)*

	1	2	3	4	5
• cognitive development	1.3	3.8	11.3	40.0	43.8
• fine motor skills development	2.5	3.8	17.5	51.3	25.0
• language development	2.5	13.8	25.0	52.5	6.3
• social development	13.8	43.8	27.5	13.8	1.3
• gross motor skills development	35.0	38.8	16.3	10.0	0

Note: (a) All above figures represents percentages within each item.

(b) 1= strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree

Discussion and Conclusion

In relationship to the reason that people use technology, the UTAUT cited in Blackwell et al. (2013) indicates that effort expectancy is one of the four key determining factors in peoples use or non-use of technology. It was found in this study that 96.3% of parents indicated that they were between a mid to expert user of technology and that 87.5% of parents were very confident about what an App was. Therefore parents have exposed themselves to technology and feel confident when using technology for themselves. This is consistent with Cocker (2011)'s statement that parents have access to technology and through their own experiences are allowing children to be exposed to a wider variety of educational media alternatives, such as iPad, to enhance and build on children's experiences and develop their own pedagogical practices. In addition, the most commonly listed reason as to why a gestural interface device is appropriate for young children was the "easy use of screen", thus appropriately linking effort expectancy for the child.

Additionally within the UTAUT cited in Blackwell et al. (2013) another key factoring when choosing to use or not use technology is performance expectancy. It was found that most of the parents agreed that Apps designed for preschool educational purposes was indeed assistive of children's learning. Moreover, the participating parents' thought use of touch screen devices were appropriate for preschool age children. This finding is consistent with Fleer (2011) and Plowman, McPake and Stephen (2010)'s findings that the use of iPad and its touch screen is appropriate within early childhood. In terms of performance expectancy for curricula domains participating parents thought that use of educational media could be used to teach literacy, numeracy, science, and art. However, they did not agree that educational media could be used to teach physical education. Moreover, in terms of child development, it shows that the most parents thought that use of educational media could be used for children's cognitive development, fine motor skills development and language development, which is consistent with findings by Jay Blanchard (2010) and Scooter et al. (2001), cited in Shoukry (2013). However, contradicted those findings as the participating parents did not agree that educational media could be used for children's social development.

There are limitations to the present study. The data were drawn from 80 parents in South Australia and Northern Territory in Australia. A number of research directions can be identified. Data need to be gathered from other states and territories. Further research will be needed to understand the educators' and child care directors' attitudes towards the use of iPad in educational settings to

compare their attitudes and therefore develop strategically the teaching approaches with the use of iPad in early childhood settings.

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ACEC2014 - DEVELOPING QUICKSMART ONLINE TO ENGAGE LEARNERS

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Abstract

Literacy and numeracy are identified as necessary skills for employment. QuickSmart Online (QSO) was developed with the aim of closing the gap in numeracy skills to enable the unemployed to break the cycle of long-term unemployment. QSO focuses on the learner developing fast and accurate basic skills, which in turn develops their neural pathways, allowing the learner's working memory to be freed up to enable further learning. This paper focuses on researching facilitator stories based on feedback from learners and teachers, and on observations of QSO usage. These stories reported on the learner experience during the initial development of QSO. The program was informally trialed for a period of twelve months with learners, ranging in age from eight to the late fifties, from a variety of learning institutions. There was some evidence of engagement with the program. The five main aspects of the program that impacted on this engagement: learner confidence, learner support, learner e-literacy, online environment style, and context of learning are described. Key recommendations to increase learner engagement for the next iteration of QSO are outlined.

More than seventy-five percent of employers in 2009 reported that their businesses were affected by low levels of numeracy and literacy skills amongst their workforce (Ai Group, 2010), whilst the Industry Skills Council (ISC) reported more than half of working age Australians have Language, Literacy and Numeracy (LLN) problems (Industry Skills Councils, 2011). Successive Australian Governments have reported low LLN skills of Australians. The Australian Government has co-operated with The Organisation for Economic Co-operation and Development (OECD, 2013) resulting in an International Report on LLN skills of adults, which described such skills every individual needed to participate in society. Capraro, Capraro, and Jones (2014) also stressed that numeracy is an important skill for full participation in the workforce. The Science, Information and Communication Technology, and Mathematics Education for Rural and Regional Australia National Research Centre (SiMERR) received an Australian Federal Government (AFG) Grant in 2012 to develop and produce an online version of QuickSmart, called QuickSmart Online (QSO) targeted at Adult Job Seekers with identified low levels of LLN skills. This grant was part of the NBN-enabled Tele-education Trial to support the Australian Government's Digital Economy Goal for expanded online education (Hand, 2013). This paper focuses on the numeracy component of QSO. First, some background is provided about QSO, engagement with learning and the QSO software development cycle, then, some results are discussed from the initial trialling of QSO. The results include the main aspects of QSO that impacted learner engagement and recommendations for improving QSO to increase engagement.

QuickSmart

QuickSmart (QS) was first developed in 2001 as a face-to-face (f-2-f) early intervention numeracy program for middle-school students, followed by an additional literacy component. QS focused on enhancing the students' fluency in either numeracy or literacy (automaticity) through improving their working memory. Students work in pairs with an instructor for thirty minutes, three times per week, for an average of thirty weeks. Pegg, Graham, and Bellert (2005) defined automaticity as learners' fluency and facility with basic number facts. They researched the links between working memory and the ability to recall basic number facts and found that improvements made to a person's processing speed of basic skills frees up his/her working memory capacity, which then becomes available to address more difficult mathematical tasks. This research also showed that the improvements made to

a person's working memory continued for at least twelve months following the completion of the QS intervention program.

QuickSmart Online

The QS f-2-f program was the framework used to develop QSO numeracy. A team from SiMERR was responsible for creating the content while an emerging software development company was contracted for the technical development of the online environment. Like QS the development of QSO was aimed at improving a person's automaticity in numeracy, thereby freeing up his/her working memory to allow him/her to perform more complex tasks. It is important to emphasise that QSO is not intended to be a computer game. However, QSO does align with Whitton's (2014) game definition of providing a challenging activity and containing structure, rules, goal progression and rewards. The numeracy component of QSO commenced trialling in April 2013. The remainder of this paper focuses on this trial of QSO numeracy.

The QSO numeracy program consists of seven components: Warm-Up, Focus Facts, Flash Cards, SpeedSheets, Fast and Accurate Basic Skills (FABS), Problem Solving (PS) and a game. After enrolment into the program, the learner completes an eighty-question pre-test covering each of the four basic mathematical operations. This was designed to establish a learner's entry point into QSO. Many learners have low e-literacy skills and/or low LLN. A calibration activity to assess a learner's keyboarding skills was included for the timed activities, i.e., Flash Cards, FABS and SpeedSheets. All seven components of QSO were designed to help the learner engage with his/her learning.

Engagement with Learning

To better report on aspects of the engagement of learners when using QSO, it is first necessary to clarify what is meant by engagement. Engagement, *energy in action* (Russell, Ainley, & Frydenberg, 2005), focuses on the connection between the learner and the activity. Care must be taken not to confuse engagement with motivation, which is about *energy and action* and focuses on the reasons for behaviour (Russell et al., 2005). Engagement is more likely than motivation to be affected by learning experiences and rapport with people involved with those experiences. Students who are motivated are not necessarily engaged. Teachers need to be able to design learning environments (f-2-f or online) that will engage students.

Three distinct types of engagement: behavioural, cognitive and emotional, as described by Fredricks, Blumenfeld, and Paris (2004), provide a useful framework for elaborating the concept of engagement. *Behavioural* engagement involves: positive conduct, e.g., absence of non-disruptive behaviours; and involvement in learning tasks, e.g., persistence. *Emotional* engagement involves: affective reactions in learning situations, e.g., interest; and affective reactions to those delivering the learning, e.g., respecting teacher. *Cognitive* engagement involves psychological investment in learning, e.g., desire to go beyond the requirements; inner psychological investment, e.g., desire to learn; and self-regulation, e.g., evaluating cognition when accomplishing tasks. Although categorising these three types of engagement can assist in expanding perceptions of engagement, care needs to be taken as confusion can result from these three types of engagement being "dynamically interrelated within the individual" (Fredricks et al., 2004, p. 61). Such an expanded view of engagement, with three types, provided a suitable framework for considering how learners were engaging with QSO.

QSO Software Development Cycle

QSO needed a software development cycle to monitor and evaluate each step of the development process. The *Most Significant Change* (MSC) technique, developed by Davies and Dart (2005), was favoured as a framework to collect stories from researching facilitators, hereafter called facilitators, working closely with the QSO trial. MSC is primarily a monitoring technique (Willettts & Crawford, 2007) involving collecting *significant change* stories from the people who are most closely involved

with a program and then the *most significant* of these is selected by the stakeholders. Adapting the MSC technique for implementation in a specific evaluation situation, Willetts and Crawford (2007) developed a monitoring and evaluation model, called the *Monitoring and Evaluation Data Cycle* (M&E). Learning rather than accountability is the focus of the M&E Data Cycle.

The *QSO Software Development Cycle* (Figure 5), was created as an adaption of the M&E Data Cycle. The six stages in the process were: 1) *Identification* - involves selecting the data to be captured with indicators tracked throughout the life of the project; 2) *Capture* - involves collecting data, through informal and formal processes, relevant to the chosen indicators; 3) *Analysis* - involves analysing the raw data and developing recommendations for further software development; 4) *Development* - (Dissemination in M&E Data Cycle) involves acting on the recommendations to develop the next iteration; 5) *Implementation* - (Utilisation in M&E Data Cycle) involves the implementation of the new iteration; 6) *Assessment* - involves assessing and reflecting on whether or not the indicators in the Identification stage were the most appropriate and whether they need to be refined in subsequent iterations. This paper focuses on the first three stages of the development cycle, coloured green in Figure 5, as undertaken in the QSO trial.

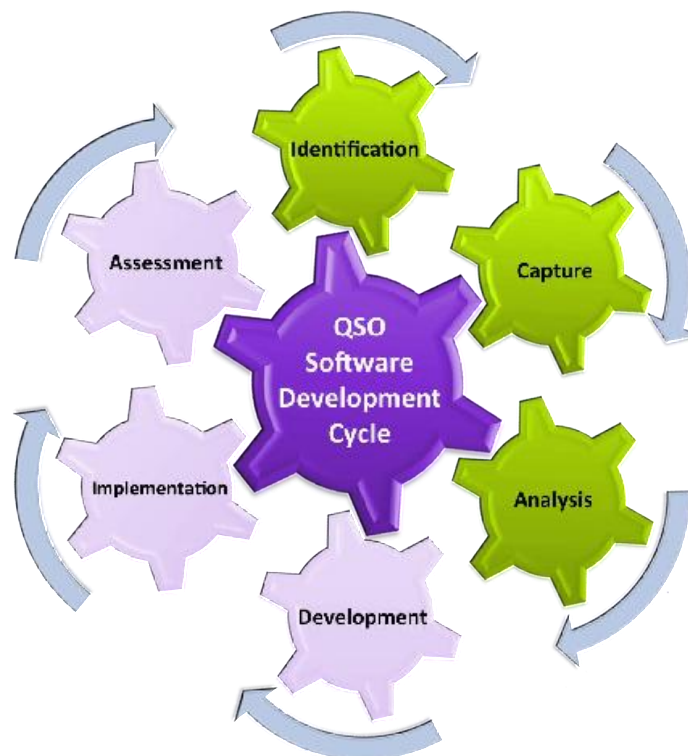


Figure 5: QSO Software Development Cycle

Method

The QSO trial occurred in 2013, with three facilitators who worked with 40 early-school-leavers and adult learners and 44 school-aged learners. The early-school-leavers participated in a youth-off-the-streets program and the adult learners in a government education program. Both programs required the study of basic skills because these learners had been identified as having skills too low for satisfactory employment. The school-aged learners struggled with mathematical skills, but were not necessarily the lowest achievers in their respective cohorts.

Unlike QS, where instructors work with pairs of students, QSO was designed for the learner to use independently. For the trial both teachers/teacher aides and facilitators were present during each

session. The teachers/teacher aides were there to learn how to support the use of QSO in their class rooms. The three facilitators were there to assist with overcoming any technical issues, and to observe the learners, which informed the monitoring, and evaluation of the program. Each of the facilitators attended at least one session weekly.

The research presented in this paper aimed to monitor and evaluate the trial of QSO to determine improvements needed to increase student engagement. The first three stages of the QSO Software Development Cycle (see Figure 1), as followed in the QSO trial, are now described. The first stage, Identification, involved choosing the data to be collected. In accordance with the MSC approach, the most significant change stories provided by the three facilitators were chosen. These facilitators had the opportunity to observe the learner use of, and reaction to QSO and also to have informal conversations with the learners and the teachers/teacher aides. The key indicator of interest was student engagement. The second stage, Capture, involved the three facilitators writing their individual stories recording their observations of student engagement with QSO, including identifying significant changes that occurred. The third stage, Analysis, involved the facilitators collaborating with an independent researcher to combine the three stories to synthesise the most significant outcomes and impacts about learner engagement. The indicators of engagement, as evidenced in the combined story, are reported across all three types, behavioural, emotional and cognitive, to demonstrate the breadth of engagement.

The Story

During the Analysis phase information shared by the three facilitators about their observations during the trial of QSO varied considerably, justifying the need to consider the stories from all three facilitators, rather than just using feedback from one. Two important common themes were that QSO gave the learner the opportunity: to improve basic number skills thus developing automaticity; and to practice those skills with contextually appropriate problems. As a consequence of the improved skills, learner confidence increased both within and beyond the learning environment.

However, consideration of the diversity within the three stories showed that the learner experience varied accordingly to three key factors: perceived employment opportunities, learner age, and teacher engagement. First, employment opportunities, as perceived by the learners, differed between geographic locations with some learners believing that there was no point in engaging with the program when there were no job opportunities relevant to their skill levels. Second, the learners varied in age from eight to late fifties. Typically, school-aged learners could overcome technical issues and engage from the outset and the early-school-leavers did not engage because of recent failure with the school system, while adult learners could see the value in trying a new approach to learning LLN. Third, teacher engagement decreased during the trial, when it became apparent that QSO was not aligned to their specific curriculum requirements and that they were unable to access learner results to map performance outcomes. Learners were more engaged when teachers were engaged.

Analysis of the stories showed that some learners were more engaged than others. Evidence of engagement spread across all three types of engagement: behavioural - seeking assistance, persisting with difficult tasks, completing work above minimum requirements, and assisting peers; emotional - liking the facilitators, reacting positively to progress, and reacting positively to constructive comments; and cognitive - using feedback, interpreting progress graphs, recognising when a fact is "learnt", linking progress to non-QSO life events, and acknowledging the value in learning.

Of most importance to the QSO team was identifying what had the greatest impact on learner engagement and what recommendations could be made to inform the next iteration of QSO in the Development stage of the QSO Software Development Cycle. The five main aspects of QSO found to impact on learner engagement were: learner confidence; learner support; learner e-literacy; online environment style; and context of learning. These are elaborated below.

Learner Confidence

The trial commenced with learners displaying varying levels of confidence. There were many issues that affected their confidence, most importantly, socio-economic status, family attitude to education, fear of mathematics, and prior learning experiences. Despite lacking confidence, some learners were excited to be part of the trial. Generally, the school-aged learners lacked confidence in their mathematical abilities, however were confident using the online environment. Early-school-leaver confidence was affected by previous failures at school. Being labelled as an early school leaver defines a person as a failure, not achieving success in current societal norms (Schwab, 2012). The confidence of many adult learners was affected by the fact that they previously achieved recognition for attending and completing courses, yet were self-aware that they still lacked the basic skills.

Generally, adult learners were confident that QSO provided an alternate learning environment beyond what they had previously experienced. They willingly persevered and continued to engage with the program even when they experienced little academic progression due to technical issues.

Both starting level and automaticity were important influences on learner confidence. QS was designed to start a lesson with Focus Facts, where the learner starts with facts already known and then moves onto the unknown (Pegg et al., 2005). For the trial, QSO was designed so that every learner started from the easiest Focus Fact, plus 2. For some this meant working on facts already known. However, being able to answer the questions correctly helped the learner to develop confidence before going on to the questions at a higher level for a new Focus Fact. Similarly, the rate at which automaticity was achieved was linked to developing confidence. On completion of the trial, many learners demonstrated greater confidence with most able to articulate that they had noticed improvement in their confidence, both within and beyond the online learning environment.

Recommendation 1: QSO calibration be adjusted to start a learner practicing new skills at one level lower than the level at which he/she tested successfully and to stop the learner from spending anymore than six sessions on each Focus Fact.

Learner Support

There were four types of learner support involved: from facilitators; from progress feedback within the online environment; from engaged teachers; and from peers. Initially, increased engagement with QSO occurred when the learner had a facilitator encouraging him/her to get started and/or continue. The facilitator continually encouraged the learner to attempt the questions. The facilitators realised that QSO failed to replicate, within the online environment, what the instructor does in the f-2-f QS. There are two types of progress feedback within the online environment: results, which are graphed in a learner portfolio and incorrect answers which are displayed at the end of each activity. When the learner engaged with his/her portfolio, there was a greater understanding of results and what was necessary to achieve automaticity. Support from the teacher is important to a learner's success in QSO. Teachers were more likely to support learners if QSO helped the learners to achieve curriculum-based outcomes. Many teachers admitted to having poor e-literacy skills themselves and therefore were not confident using QSO without facilitators to support them. A few teachers showed an obvious lack of engagement with the learners and with QSO and generally when this occurred learners were not engaged. Support from peers appeared to have more benefits for the peer who provided the support than for the actual learner. In fact, some of the peers providing the support increased their own confidence to such an extent that they went on to further study.

Recommendation 2: QSO incorporates features to replicate the facilitator in the classroom by providing assistance through intelligent feedback and presenting progress graphs on completion of each activity.

Learner e-Literacy

Many of the learners had low levels of e-literacy, with a few having never used a computer prior to the trial. The exception being some of the school-aged learners who had computers and internet access at home. This lack of e-literacy had not been anticipated. Enrolment in QSO required each learner to have an email address, which the majority of the early-school-leavers and adults did not have or if they did they did not know how to access. Therefore, the facilitators were required to enrol each learner with a username and password. This included a master list given to the teacher to assist those learners who could not remember their details from session to session. The facilitators spent valuable time in the beginning teaching basic keyboarding skills to the learners, including skills as simple as the use of enter key and the numerical keypad on desktop computers. The learners tended to switch between data entry methods throughout an activity between the numerical keypad, the numbers on a standard keyboard, and pointing to the onscreen keyboard using the mouse. This then had the unintended effect of compromising the calibration data in the timed activities, and hence the ability to achieve automaticity.

Recommendation 3: QSO restricts learners to one entry method for numeric characters and incorporates the capability for bulk enrolment of learners.

Online Environment Style

Three important aspects of the QSO environment style related to learner engagement: the interactivity in screen layout, the capability for learners to have individualised programs and the opportunity for non-judgemental anonymity. For the QSO trial, the screen was divided visually into three sections, the centre, left side and right side. Screen layout design was found to have less impact on engagement of the school-aged learner than the older adult learners. School-aged learners were observed to be more adaptable and confident with the screen layout design, enabling them to proceed with few difficulties. The early-school-leavers generally wanted the QSO screen design to be more interactive or game like. Due to their generally poor e-literacy levels the older adult learners found the screen layout design not to be intuitive and they required more help. The adult learners found the lack of explanation as to why they were doing the activities and how they were to do the activities confronting, likening QSO to just one test after another and expressing fear of being unsure as to what was expected next. This affected their academic progress, particularly in the timed activities, and hence their automaticity.

Many learners were more engaged because the individualised learning program nature of QSO gave them the opportunity to learn at their own pace. This was the first time they had felt like they were actually achieving on their own merit. Previously some adult learners had “completed” courses in LLN, however they still could not read or complete basic mathematical skills. These particular learners gained an enormous amount of self-efficacy when they were engaged willingly with QSO to achieve on their own merit.

Some adult learners articulated that the online learning environment was non-judgemental which made it more comfortable than a f-2-f learning situation. This gave the learners the security to engage with QSO and not be embarrassed by having incorrect responses made public. It had been observed that many of these learners sat very quietly in a traditional classroom situation, not engaging and/or not comprehending the classroom instruction.

Recommendation 4: QSO be more interactive by following a logical flow process through the activities and presenting components of QSO when they are needed, making the environment more App-like.

Context of Learning

To engage the early-school-leaver and the adult learner with QSO, the trial identified the importance of linking Problem Solving (PS) learning material to the course(s) being studied and the application to their everyday life, e.g., Foundation Skills Course (FSK). From the adult trial, it was also evident that teacher engagement and support for QSO is dependent on the learning material being linked to relevant curriculum. The classroom teacher requires access to the learners' results of the PS learning material in order for them to be able to validate the learners' progression through their overall course of study. The engagement of the school-aged-learners was not linked to the learning material of the PS activity. However, conversations with the school principal said that PS was a focus of their school and would recommend that the learning material be linked to the Australian Curriculum (Mathematics).

Recommendation 5: QSO includes a teacher-accessible mapping of the problem solving activity questions to the foundation skills package for numeracy and the Australian Curriculum (Mathematics).

Conclusion

Engagement with QSO was evident to varying degrees across the range of learners who participated in the trial. The fact that a variety of engagement indicators were reported indicates that the learners were able to engage with QSO. The breadth of aspects of the QSO experience that impacted the level of engagement indicates that designing an engaging online environment to “house” a learning experience previously designed for a f-2-f situation is not such a straight-forward task. This is especially true when the learners have low levels of literacy and/or numeracy and have previously experienced failure in formal learning situations.

As a consequence of the trial, five key recommendations were reported to enhance QSO and thus better engage the learner. These will inform improvements to be made to QSO in the Development stage. Although these reported findings are specific to QSO, there are lessons to be learnt for other educators designing online environments for learning basic skills. First, the designers must be aware of learner background. Previous education experiences and level of e-literacy impact on learner engagement. What is suitable for school-aged learners may not be suitable for early-school-leavers and adults. Second, the designers need to build in suitable support structures. These should replicate, as closely as possible, learner needs as previously identified in successful f-2-f learning situations. Finally, the designers must set the learning activities in a suitable context. This would ideally include a specific curriculum focus and linking to practical applications. Further research into building such online environments is encouraged to maintain learner engagement.

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IPADS IN THE PRIMARY SCHOOL: EMERGING FINDINGS FROM RESEARCH

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Abstract

Since its introduction in 2010, Apple's iPad has received much attention from education commentators, citing its unique touch screen, portability, relative low cost and huge array of apps, as offering significant potential to support learning at all levels.

This paper summarises key findings from the first two phases of a 3-year study exploring primary school students' use of iPads and apps in general class settings. These phases focused on using iPads for developing foundation literacy, numeracy and problem-solving skills, and analysed the nature of oral discourse that occurred while students were completing iPad-based learning tasks.

Data were collected using a specially-developed 'observeware' app that recorded the iPad's display and student verbal interaction while they were working with a range of open and closed-design apps.

Findings highlight a complex relationship existing between student knowledge and dispositional factors, peer-interaction, and app design, content and features that influences the quality of learning students generate. Furthermore, they suggest using open-design apps in pairs or small groups can provide valuable opportunities to develop exploratory talk, when iPads are used as public work space devices.

This paper will present illustrative data from the study, and raise considerations for teachers, researchers and app developers to help inform more effective designs and use of apps for learning.

Introduction

While much rhetoric surrounds the advent of iPads to the array of digital resources available to teachers and students (Apple Inc., 2014), limited empirical research presently exists analysing how their much-heralded features, such as touch screen interface, huge range of low-cost 'educational' apps, portability and connectivity, offer unique possibilities for supporting student learning. While some qualitative, perceptions-based studies have been undertaken, many of these have focused on information management or logistical efficiency benefits, such as supporting moves towards paperless environments or advantages from 'anywhere, anytime' access to information and online services (Shepherd & Reeves, 2012). Other studies have documented often anecdotal perceptions of learning and motivational advantages from iPad use in special education (Cumming & Strnadova, 2012; Jowett, Moore & Anderson, 2012), early years literacy development (Dobler, 2012; Getting & Swainey, 2012; Harmon, 2012), pre service teacher education (Saine, 2012) and English language learning (Godwin-Jones, 2011).

Media reports have also highlighted moves by a number of schools towards 'Bring Your Own Device' or BYOD programmes, where parents are encouraged to purchase tablet devices such as iPads for their children to use at school, in much the same way as conventional stationery (Bilby, 2013; Irwin & Jones, 2014). Some schools have even gone as far as providing a device for each student (Jones, 2014; Moran, 2014). However, until recently few studies have moved beyond the use of qualitative,

self-report data in attempting to reveal more about the potential of these devices to support student learning. In particular, limited visible evidence has been gathered of the specific nature of students' interactions with each other and the device while using them to solve learning problems, and the influences on this process.

From early 2012, a researcher from the University of Waikato in Hamilton, New Zealand, has used a unique display recording app to gather video and audio data accurately portraying young students' interaction pathways and strategies when using iPads and selected apps for a range of learning tasks. This paper describes the methodology and summarises the main results from the series of studies. As detailed outcomes from each study have been published separately elsewhere (Falloon, 2013a; Falloon, 2013b; Falloon & Khoo, 2014), it provides a synthesis of these and draws out implications for practice.

Research Establishment and Context

Since the launch of the iPad in 2010, some commentators have pointed to the relative affordability of iPads as the key to addressing the perennial issue of access to sufficient devices to make them useful in a conventional classroom (eg., Conn, 2012). However, the reality is that few schools have sufficient funds to purchase devices for their students, instead relying on BYOD-type programmes to address this issue. Acknowledging this fact, in late 2011 an application was made to Waikato University's Education Faculty research fund to purchase eight iPads. These were to be used in the junior area of the primary school on a one-device-per-student-pair basis, to investigate their potential to support literacy and problem-solving skill development. The selected school was a decile² 5 contributing primary (Years 1-6) with a roll of 360 students, located in a small semi-rural town approximately 20kms from Hamilton city.

The school was chosen following a positive response to a personal communication inviting participation, and followed on from previous successful studies the researcher had undertaken with the school. Junior students were targeted following indications from other research that suggested evidence of enhanced learner engagement from iPad use contributed to significant literacy learning gains in young children (McClanahan, Williams, Kennedy, & Tate, 2012). Subsequently, eight iPad 3s were purchased in February 2012, and research foci and goals collaboratively negotiated with the school. A broad implementation plan was also developed, providing a structure to support the study for its first year. This was subsequently revised and redeveloped for the second year, to reflect emergent findings from year 1.

After discussion with the principal and because a number of junior school teachers indicated keenness to be involved, 'expressions of interest' were called for from teachers wishing to participate. This required them to respond to specific criteria relating to their motivation for involvement and outlining their pedagogical and curriculum strengths, as well as suggesting ways in which the devices could be used to support the research foci within the context of their classroom programme. The school's senior management team selected an experienced practitioner, based on her "history of receptiveness to innovation, and very sound, child-focused pedagogy" (Principal, interview, June 2012). The selected teacher, Tonia, had been teaching for 16 years, the last 5 of which had been at the school in year 1-3 classes. At the time data collection commenced she was in her third year of teaching new entrant/year 1 classes. A series of planning meetings were held with Tonia during May and June 2012, during which specifics of data collection for Phase 1 were negotiated. It was decided that data aligned with each research question would be collected separately across the two years, due to their dependence on students using apps of different designs for different learning purposes.

² A full explanation of the New Zealand school decile system can be found at www.minedu.govt.nz/Parents/AllAges/EducationInNZ/SchoolsInNewZealand/SchoolDecileRatings.aspx

Research Classes and Questions

The research was structured with two different classes – the first phase focused on question 1 (data collection from July-December, 2012) and the second phase on question 2 (data collection from June – November, 2013). The 2012 class comprised 18 students (11 girls and seven boys, making up nine pairs) while the 2013 class numbered 19 students (10 girls and nine boys, making up eight pairs and one threesome).

The following questions guided data collection for the study:

1. How do design and content features of selected apps used on iPads affect the learning pathways of pairs of young students using them independently for problem-solving tasks?
2. What is the nature of student talk when planning and creating literacy-based content in pairs using open-design iPad apps?

Research Method and Data Collection

Across both years, case study method located within an interpretive theoretical framework informed the research approach used. Following unsuccessful trials of over-the-shoulder video and observation for data collection that resulted in ‘staged’ student performances, university computer support personnel adapted code from a Cydia app called Display Recorder that allowed recordings to be made of the iPad’s screen and audio via the built-in microphone, while students were working. The app also recorded using a white dot student finger placement on the display, so actions associated with the video and dialogue were captured (see Figure 1). The recorder was activated via a combination of finger taps on the left top corner of the display, but no other evidence of the recorder’s operation was visible to students. Following each recording session (of between 25-40 minutes) the video files were downloaded to the researcher’s laptop for later analysis. In all, nearly 72 hours of student data were collected across the 2 years, of which just over 37 were analysed using Studiocode.



Figure 1. Screenshot from Pic Collage showing recorder finger-placement indication

App Selection and Device Organisation and Use

In both research phases, iPad use was integrated with the normal classroom programme as much as possible. The apps were selected by Tonia to meet what she judged to be the learning needs of her students, within the curriculum topics being studied over the course of data collection. Selections were made following appraisal of reviews in Apple's App store, online and own-school assessments made by other teachers, and a personal evaluation based on use with her own primary-aged children. Apps selected for Phase 1 were of a problem-based, 'learning game' design (see Appendix A). They required students to work together to complete literacy (mainly spelling and phonics) and numeracy (number) learning problems, often embedded in game-like formats. They were generally of a closed design – that is, students were required to work within defined parameters imposed by the structure and format of the app, usually responding to cues and prompts to select from a range of provided responses, or enter their own in pre-set fields.

Phase 1 apps were organised into separate folders according to the different days of the week, and were changed regularly. This decision was made following early realisation that having access to many apps at the same time led to a 'lolly scramble' effect, where students skimmed from one to another without substantially engaging with any. During Phase 1, use of the iPad was integrated into the class's literacy tumble so different pairs of students from targeted reading groups could access the devices at different times, as shown in Figure 2. Within each reading group pairs were teacher-selected, and remained stable for the duration of the trial.



Figure 2. The Literacy Tumble Planner incorporating the iPads

The apps selected for Phase 2 were of a more open design, allowing students to generate and input their own content far more flexibly, in response to learning outcomes rather than app-imposed parameters. Apps used in this phase comprised mindmapping (Popplet), graphic/design (Pic Collage) and oral language/storytelling (PuppetPals HD). In Phase 2, the whole class accessed and used the apps for units involving story planning (Popplet), celebrations (Pic Collage) and drama recount (PuppetPals HD).

Data Coding

Studiocode is an analysis tool for coding video data according to identified themes or repeated occurrences existing across datasets. It allows the creation of analysis tags or labels identifying specific incidents within videos aligned to a particular theme, which have usually been identified through an initial review of a data sample. Coded incidents can be replayed collectively by activating the appropriate code label on a timeline, or single samples accessed individually by double-clicking (see Figure 3). Due to the time-consuming nature of coding video data and resource constraints, not all data were coded. Data aligned with each question were purposively selected for coding after an initial appraisal was made to ensure a balanced coverage of apps used, inclusion of at least one sample from each student pair, and representation within all curriculum topics where apps were used. Overall, 24 hours of video were coded from Phase 1, while just over 13 were coded from Phase 2. To enhance reliability, the researcher employed a postgraduate student to carry out a blind review of data samples. Inter-rater agreement calculations were then performed on the samples using Kappa coefficient (κ). After some adjustment and negotiation, coding agreements in Landis and Koch's (1977) *good to substantial* range were secured³.

³ Further details of this process can be found in Falloon, 2013a; Falloon, 2013b; Falloon & Khoo, 2014.

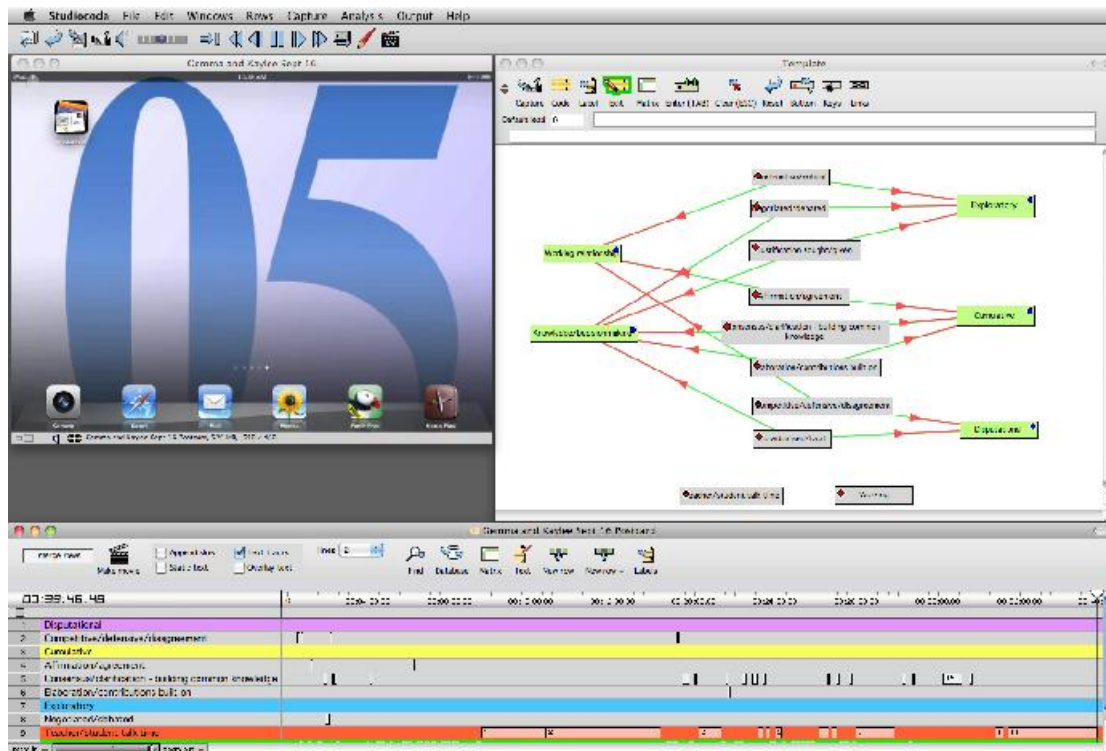


Figure 3. A Studiocode coding window showing timeline, code labels and video sample for Phase 2 data

Results Summary

Detailed tables, results and analysis of data from both research phases have been published elsewhere, and due to space constraints, will not be repeated here (see Falloon, 2013a; Falloon, 2013b; Falloon & Khoo, 2014). What follows is a summary of the main findings from each phase, and a discussion of the implications they hold for teachers integrating iPads into their classroom programmes.

Phase 1

This phase focused on analysing student learning pathways while using selected ‘closed-design’ apps. In particular, it targeted the relationship between app design and/or content features and student interactional strategies, in an attempt to discover if and how particular combinations of these supported (or not) their learning progress. Figure 4 summarises the findings from this phase. It depicts the interaction of four key ‘drivers’ – knowledge, cognitive effort and strategy, device/app content design and response, and student work techniques, as influential in determining the quality of ‘learning value’ students derived from their use of the apps.

Data clearly indicated the cornerstone of quality learning interactions with the apps was the existing knowledge students, metaphorically-speaking, ‘brought to the table’. This knowledge took two forms – declarative (*knowing what* content and conceptual knowledge was needed to solve the problems) and procedural (*knowing how* to solve the problems - both technically and conceptually). While the apps created highly engaging and motivating interactional environments, due to design limitations restricting the nature and type of feedback they gave in response to student inputs, their capacity to help students generate new knowledge or remedy mistakes, was limited.

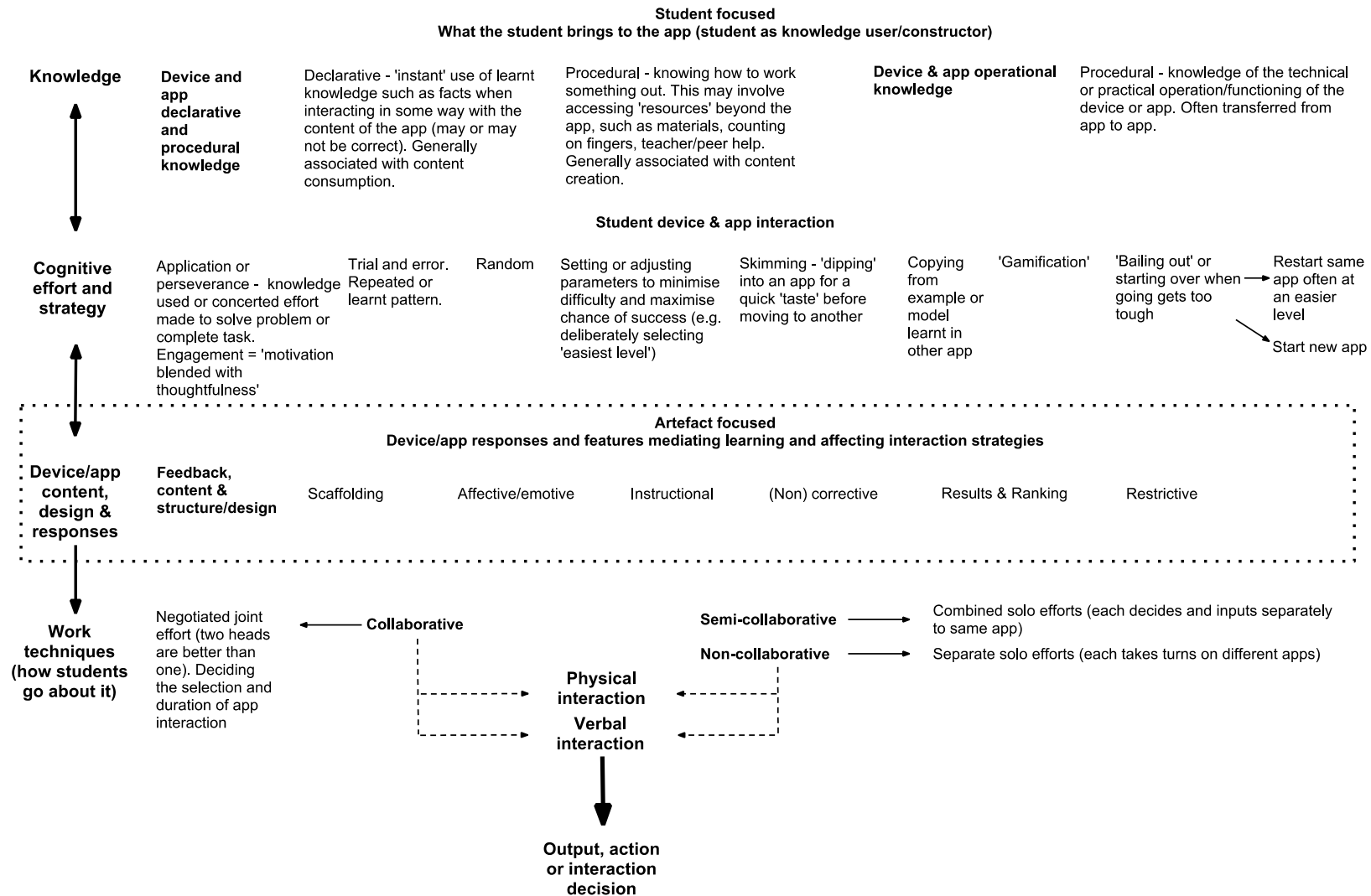


Figure 4. Factors influencing students' learning pathways while using the apps (from Falloon, 2013a)

A characteristic of most of the learning game apps used to provide only positive or negative affective feedback (eg., hand claps, cheers, animations, star/reward charts or 'try again' type voiceovers) did not assist students to learn new knowledge or the strategies needed to advance their learning. Virtually no apps provided feedback of a formative or corrective nature, which would have allowed students to analyse mistakes and learn from them, to improve future performances.

Additionally, a noticeable trend during Phase 1 was the diminished benefit of affective feedback from the start of data collection compared to the end. Put simply, the more feedback of this nature students received, the less impact it appeared to have. In fact, towards the end of Phase 1 data collection, affective feedback appeared to inhibit the quality of some students' learning. End point data contained several examples of students deliberately inputting incorrect responses or randomly guessing answers in order to beat their workmate to the finish, which more often than not was marked by an entertaining image or animation. A good example of this was seen in the app *Rocket Speller*, where students were often recorded challenging each other to see how many pieces they could get the rocket to explode into upon its return to earth, by making it fall the quickest (see Figure 5).

This phenomenon was labelled *gamification*, and was a very common occurrence in data. Basically, it referred to students diverting their attention from *learning* engagement with the app to *entertainment* engagement. Gamification was generally triggered by two scenarios. The first, which was labelled 'app fatigue', came from student over-exposure to, or over-familiarity with, an app or apps. If an app was used too frequently, these young students quickly became bored or mastered techniques that enabled them to skip through parts they found repetitive, unappealing or routine, to get to entertaining or game content. While restricting the numbers of apps in the daily folders helped lessen the 'skimming' effect, it was equally important to ensure there was regular turnover to avoid app fatigue.



Figure 5. The exploding rocket in the app *Rocket Speller*

Gamification also occurred in situations where app content became too difficult for students to work on independently. Most often this resulted from apps automatically increasing the level of content difficulty

in response to students' answers, or where initial level selection had been set beyond the students' capability (or they had done this themselves). While a few students displayed a combination of perseverance, effort and strategy that allowed them to attempt more difficult problems, all eventually reached a point where their cognitive and affective resources 'ran out'. At this stage some reverted to gamification, while others opted to close the app and select a different one. This latter characteristic was labelled *bailing out* (Figure 4). As previously, the absence of built-in scaffolds or formative feedback was instrumental in limiting the progress students could independently make.

Recordings also provided evidence of different ways these students worked with each other and the iPads, while completing learning tasks. These were coded as collaborative, semi-collaborative and non-collaborative, and were influential in how much progress pairs were able to make. The output from pairs coded as collaborative in Phase 1 (n=4) could best be described as joint efforts, where recorded discourse indicated decisions were negotiated and agreed upon, and where evidence existed of both students having reasonably equal device access in pursuit of a commonly-viewed goal/s. Student pairs coded as semi-collaborative (n=3) at times displayed some of the characteristics of collaborative pairs, but were more inclined towards shared device access (often determined by equal 'hands on' time) and separate decision-making, albeit while working on the same app and towards the same goal. Two pairs were coded as non-collaborative, and typically these pairs shared the iPad, but seldom on an equal or equitable basis. Access was usually determined through a 'battle of wills' or physical interaction of some type, and generally resulted in one student dominating to the detriment of the other. Although device access time was shared in some way in these arrangements, often students chose to work on different apps, closing their partner's when their own turn eventuated. Thus for these pairs, progress towards task goals was, at best, incremental.

Data collected during Phase 1 suggested merit in exploring in greater depth the oral interaction between students, as they appeared highly influential on their decision-making when solving learning problems in the apps. This observation provided the direction for the second phase of the research (2013) that focused on analysing student interactional talk while using the iPads for content-creation tasks.

Phase 2

Data for Phase 2 were gathered while student pairs were using apps of an open-ended, content creation design, within literacy-based units of learning. This was a deliberate decision motivated by Neil Mercer's (1994) SLANT (Spoken Language and New Technology) research with primary school students, that suggested learning benefits could be gained through small group exposure to software where students are required to negotiate and talk when making content-related decisions. Three apps were selected for this phase (Popplet, PuppetPals HD and Pic Collage). Student pairs were once again teacher-selected, but unlike Phase 1, pairings were social and not achievement-based. The pairs had been formed three months into the school year and approximately two months before data collection commenced, and had remained largely unchanged. Tonia made this decision based on her earlier observations of 'learning efficiency' benefits from maintaining stable groups, or as she put it, "they seem to settle down more quickly and just get on with it" (Tonia, personal communication, July, 2013).

To help make sense of the recorded oral interaction between students, codes were developed based on Mercer's 'talk type' classifications of *disputational*, *cumulative* and *exploratory*. Briefly, talk coded as disputational indicated defensiveness, disagreement, competition or person-focused conflict, with individuals possessing contributions rather than collaborating in joint content development. Talk coded as cumulative was affirming but non-critical in nature, often building on previous activity but in a non-expansive, passive manner. Exploratory talk was more critical, but focused on critiquing ideas with the goal of improving content, rather than being of a personal nature.

Talk coded as exploratory frequently indicated negotiation, synthesis and respectful cognitive engagement with others' views, with the purpose being to improve decision-making and content quality. This talk type, Mercer suggested, should be encouraged, as it is integral to the role of educational institutions in societies where principles of "accountability, (of) clarity, constructive criticism and

receptiveness to well-argued proposals” (1996, p. 370) are valued. As for Phase 1, specific codes aligned to each of Mercer’s talk-type classifications were entered into Studiocode (Figure 3), and oral interactions recorded by the display capture app were coded using these.

Analysis of Talk Types

Figure 6 summarises the percentage of student talk coded under each of the talk type categories. It also includes recorded talk not specified by Mercer’s original categories (ie., teacher-student, working and other). However, these were not included in the time analysis, as they did not represent task-related student-to-student dialogue. Typically, these categories comprised teacher-to-student (one-to-one or pair), ‘working’ (talk-to-self or thinking aloud) or ‘other’ (student-to-student non-task related, or teacher to whole class) exchanges. As indicated in Figure 6, the most frequently occurring talk type was cumulative, with the sub-code of *consensus* talk featuring prominently across all pairs. Although task-focused, these interactions were typically compliant, consensus-oriented and non-critical, and contributed to outputs that met the intended learning outcomes, but in a safe, unchallenging and non-expansive way.

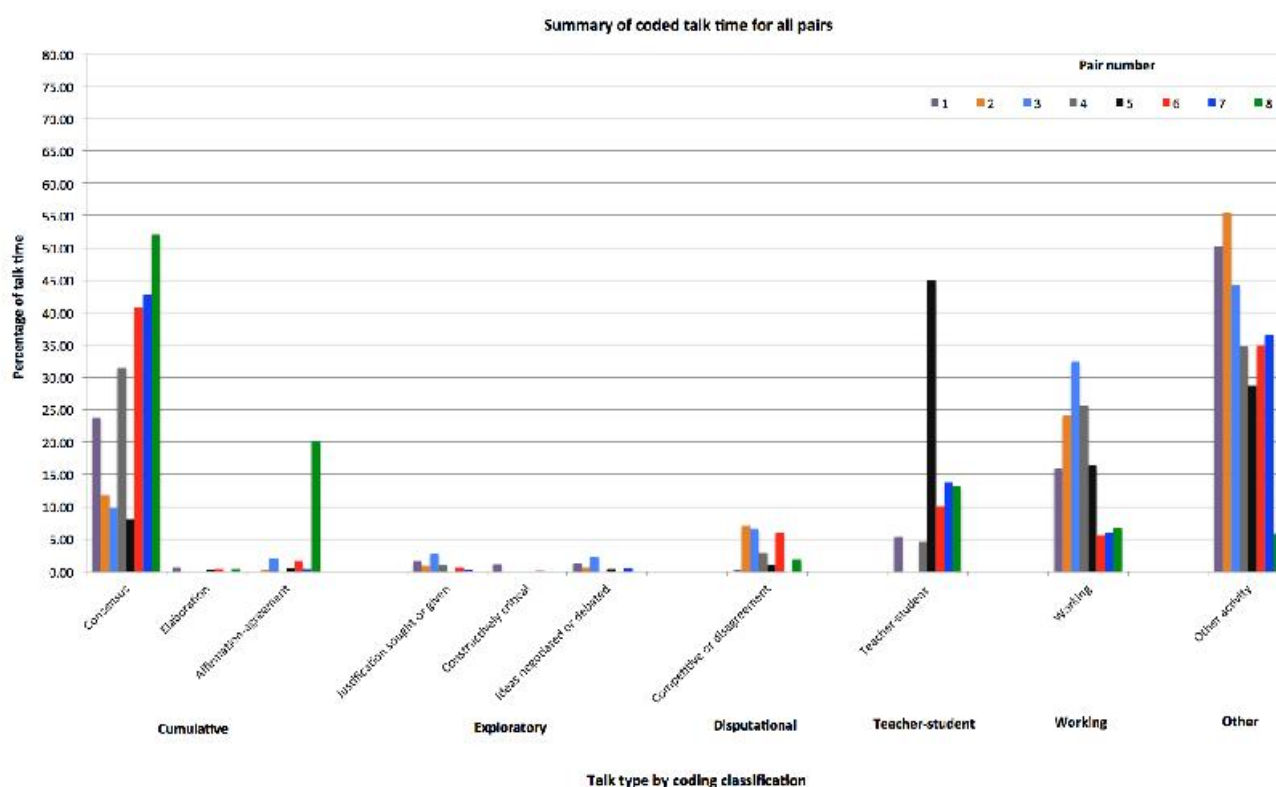


Figure 6. Talk type summary for student pairs (Phase 2)

Only one pair (Pair 1) displayed emerging evidence of exploratory talk. This talk was mainly channelled towards seeking justification from their partner relating to suggestions they made about content, or debating the merits of including particular content in terms of its value for improving overall work quality. An apparent difference between the talk of these students and that coded as predominantly cumulative, was their willingness and ability to question their partner in a way that focused on critiquing the suggested course of action or input, not their partner. This pair frequently used carefully worded open questions and sought explanations, or made suggestions about how inputs could be changed to improve overall work quality. Audio evidence was gathered of repeated debate and collective refinement and revisiting of content, to improve its quality before submission. Although evidence of this talk was restricted to a single pair, it at least suggests that potential exists for iPads, when shared or used in small groups, to support the development of this desirable talk type. This will be discussed in more detail later.

Three pairs (2, 3 and 6) at times exhibited disputational talk of a competitive or defensive nature, although overall percentages were minimal (5-6%). This talk was usually associated with perceptions of unfairness about the amount of device access time each student had (defined as ‘hands on’), or about whose idea should be prioritised when deciding on inputs. Such events spasmodically punctuated the talk of these three pairs and did slow work progress, but once resolved (usually determined by who backed down first), appeared to have limited overall effect on work quality.

An interesting statistic related to this revealed by Studiocode, was the extremely high percentage of talk across all pairs that was ‘on-task’ (ie., clearly focused on learning outcomes). Overall, this accounted for nearly 95% of talk (including that in the three additional categories), indicating very high and sustained levels of learning goal focus by all students.

Reflecting on these results and their significance prompted attention to research completed by Fisher, Lucas and Galstyan (2013), that investigated the affordances of iPads as *public work space devices*. Although their study was undertaken at university level, their results suggested that iPad attributes such as flat, ‘top-of-the-desk’ and unobstructed access, ease of physical device transfer between collaborators, portability, wide viewing angle and multi user-accessible interface, offered unique points-of-difference supporting more collaborative use, when compared to other devices such as laptops or desktop computers. Display-recorded evidence in the current study appears to offer some support for these claims also being applicable to younger students. Particularly evident in the video data was how easily the students passed or slid the device between each other, and how multiple contact points (fingers obviously belonging to different individuals) were often recorded simultaneously interacting with content. Although these behaviours were recorded at some time with all pairs, they were especially prevalent in the actions of Pair 1 (coded exploratory-emergent). It tentatively suggests that such handler affordances *may* be useful for supporting students to work towards using more exploratory talk, although further research is needed to draw firmer conclusions.

Implications for Research and Practice

First, researchers now have the capacity to use innovative digital tools such as the recording app developed for this study, to gather data that naturally and accurately depicts student work practices with devices like iPads, without reliance on self report data, or risking observer effects from observational or over the shoulder video methods. Such data is valuable in that it provides real-time visual and audio evidence of how students apply different strategies and resources to solve learning problems, and how design and content elements of apps either support or inhibit this process. This knowledge can then be used by developers to improve the learning design of apps, and by teachers to help them make better-informed choices about features and content of apps suited to the learning needs and preferences of their students. Additionally, this type of evidence could be useful to help make explicit to parents and other stakeholders the learning progress of students when using digital technologies, as clips may be extracted and used for reporting purposes, perhaps by being incorporated into digital or online portfolios.

Second, results suggest teachers need to be mindful of the limitations of ‘learning game’ type apps for *building* student knowledge. While much evidence from this study points to these apps being highly engaging in terms of student attention, it also indicates that without sufficient conceptual and domain knowledge, students can struggle to derive much ‘learning value’ from them. Most apps used lacked embedded formative feedback mechanisms that students could use to learn from their mistakes, and thereby make learning progress. The absence of these triggered a range of responses that included repeating the same errors, random guessing, gamification, bailing out and app skimming. From a distance this activity may have appeared to be thoughtful learning engagement, but as revealed by the recording app, this was often not the case. While iPads and apps can provide engaging environments for students to practise learnt skills and exercise knowledge, teachers have a very important duty to ensure they have sufficient cognitive and affective resources to purposefully apply to the task.

Third, tentative evidence exists in these results indicating that if devices are shared, there may be some benefit from maintaining stable group or pair access arrangements for significant periods of time. Acknowledging there were different classes and apps used in each study phase, feedback from the teacher and cumulative Studiocode on-task time data, suggested maintaining reasonably stable arrangements decreased the amount of time students spent preparing and negotiating work arrangements. The stable structure appeared to help them slot back into a known organisational system and quickly get on with the task at hand, without the need to repeatedly form new arrangements.

Fourth, Phase 2 data suggests the use of open-ended, content creation apps embedded in authentic learning tasks, could provide useful opportunities for teachers to help students develop exploratory talk capability. Given current educational drivers emphasising the desirability of critical and higher order thinking skills for '21st Century Learners', it seems reasonable that such opportunities should be capitalised upon. Although emerging evidence of exploratory talk was only found in the data of one student pair, the volume of cumulative talk generated signalled potential to evolve this into talk of a more exploratory nature, perhaps through deliberate teaching focused on building questioning and critical thinking skills. Additionally, the handler affordances of the iPad when used as a public work space device, appeared ideally suited to supporting this. Just as knowledge was vital to maximising the learning potential of game-like apps, questioning, debating, negotiating and critique are important resources promoting exploratory talk, which is likely to support higher quality outputs when students use apps for creating and sharing content.

Conclusion

As indicated in the introduction, this paper synthesises key findings of the first two phases of a three-year research project. More details and other findings have been published elsewhere (Falloon, 2013a; Falloon, 2013b; Falloon & Khoo, 2014). The display recording app used in this research has provided unique insights into how students work with these devices, their problem-solving strategies, how different features of apps affect their learning, and the nature of discourse as they interact with each other when using them. The final phase of the project in 2014 will use the recording app to explore older students (year 5&6) use of iPads within inquiry-based units of learning in BYOD classrooms. It will investigate if and how iPads and apps when used within inquiry-based pedagogical frameworks, might promote student thinking skills as outlined in the Key Competencies of the New Zealand Curriculum (2007).

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Appendix A

Apps used during Phase 1

1. Play Square
2. Rocket Speller
3. Smarty Pants School series
4. BlobbleWriteHD
5. Mr Phonics series
6. Pinocchio
7. Icky bathtime
8. Cat in the Hat (Lite)
9. Scramble PCS 3 Letter Words
10. Hay Day
11. Pirate School
12. Where's my water?
13. Cut the Rope
14. Treasure Hunt
15. Pet Shop
16. Green Farm
17. Kids' Puzzles
18. Pattern Game
19. Animal Fun
20. Matches
21. PickinStick Classic
22. Math Bingo
23. Game of Life
24. Dots for Tots
25. Jungle Time
26. PopMath
27. Rocket Maths Free
28. Geometry Maze
29. Toy Puzzles
30. Logos Quiz
31. Blitz
32. Reading Comprehension
33. Princess Pea
34. The Three Pigs
35. Gingerbread Maker
36. Snow White
37. Hairy Maclary
38. Golden Lite
39. Magnetic ABC
40. Talking Tom and Ben News
41. My Dogs
42. The Emperor
43. Little Mermaid
44. The Berenstain Bears Lite
45. Pirate Treasure Hunt

MOOCS AND QUALITY ISSUES: A STUDENT PERSPECTIVE

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Abstract

Massive Open Online Courses (MOOCs) have become the focus of exploration and analysis as a disruptive innovation (Christensen, 1997) to education. There are significant claims made about the potential of MOOCs to transform schooling and higher education (Ernst & Young, 2012; Norton et al., 2013). Education policy and practice is guided by considerations of quality. This paper provides a student perspective 'from the inside' in relation to MOOCs and questions of quality. The perspectives are situated within wider, more general, questions about quality issues about MOOCs 'from the outside' which remain largely unresolved (Kinash, 2014). Those concerns about quality include questions relating to the business model to sustain MOOCs, intellectual property issues, course design including the assessment design, and questions about credit for completing a MOOC. Value propositions for students and for faculty staff involved in the design, creation and delivery of MOOCs are discussed. The paper concludes that, while MOOCs are potentially a disruptive innovation, it is possible that future designs of MOOCs will see improvements on the current learning design evident in early versions of MOOCs.

Introduction – MOOCs, Quality and Student Perspectives

Massive Open Online Courses (MOOCs) have become the focus of exploration and analysis as a disruptive innovation (Christensen, 1997) to education. There are significant claims made about the potential of MOOCs to transform schooling and higher education. This is reflected, for example, in the Ernst and Young (2012) report *University of the future A thousand year old industry on the cusp of profound change* which sees digital technologies and global mobility as two of five megatrends as drivers of change that will transform higher education; namely,

- Democratisation of knowledge and access,
- Contestability of markets and funding,
- Global mobility,
- Integration with industry, and
- Digital technologies (Ernst & Young, 2012).

In relation to digital technologies and MOOCs, they indicate:

The so-called Massive Open Online Courses (MOOCs) are an early stage example of the search for new models. Some of these models will decline and fail, others will create very substantial economic value. Winners are likely to be a mix of new, pure play online businesses and traditional businesses with powerful online models and capability. (Ernst & Young, 2012, p. 9)

In relation to global mobility, they warn:

Global mobility of academic brands is a newer phenomenon, but is also growing in importance. 'MOOC-based' distribution of content by the likes of Harvard, MIT and others is creating a global brand impact, if not revenue at this stage. (Ernst & Young, 2012, p. 10)

While these transformations might be possible (Ernst & Young, 2012; Norton et al., 2013), education policy and practice is guided by considerations of quality. Similarly, as shown in the

review of relevant literature presented in this paper, the growth of MOOCs has been accompanied by questions of quality (Fain, 2012; Legon, 2013; Quality Matters, 2014) with unresolved issues (Kinash, 2014). This paper provides a contribution to this ongoing MOOC conversation by providing a student perspective in relation to MOOCs and questions of quality. The perspectives have been generated by a co-author as participant in the *Surviving Disruptive Technologies* MOOC offered by Coursera in late 2013.

Thus, this paper, in presenting these student perspectives *from the inside* (Everet & Louis, 2001), is situated within wider, more general, questions about quality issues about MOOCs *from the outside* which remain largely unresolved. Those concerns about quality include questions relating to the business model to sustain MOOCs, intellectual property issues, course design, the assessment design, and questions about credit for completing a MOOC. Value propositions for students and for faculty staff involved in the design, creation and delivery of MOOCs are discussed. The paper concludes that, while MOOCs are potentially a disruptive innovation (Christensen, 1997), it is possible that future designs of MOOCs will see improvements on the current learning design evident in these early versions of MOOCs.

Review of relevant literature

This review of relevant literature examines the emergence of MOOCs, and then proceeds to examine and identify some of the issues being raised in relation to MOOCs and quality.

Emergence of MOOCs

The rapid emergence of MOOCs in 2012 and their subsequent growth has been highlighted well by Norton et al. (2013) in the Grattan Institute report *The online evolution: when technology meets tradition in higher education*.

In higher education, 2012 was the year of the MOOC – the massive open online course. At the year's end, several million students had enrolled in education providers started during the year. The big MOOC providers – Coursera, edX and Udacity – were the fastest-moving start-ups in higher education history. (Norton et al., 2013, p. 5)

To illustrate the growth of MOOCs, that report published in April 2013 stated that Coursera had “signed up over 60 top-tier universities from around the world and enrolled more than three million students in 330 courses” (Norton et al., 2013). At the time of writing this paper, approximately 12 months later in March 2014, this had grown to Coursera having 108 partners, with more than 6,500,000 ‘Courserians’ and Coursera now offering 631 courses.

Similar growth and presence is evident in edX (edX, 2014 - see <https://www.edx.org/>) governed by MIT and Harvard University, and Udacity (Udacity, 2014a - see <https://www.udacity.com/>), started by several scientists from Stanford University. There are similar themes conveyed in their respective missions. For example, Udacity claims that:

Our online courses are rigorous and may even make you sweat. Tackling projects built by tech leaders like Google, AT&T, and Intuit, you'll stretch yourself and learn new and relevant skills. Enroll today—we'll help you succeed and cheer you on every step of the way! (Udacity, 2014b)

Elsewhere, the Coursera mission is outlined on their website as follows:

Coursera is an education platform that partners with top universities and organizations worldwide, to offer courses online for anyone to take, for free.
We envision a future where everyone has access to a world-class education. We aim to empower people with education that will improve their lives, the lives of their families, and the communities they live in. (Coursera, 2014a)

Undoubtedly, the emergence of MOOCs reflects not only significant growth in the numbers of students and courses being offered, but there have been associated issues in relation to MOOCs and quality, which are discussed briefly in the following section.

MOOCs and quality

An excellent starting point in discussions about quality of online courses is the *Quality Matters (QM) Higher Education Rubric* (Quality Matters, 2014) which highlights the importance of alignment of course components, including the Learning Objectives, Assessment and Measurement, Instructional Materials, Learner Interaction and Engagement, and Course Technology and how these enable students to develop and demonstrate the learning outcomes. The rubric provides 8 general standards and 41 specific standards and can be used to evaluate the design of online and blended courses. Moreover, “The Rubric is complete with annotations that explain the application of the standards and the relationship among them” (Quality Matters, 2014, p. 1). To illustrate, one of the standards – Standard 5 – focuses on *Learner Interaction and Engagement* and provides 4 indicators; namely,

- 5.1 The learning activities promote the achievement of the stated learning objectives.
- 5.2 Learning activities provide opportunities for interaction that support active learning.
- 5.3 The instructor’s plan for classroom response time and feedback on assignments is clearly stated.
- 5.4 The requirements for student interaction are clearly articulated.

Earlier in 2012, the Gates Foundation which had offered grants to support the development of MOOCs, engaged QM involvement with that grant program in what might have been “the first effort to test whether MOOCs can meet quality design standards, incorporate proven methods of effective online instruction, and be effective for different learners” (Quality Matters, 2014, p. 1). The QM review involved MOOCs delivered through various platforms, including Blackboard, Udacity, Coursera, D2Learn, and EdX. In relation to QM standards, the outcomes of that review were disseminated in December 2013. Twelve courses were completed by the review deadline, with three courses meeting the standards after the first review, one course met the standards after an amendment, and one MOOC is expected to meet the standards after changes are made. Consequently, the inference can be made that the other seen courses were problematic on one or more of the QM standards.

Shown in Table 1 is a synthesis from the summary provided in *Quality matters applied to MOOCs* (Heidi, 2 December 2013) drawn from the Eli Webinar presented by Deb Adair, QM Managing Director and Chief Planning Officer, and this represented QM’s first attempt at applying QM to MOOCs.

Table 1 Synthesis of Key Findings – *Quality Matters applied to MOOCs* (Source: Heidi, 2013)

What was done well
• Course Overview and Introduction • Assessment and measurement • Instructional materials – depth and quality seemed to be strong • Technology – navigation was clear and functional
QM Standards Issues*
• Technology skills expectations clearly stated, articulation of course support services, uses accessible technologies - 50% missed these standards • Learning outcomes clearly stated, module learning objectives measurable, articulate accessibility policies - 42% missed these standards • Course learning objectives measurable, response time clearly stated - 33% missed these standards
* It was determined that many of the accessibilities issues were related to the chosen delivery platform, not necessarily an issue with the way the MOOC was developed.
The Bottom Line
These non-credit bearing MOOCs could have obtained certification by addressing some basic policy information that should be standard in any course.

Elsewhere, Fain notes that “Early returns show that massive open online courses (MOOCs) work best for motivated and academically prepared students” (Fain, 2012, p. 1). However, Fain suggests that the question which the Gates Foundation wanted to answer was - could high-quality MOOCs benefit a broader range of learners? Similarly, Ron Legon, Executive Director of QM, in commenting on the quality of MOOCs, argued that far too little attention has been evident, and stated:

On the face of it, the organizing principles of MOOCs are at odds with widely observed best practices in online education, including those advocated by my organization, the Quality Matters Program. Many of the first MOOCs are providing quality of content, but are far behind the curve in providing quality of design, accountable instructional delivery, or sufficient resources to help the vast majority of students achieve a course's intended learning outcomes. (Legon, 2013, p. 1)

Importantly, Legon suggests that “the best MOOC 2.0 courses may turn out to be “hybrids” that combine the characteristics of quality online courses with a lower threshold for risk-free exploration, enabling them to reach more online learners and stimulate them” (Legon, 2013, p. 1). Elsewhere, Gregson (2013) identified several concerns about the MOOC agenda. These included risks associated with corporate sponsorship and influence over content, MOOCs might become the ‘cheap seats’ of the increasingly, stratified, unequal higher education sector, and that MOOCs represent a “fairly naked threat to the working conditions of existing and future higher education workers” (Gregson, 2013, p. 33). Gregson concludes with a strong caution in relation to MOOCs and quality.

MOOC fans will say this horse has long since bolted and those of us who still think quality pedagogy requires time and space are hopelessly utopian, but if we do not retain some vision of what quality higher education should look like, this form of online 'learning' may well become just another sign that the real focus is on the price/cost of education and not its true value.” (Gregson, 2013, p. 33)

The co-authors of this paper attended and participated in the eLearn 2013 World Conference Pre-Conference Symposium dedicated to MOOCs in Las Vegas, and actively engaged in the MOOCs and Course Quality roundtable. Associated with the QM issues identified in the literature review, that roundtable identified issues associated with the monetisation and business models to sustain and grow MOOCs, intellectual property issues, MOOCs and assessment design, and credit issues. Evident also was the question – what is the value proposition for students and for faculty staff involved in the design, creation of MOOCs? At that symposium, George Siemens, in his presentation *MOOCs: Where next?*, suggested that, “While MOOCs as a concept are over-hyped and will likely fade in prominence, the attention now being directed to online learning, development of new software, new assessment techniques, and new pedagogies will last” (Siemens, 2013). The emerging analysis of this discourse about MOOCs reflect questions of quality and questions of what MOOCs might become and/or inform other forms of online learning.

Research design

This study aimed to investigate a student’s perspective on the experience of studying a MOOC in order to make assessments about MOOCs and quality issues. The course selected for this study was *Surviving Disruptive Technologies* offered by the University of Maryland, through Coursera, and was undertaken in late 2013. The authors disclose from the outset that the co-author was a participant in this study, who undertook this course, and successfully completed the assessment tasks for the course. This is important to disclose, so that critical perspectives are not seen as being influenced by a negative outcome achieved by the co-author as the course participant. Thus, this should not be seen as an assumption that the outcome was negative from this student perspective. Similarly, as this student succeeded in this course, it should not be assumed that everything about the MOOC experience was positive.

Consequently, rather than relying solely on reports and research by other parties about MOOCs, this study was initiated by a desire to gain first hand experiences through a student perspective by one of the co-authors engaging in a MOOC. The co-author became a participant in the course. Therefore, the methodology was guided by this aim of the study which focused on a values-based approach, as there was a need to work within a qualitative, naturalistic paradigm in which the inquiry is value-bound, influenced by inquirer values as expressed in the choice of the problem itself, and in the framing, bounding and focusing on that problem (Cohen, Manion & Morrison, 2004, p. 137). In addition, as a co-author was involved in a program of learning, the context within which the study took place assumed that the attribution of meaning was continuous and evolving over time (Cohen et al., 2004, p. 137).

Elsewhere, in relation to organisational research, relevant to this study are two different paradigms discussed by Evered and Louis (2001) as inquiry *from the inside* and *inquiry from the outside*, with the former evident in this study in which the researcher is a participant in the course, rather than being detached *from the outside*. However, *from the inside* observations are complemented by an analysis *from the outside*, by couching the student perspectives of participating in the *Surviving Disruptive Technologies* course within wider literature, implications and issues.

In summary, data were collected throughout the course *from the inside*, focusing on the design and implementation of the course, including the content, delivery (such as the Video Lectures, Discussion Forums), and the assessment design (Mid Term and Final Term Projects. Specifically, these are couching within the 10 unresolved MOOC issues *from the outside*, as identified by Kinash (2014) and shown later in this paper in Table 2 in the following section, which provides a summary of the findings from a student perspective. This reflects alternating between inside and outside perspectives, and addresses the limitations associated with being limited to only the inside set of perspectives (Evered & Louis, 2001).

Summary of Findings – A Student Perspective

About the course – Surviving Disruptive Technologies

The course *Surviving Disruptive Technologies* was offered by the University of Maryland through Coursera. As shown in Figure 1, the purpose of this course was “to help individuals and organizations survive when confronted with disruptive technologies that threaten their current way of life” (Coursera, 2013). The aim of the course goes on to outline the focus of the course; namely,

We will look at a general model of survival and use it to analyze companies and industries that have failed or are close to failing. Examples of companies that have not survived include Kodak, a firm over 100 years old, Blockbuster and Borders. It is likely that each of us has done business with all of these firms, and today Kodak and Blockbuster are in bankruptcy and Borders has been liquidated. Disruptions are impacting industries like education; Coursera and others offering these massive open online courses are a challenge for Universities. In addition to firms that have failed, we will look at some that have survived and are doing well. What are their strategies for survival? (Coursera, 2013).



Figure 1: Coursera - *Surviving Disruptive Technologies* – University of Maryland

It was easy to enrol online, and there were no costs associated with enrolling. The admission requirements indicated that:

By registering or participating in services or functions on the Sites, you hereby represent that you are over 18 years of age, an emancipated minor or in possession of consent by a legal parent or guardian and have the authority to enter into the terms herein. In any case, you affirm that you are over the age of 13 as the Site is not intended for children under 13. If you are under 13 years of age, do not use the Sites. (Coursera, 2014b)

Therefore, as a student, it was noted that, with parental consent, a student might be 13 years or over. In addition, it was noted that there were no other entry requirements, such as previous secondary school or tertiary qualifications. This is an important consideration when assessment design is discussed later in this paper, particularly in relation to the use of peer assessment.

Course Format

The 7 week course format consisted of a ‘Syllabus’ which had two ‘classes’ each week. For example, Week 1 consisted of Topics, such as Class 1 – Survival, and Class – 2 Kodak misses its moment. As shown in the Course Menu in Figure 2, the course design provided Video Lectures, Discussion Forums, Weekly Assignments, details about the Mid Term and Final Term Projects, the Syllabus, Surveys, Course Wiki, and Join a Meetup.

Also, as shown in Figure 2, these video lectures ranged in duration from 4:56 minutes through to no

longer than 21:47 minutes. Interestingly, from a student perspective, the asynchronous access was an effective design, as the student was travelling from Australia to the United States, Singapore and Malaysia during this course. From a student perspective, it seemed that videos that were 4-6 minutes seemed optimal, while those longer than 10 minutes seemed to be too long. Thus, weekly topics broken into smaller video lectures seemed to reflect better design than, for example, presenting a single one hour video lecture each week.

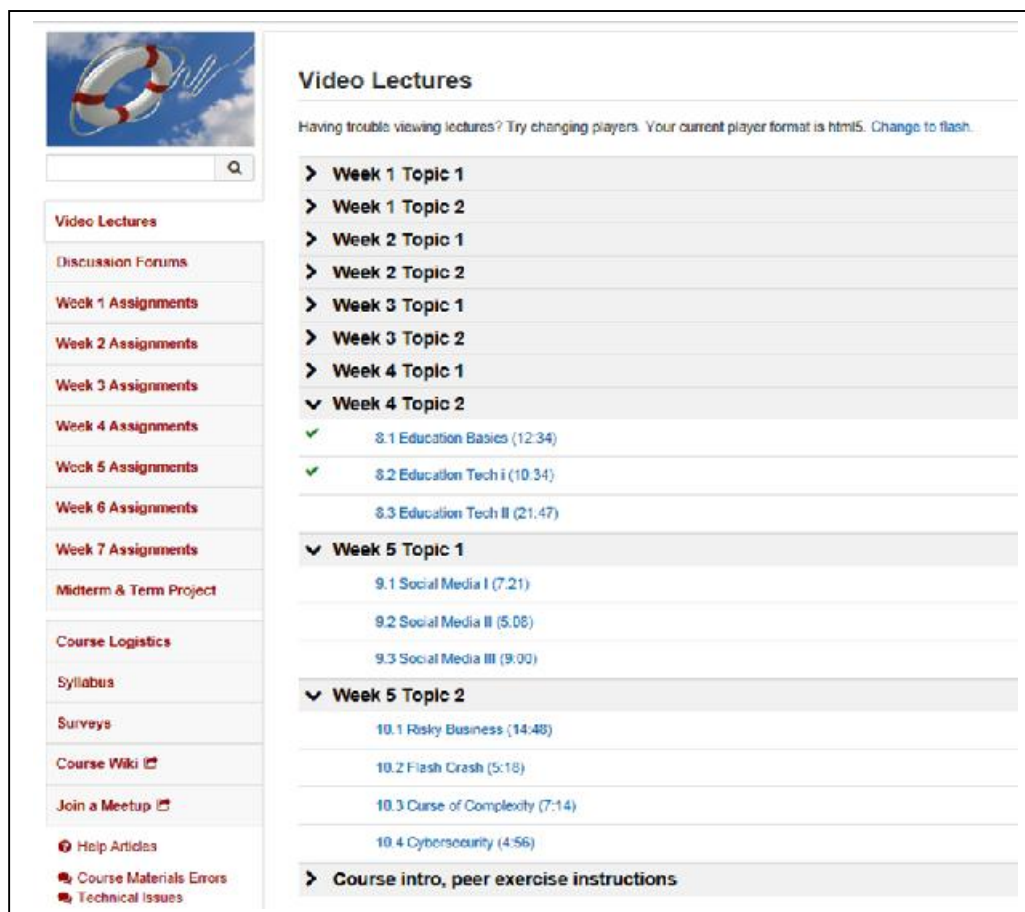


Figure 2: *Surviving Disruptive Technologies* Course Menu and Video Lectures

Student Perspective – Course quality – Discussion forums and peer assessment

There was a heavy reliance on the participation of students in the Discussion Forums, and all assessment tasks relied totally on students undertaking peer assessment.

While participation on the Discussion Forums was not an assessable component of the course, there was the generation of 'Forum Reputations'. To some extent, this incentivized and encouraged the co-author as participant to engage in the forums. As shown in Table 1, the co-author as participant created 4 threads, provided 50 posts, and achieved 10 points, ranking 7th on the Forum reputations.

Table 1 Forum Reputations – at 16 December 2013 after the course was completed

Name	Threads	Posts/Comments	Upvoted/Downvoted		Points
Student Name Removed	6	30	26	0	25
Student Name Removed	9	83	22	0	17
Student Name Removed	12	31	19	0	15
Student Name Removed	4	76	20	0	14
Student Name Removed	11	45	25	11	13
Student Name Removed	6	20	23	0	12
ACEC 2014 Paper Co-author as participant	4	50	13	0	10
Student Name Removed	2	11	14	0	10
Student Name Removed	7	27	16	0	9
Student Name Removed	7	30	13	0	9
Student Name Removed	1	11	15	0	9
Student Name Removed	16	34	10	0	8
Student Name Removed	2	7	24	0	8

As the Course Statistics are unknown, no commentary can be provided in relation to the number of students undertaking this course and the percentage of students who contributed to the Discussion Forums. However, it seemed that most of the discussion was contributed to by approximately 20-30 highly engaged, visible students in these forums. In addition, it was observed that comments were frequently about course related matters, rather than substantive dialogue about the content and the development of deep learning.

These perspectives are consistent with the findings by Brinton et al. (2013) who investigated forum activities, since social learning is a key MOOC design feature and driver in scalable models. They noted two features of MOOC forum activities, namely, a high decline rate whereby the volume of discussions in the forum declines continuously throughout the duration of the course, and that ‘high-volume, noisy discussions’ are evident. They warn that approximately 30% of the courses produce so many new discussion threads that it is not feasible for either the students or the teaching staff to read through and respond to these. Furthermore, a substantial portion of the discussions are not directly course-related, as experienced in the *Surviving Disruptive Technologies* discussions. Examples include the introductions which sometimes result in threads which talk about the roles and locations of students, rather than the course content.

Brinton et al. studied the discussion threads associated with 73 courses offered by Coursera, involving 115,000 students who wrote over 800,000 posts in 170,000 different threads. They noted a dramatic decline as a course progressed, and, classify the posts into three categories; i.e. small talk (student introductions that are of little use in completing the course), discussions about course logistics (such as when to submit assignments), and course-specific questions which are the most useful for students. This is consistent with the experience of the student in this study.

Student Perspective – Assessment issues

Students undertaking this course were not required to complete the assessments. However, for those seeking the Certificate, there was a Mid Term Project and a Final Term Project. For a student to have her/his work assessed, there was a requirement that the student agreed to peer assess at least 5 other student assignments. Both the Mid Term Project and the Final Project were peer assessed.

In relation to the Mid Term Project, no clear statements about the standards, criteria, length or referencing system and expectations were provided. Therefore, there were no standards descriptions for calibrating and moderating to guide the making of judgements about the standards of work being assessed. Importantly, there was no process for developing assessor capabilities. Given that enrolment

in this course was ‘open’ to anyone over 13 years and previous tertiary experience was not required for admission, this held the potential for a novice student to be assessing the work of another student at a University level.

These concerns were evident in the discussion forums after the Mid Term Project had been assessed. To illustrate, the co-author as participant stated:

As a student in this course who wanted my work assessed, and therefore I agreed to assess the work of others, I had searched carefully for standards and criteria upon which to create my assignment, and to be able to reliably assess the work of other students. I was quite surprised when I saw these when I undertook the assessment of other students. (Co-author)

Another student commented, “I must say that the midterm exam was the worst exam I’ve ever taken”. In the Discussion Forums, the co-author noted that some who undertook the peer assessment said that they marked students low if their responses were short, while others indicated that they marked students low if they provided long answers. The way in which this was designed and implemented did not enable inter-rater reliability. For students who believed that there were problems in their marks, there was no review of grade or appeals process. In terms of quality and governance of assessment, Universities must have well articulated assessment policies which include these provisions. These were not evident in this MOOC.

Professor Hank Lucas, who was the lecturer for this course, provided the following, honest explanation, though this did not engender confidence in relation to inter-rater reliability. It is interesting that he refers to ‘grading rubrics’ as none were provided. This might be explained as he indicates that he found these difficult to construct.

I have found creating the grading rubrics the most difficult part of preparing the course. I do not particularly like multiple choice questions and objective tests because they tend to go after facts. An essay lets people show that they can think about the issues and reason from what they have studied. I hope that in evaluating answers people will use the rubric as a guideline. In most cases I think the answers should say mention some of the items in the rubric. For example, in question 1 a student should observe the relationship between loss of viewers, loss of advertising and then loss of revenue. However, if there is a great answer that deviates from the rubric I would give it full credit. (Professor Hank Lucas)

It seemed that fewer students completed the Final Term Project, which logically meant that it was more likely that the students completing this were more likely to have been engaged and understood the key concepts and content being developed in the course. It was perceived, from comments in the Discussion Forums, that those who failed the mid term project were less likely to complete the final project. The student perspective was that, while there were issues relating to inter-rater reliability for the Mid Term Project, the marks and the quality of the comments received for the Final Term Project seemed to have been provided by a smaller set of students who had developed deeper learning in this course.

Student Perspective – Unresolved MOOC issues

Due to length limitations of this paper, these are presented in summary form in Table 2. *From the outside*, Kinash (2014) identifies 10 unresolved MOOC issues which are used as organising issues in Table 2, and supporting commentary from Kinash is provided to elaborate on those 10 unresolved issues. These are used to frame student perspectives gained by being a student in this MOOC *from the inside*.

Table 2 MOOC Issues - A Student Perspective on *Surviving Disruptive Technologies*

Unresolved MOOC Issues	Supporting Commentary (Kinash, 2014)	Student Perspective in relation to Surviving Disruptive Technologies Course through Coursera
1. High drop-out rate.	“Estimates vary, with some news articles listing drop-out rates of 40-85 per cent. ...Surveys from people who have failed to complete MOOCs state that it was not what they expected and/or that the quality of the MOOC they tried was poor.” (Kinash, 2014, p. 57)	• Course statistics were sought by several students, but these were not provided. • Indications were that few students successfully completed the Mid Term Project, and even fewer completed the Final Term Project. • It was perceived that to succeed, a student needed to have the academic capabilities for independent, self-directed learning.
2. MOOCs are online.	“Advocates for a blended approach believe that some learning content and activities are best suited for online (e.g. multimedia lectures) whereas others must be facilitated face-to-face with educators present (e.g. labs).” (Kinash, 2014, p. 58)	• The content of this course was suitable for being provided online. • As the student was travelling overseas during the course, online was very effective.
3. MOOCs produce sub-standard or lower tier graduates.	“A high proportion of surveyed employers have indicated that they would not consider graduates from university programs offered via MOOC... MOOCs often have no criteria and poorly developed pre-requisites for student enrolment.” (Kinash, 2014, p. 58)	• Due to the issues associated with the assessment design, there are major concerns regarding the relationships between the learning outcomes expected and the way that students were asked to demonstrate these through the assessment tasks. • Peer assessment lacked inter-rater reliability.
4. MOOCs have proliferated before a rigorous and robust business model has been developed.	“Is there cost-recovery for the original university?” (Kinash, 2014, p. 58)	• There were no costs for students to enrol. However, it was evident that considerable investment had been made to construct this course, and to employ those who delivered the course. • There was an option to pay a small amount (\$39) to

5. The **development of a crediting system.**

“Who decides which MOOCs are credited for which programs in which universities? Will there be a global master-list of transfer credits? Will there be an accreditation process and quality audits? ...What if the subjects are offered through corporations rather than universities?” (Kinash, 2014, p. 58)

6. Will MOOCs become **the enactment of an Ivory Tower Imperialism?**

“There is a fear that a few powerful universities will situate themselves to offer, credit and advertise MOOCs, and that the current context of diversity and multiculturalism through numerous universities in each nation will be replaced by online global learning through a few dominant institutions.” (Kinash, 2014, p. 57)

7. **Quality MOOCs are resource demanding** in the design, student administration and teaching phases.

“...requires a team who understands the discipline and curriculum, pedagogy, contemporary students, and technology-enabled and technology-enhanced learning.” (Kinash, 2014, p. 58)

8. MOOCs are **new in their development.**

“Universities must invest time and money into keeping the content, pedagogies and technologies current, up-to-date and cutting edge.” (Kinash, 2014, p. 58)

9. MOOCs heighten **intellectual property issues.**

“Who has the copyright on online materials?” (Kinash, 2014, p. 58)

10. Many universities are hesitant to enter the MOOC arena is that they worry

“The curriculum and teaching approaches may provide a market advantage to the university. Putting those strategies up online for their

undertake the ‘Signature Track’.

- While the intention was not to gain credit, the Certificate was able to be recognised through the student’s profile on LinkedIn.

- Importantly, the student can claim that they were immersed in a course offered by the University of Maryland, which provides some status to this course.

- There is a perception that MOOCs might be positioning themselves to be the ‘Google of Higher Education’.

- While this was not researched, it was evident that significant resource investments had been made to construct and deliver this course.

- If this course is offered again, it will need upgrading in terms of content.

- Course improvements are needed, for example, in assessment design.

- There were some student concerns that solutions provided by them became the intellectual property of Coursera.

- The co-author as participant undertook this course with the purpose to learn both the content and to

about sharing trade secrets

competitors to see may be counter-productive.” (Kinash, 2014, p. 58)

learn how this MOOC was designed.

- A great deal was learned from this immersion in this MOOC, which can be used to inform online course development elsewhere.

Conclusion

This paper examined MOOCs and quality through the presentation of a student perspective through immersion in the *Surviving Disruptive Technologies* course offered by the University of Maryland through Coursera. These perspectives *from the inside* were situated within 10 unresolved MOOC issues provided *from the outside* by Kinash (2014).

This paper has identified and examined the challenges associated with improving the quality of MOOCs, and associated questions relating to the business model to sustain MOOCs, intellectual property issues, course design, the assessment design, questions about credit for completing a MOOC, and the value propositions for students and for faculty staff involved in the design, creation and delivery of MOOCs.

To conclude, while MOOCs are potentially a disruptive innovation (Christensen, 1997), we agree with Legon (2013) and Siemens (2013), that it is possible that future designs of MOOCs will see improvements on the current learning design evident in these early versions of MOOCs. It is also likely that there will be business models which monetize MOOCs to enable their financial sustainability. The next generations of MOOCs are also likely to be more seriously informed by quality frameworks, such as *Quality Matters* (2014).

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CALCULUS FOR KIDS

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Abstract

The 'Calculus for Kids' project builds on 'Calculus in Primary' which was conducted with final year primary school and first year secondary school students aged between 10-12 years old in four Australian states. Classroom teachers were trained to provide instruction in the use of MAPLE mathematics software. They taught their students in 1:1 laptop classrooms (and one computer laboratory) to use MAPLE to solve real-world problems using integral calculus. After eleven lessons, the students took a version of the first year engineering degree calculus examination, where they gained an average Distinction grade. The project was significant because it showed very young students could achieve at much higher levels when using computer technology. The resulting discussion can examine the ethics of withholding such support in mainstream classrooms and what we mean by 'knowing calculus'. Both questions are reviewed in this presentation.

'Calculus for Kids' was designed to extend the project to include lessons in which similarly-aged students devise mathematical models to describe real-world activities. With funding from the Australian Research Council (linkage project LP130101088) the project has been extended to more states and schools over a longer term of engagement.

Introduction

Educators have long held high hopes for the use of computers in schooling. These hopes have included access to advanced ideas at a younger age. Seymour Papert suggested this would be possible in the area of mathematics:

Many topics that were unteachably abstract in the context of pencil and paper technologies will be considered as appropriate for children in the context of a digital technology that makes the previously formal become concrete. (Papert, 2000).

The implications are that the right choice of software can provide students with opportunities for practice and rapid feedback in a motivating environment or have higher order cognitive goals (Wenglinksy, 1998). The Calculus for Kids project was created to take advantage of this potential. It also provides a chance to address a looming shortage of mathematics skills in Australia.

Universities have reported falling numbers of enrolments in tertiary mathematics, but in New South Wales at least, pre-tertiary mathematics completions with studies involving calculus have remained fairly constant since 2001 (MANSW, 2014). In the USA, SimCalc (Kaput Center, 2014) has been used to assist 12 to 14 year old students develop conceptual understanding of key concepts in Calculus (Rochelle & Kaput, 1996). This provided the impetus to re-think the curriculum by considering that the "most effective way of promoting learning is to embed basic skills instruction within more complex tasks" using computer technology (Roschelle, Pea, Hoadley, Gordon & Means, 2000). Further studies with SimCalc revealed student-level effect sizes of .63, .50, and .56 (Roschelle, Shechtman, Tatar, Hegedus, Hopkins, Empson, Knudsen, & Gallagher, 2010), all above the 'hinge point' of .4 (Hattie, 2009). An effect size of 1 is typically associated with advancing learners' achievement by one year, or improving the rate of learning by 50%, and corresponds to one standard deviation. Effect sizes above .4 are unusual in educational research. This demonstrates the correct use of software has significant potential in addressing the shortage of these STEM (science, technology, engineering and mathematics) skills.

Australia's international ranking for school mathematics is declining. In the international PISA studies it was ranked 8th in 2003, 9th in 2006 (DEEWR 2008) and 15th in 2010 (PISA 2010), placing Australia

below several Asian countries and New Zealand. In his 2011 report, Gonski recommended the need for additional investment (Gonski et al., 2011). “Australia’s weak performance in reading and mathematics...illustrates a serious cause for concern and suggests significant education reform is needed...”

The obvious disjunction between ICT use in the world of work and the less consequential uses in schools can be seen as a reason why students feel disenfranchised and disengaged with education. The responses of some education systems can seem quite dramatic. For instance, the US state of Indiana no longer requires cursive writing to be taught because of the perceived importance of keyboards (Loughlin, 2011).

Therefore, the lack of STEM skills appears to be an important problem which could well be addressed by the correct choice of software and an appropriate pedagogical approach.

Literature

Expectations computers will transform learning

There has been speculation that children can learn concepts, including mathematics, at younger ages if they have free access to computers, are as ICT-literate as they are reading-literate, and are unfettered by traditional age-related achievement. A first demonstration using the acquisition of systems concepts (Resnick, 1998) has hinted at the validity of this idea. Following the 2007 Australian Federal election, the first item on the new cabinet’s agenda was computers in schools. An interview with Mark Pesce (2007) highlighted ICT in schools as a Trojan horse to force teachers to think about not only their training but also changing the curriculum. Principals interviewed on the same program expressed their expectations that the \$1.2 billion initiative (Rudd, Smith & Conroy, 2007) would provide a real vision and move the system forward. The Australian Government committed to a Digital Education Revolution with a focus on schooling in Years 9–12, where students nationwide were to be provided with computer access throughout every school day.

Disjunction between ICT in school and at work

We witness on a daily basis the stark difference between traditional calculus instruction in schools and practical applications by professional engineers. Traditionally students have been taught how to integrate a function from first principles using a series of rules or patterns they memorise. This helps students to understand how to integrate a new function in the future. However, as the catalogue of function integrals grows, the use of poorly-memorised results using ‘first principles’ can impede practical calculation. Therefore professional engineers use a variety of specialist software to ‘crunch the numbers’. One might argue that reliance on computing equipment in engineering is analogous to the widening use of word processors in lieu of pens in newspaper offices; there is certainly a discussion to be had about the way these technologies redefine the underlying skills or their acquisition. The crucial transformational role of ICT in schooling is underlined by the need to introduce ICTs as an integral component of broader curricular reforms that are changing not only how learning occurs but also what is learned – identified for the Australian government in *Making Better Connections* (Downes, Fluck et al., 2002).

Some educational institutions are realising the importance of bringing engineering applications of calculus into the mathematics classroom. Horowitz and Ebrahimpour (2002) described the use of Matlab software at Penn State University (USA) to solve optimisation problems and predict the effect of drag forces. Tang, Ram and Shah (2005) used multimedia instructional materials and the Maple software (Maplesoft, 2014) to work on the inventory control problem and do curve fitting. The use of computers to better match the activity of professional engineers was a feature in both these approaches.

Some major reports into the efficacy of ICT as a support for student attainment in numeracy and literacy showed it can be limited when used in an inappropriate curriculum (e.g. Robertson & Fluck, 2006 and

Dynarski et al., 2007, the former carried out for the Australian Research Council). Parr (2000) showed ICT is about as effective as other methods for improving education, such as decreasing class sizes, when assessed using non-ICT based tests. Therefore we argue the impact of ICT as a general capability to assist the teaching of conventional subjects is likely to be severely limiting when assessed using conventional methods.

Method

The aim of the project was to show that advanced mathematical concepts can be taught to and understood by primary school students, who can then use these new skills to solve real-world problems usually only attempted by senior secondary students. This was achieved using specialist computer software and the development of an integrated ICT system, curriculum, and associated teacher training. The trial was conducted using a sample of students from 5 schools. The project aimed to:

- introduce techniques to assist children to learn and better understand concepts such as areas and volumes;
- develop improved ways of teaching children to understand the structure of mathematical equations through optimising the mechanisms they use to symbolically represent those equations;
- create learning modules for integral calculus and differential equations accessible by primary students;
- enable students to collaborate in problem-solving activities during the learning process.

Our main conceptual tools were Rogers' theory of innovation adoption, the non-template problem-solving method of Allen (2001), a realistic mathematics education approach (Gravemeijer, et al, 1999), and a methodology we developed on the transformational use of ICT in school education which combines professional software tools with multimedia instructional materials.

The basic design for the research was an intervention method using a cyclic approach, consisting of four stages: produce/modify procedures and material, train the teachers, intervention in schools, and assess results. We recruited schools for the project from four Australian states, ensuring a wide range of ICSEA scores (see Table 1). The local facilitators were chosen by each participating school and attended a one-day training session at the University of Tasmania. The preference was for situations where students were allocated a laptop for the duration of the program; however, due to the unavailability of equipment, a class in one school used desktop computers in a laboratory.

In each teaching package we provided materials (see Figure 1) for 12 one-hour modules to be taught over six weeks with links to worked examples in MAPLE worksheets and extension activities for students to autonomously consolidate learning. The material consisted of real-life situations presented through high-visual-impact media that students can understand and apply the mathematical techniques to solve them. Our challenge was to provide teachers with the confidence that they could master and convey the material. This included grounding in the operational aspects of the mathematics in the training day, followed by the other calculus topics in subsequent sessions. Ethics approval was gained to use a purely post-test method since we understood virtually no student would have learned calculus beforehand. The post-test contained 14 application questions taken from the first year engineering calculus examination, with one affective question: "What is calculus good for"? Students were allowed to use the MAPLE software as they undertook the post-test.

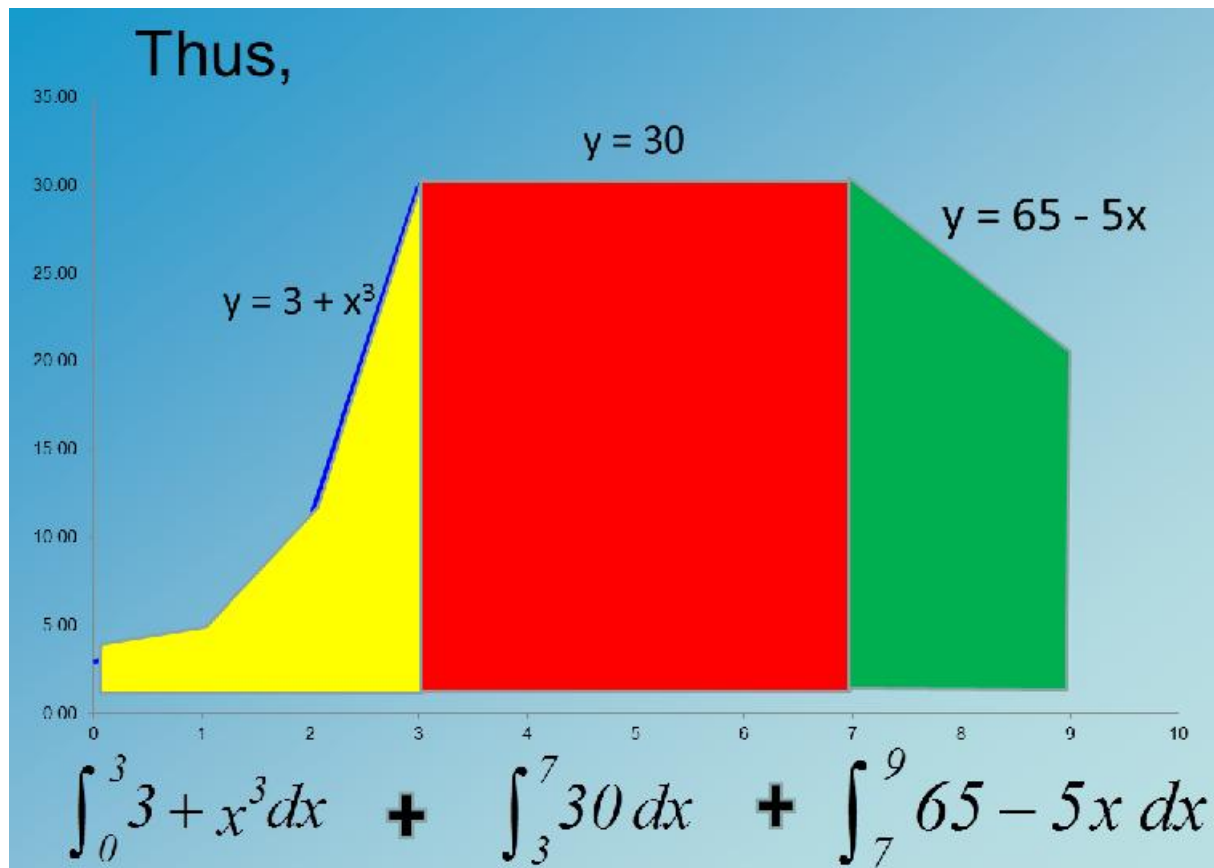


Figure 1 Example of interactive learning materials

The highly visual teaching format used full-colour cues, both stationary and animated, to create a delivery tool that suited the learning styles of both girls and boys, in a topic that is currently skewed towards males both in terms of school-curriculum and career choice. Groups of upper-primary-school children from five schools followed the learning module during one term. The initial lessons focused on the use of MAPLE, to ensure students could use this tool to solve familiar problems. Once the operational aspects of the software had been mastered, the concept of integral calculus was introduced in the fifth lesson. By the eighth lesson, students were quite happy to put together a combination of definite integrals (as per Figure 1). They went on to solve problems using integral calculus involving real-world applications, such as the quantity of wood chips required to fill a curved garden bed and how much paint will be needed for a decorated theatre wall.

Results and Discussion

Our small proof-of-concept pilot project addressed the major issue of STEM skill shortages faced by many Australian universities. To our surprise, the students scored highly on the university-level post-test, gaining Distinction and Credit grades. Table 1 provides a breakdown of the results by school and gender.

Table 1 Student demographics, location, school advantage, and overall performance by gender in post-test questions

State	Location	ICSEA *	n	Scores - Females		n	Scores - Males		n	Scores - combined	
				Mean (%)	Standard Deviation		Mean (%)	Standard Deviation		Mean (%)	Standard Deviation
NSW	Urban	1004	16	74	9	11	73	17	27	75	18
QLD	Urban	1118	13	87	9	10	89	8	23	88	9
VIC	Rural	984	8	73	17	8	56	13	16	58	27
TAS	Rural	959	12	70	12	11	67	23	23	63	26
TAS	Rural	887	4	90	7	7	86	7	11	90	10

* Index of Community Socio-Educational Advantage (ICSEA): The mean ICSEA value is 1000 with a standard deviation of 100. Values below the mean indicate schools with fewer advantages.

The results were astonishing, since young children demonstrated competence of what is currently university-level integral calculus (although the engineering undergraduates have to solve the problems without a computer). In just one narrow topic, 2D integral calculus, it was possible to harness children's passion for engaging with computers, with skill acquisition beyond the project expectations, both in terms of visual conceptualisation and the understanding of a set of mathematical processes (Fluck, et al, 2011).

The Australian Curriculum (ACARA, 2014) offers a number of content descriptors for the study of integral calculus.

- Senior Secondary | Mathematics | Mathematical Methods | Unit 3 (e.g. ACMMM115)
- Senior Secondary | Mathematics | Specialist Mathematics | Unit 4 (e.g. (ACMSM124).

These units are normally studied in Year 12, whereas the students in this project were in Years 6 or 7. Therefore the students were using computers to learn and demonstrate achievement at a level five years in advance of their chronological age. An effect size of 1.0 is associated with advancing learner's achievement by one year (Didau, 2014), so this project might reasonably claim an effect size of 5.0. This is well beyond Hattie's (2009) hinge point of 0.4 as a measure of medium educational impact.

The project has led to numerous journal papers, a book chapter, an outstanding paper award at an international conference, positive feedback from the local community and the local press, commendation from the State Education Minister and media interviews. This success story is featured in the Maplesoft "User case studies" (Chin, et al, 2012) and was presented at the Australasian Association for Engineering Education (AAEE) conference in 2011 (Penesis, et al, 2011), where it was commended by engineering peers.

Each participating school received a community report suitable for the school newsletter. The success of one school (where students were selected from several classes and used a computer laboratory) was congratulated by the Tasmanian Minister for Education who stated in the local press: "This is an outstanding result, given that integral calculus is a branch of mathematics which has widespread applications in science, economics and engineering". It was also outstanding in that this school had the lowest index of community socio-educational advantage.

This project demonstrated that primary school students, some of whom were as young as 10 years of age, can handle integral calculus when equipped with computer tools. With time on their hands after finishing the project early, students in one school went on to experiment with features of the software which were not taught. They discovered a wizard for calculating volumes of revolution, and used this to design goblets. Figure 2 illustrates one such exploration, showing how the students were familiar with the mathematical notation yet playful in their activity, a good omen for future curriculum transformation.

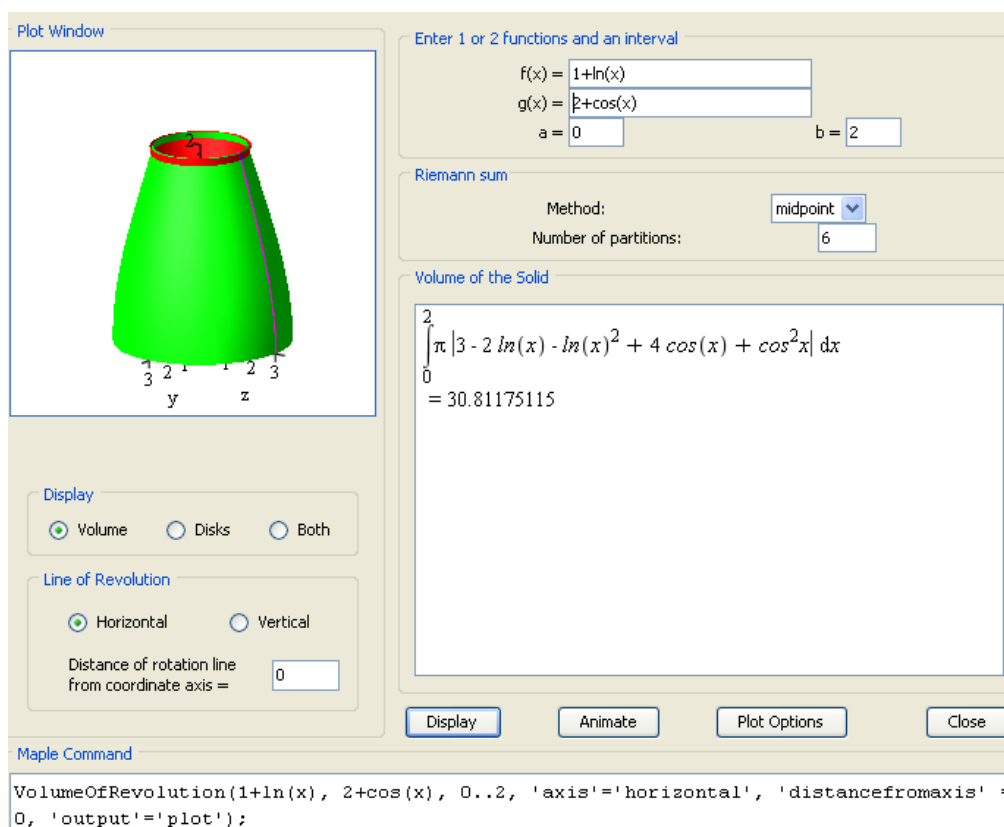


Figure 2 Goblet design in progress using the volume of revolution wizard in MAPLE

Conclusion

A 2014 Australian Research Council grant will enable this project to go into more schools and track its impact on NAPLAN numeracy results. In addition, it will allow students to look at a greater range of real-world problems and construct their own functions to model them. Two additional lessons have been inserted into the learning materials on parabolic functions. The main reason for this was to counter criticism that the students in the project were ‘merely pressing buttons’. The lessons on parabolas will provide students the opportunity to tailor a function to fit a real-world situation, then use the tools of integral calculus to solve the problem. Such a criticism brings into stark relief what we intend when we say a student ‘understands calculus’ or has mastered the subject. If passing an examination in the topic at an academically advanced level does not signify such understanding, then what does? Or do we always mean this understanding must always be demonstrated without the help of electronic equipment?

This cuts to the core of what might be entailed in the re-design of curricula through the use of computers. If our social decision is that calculus comprehension must be demonstrated without electronics (even four-function calculators), then it would be strange if authors were asked to give up their word processors.

As the *Calculus for Kids* project proceeds, we will be keeping a close eye on ways this activity impacts upon general numeracy, hopefully through generating mathematical understanding and delight in successful achievement. Our other eye will be on the future of existing curricula, wondering what other projects can contribute in a meaningful way to transformation and re-design using computer tools.

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eEXAMS TRANSFORMING CURRICULUM

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Abstract

The eExams project in Australia has sought to prove a sustainable, scalable and secure pathway for computers to be used in examinations. Initially developed at the University of Tasmania, it has been used in various degree courses and in the pre-tertiary sector across the state.

Over a thousand students have used the eExam System since its launch in 2009. Candidates bring their own devices to the examination, and boot up from a specially crafted USB stick. This provides the same modified Ubuntu software environment (based on Linux) and a full office suite to every candidate; access to the exam materials and a secure partition for the candidate's answers.

As with any long-term software development project, the eExam System continues to evolve. Work on the version 5 began at the University of Queensland in 2013. This will add a copy of the learning management system Moodle on the USB stick to include a range of computer marked question types, such as short answer and multiple-choice. A restricted network connection to an institutional LMS is also possible, using a secure gateway.

This presentation illustrates the way users have made the transition from paper-replacement to post-paper examinations. The style of emerging post-paper exams illuminates the way in which curriculum change may be facilitated through this new assessment format.

Introduction

The fundamental role of computers in education at all levels is evolving. In many cases they are used to support the existing curriculum. As students become more able to bring their own devices, this situation may change to re-define curricula (Puentedura, 2013), perhaps even schooling itself (Downs, Fluck, et al., 2001, p.23). In a cautious way, the Exams project seeks to accelerate understanding and capability where it is prudent to do so.

In 2014 the inception of the new Digital Technologies subject is foremost in many Australian computer educators' minds. They may have some difficulty assessing student achievement in the subject without using computers. It would seem anachronistic this subject should be wholly assessed on paper. This makes a case for a computer-based assessment environment that can be implemented on a class-by-class basis. A good solution will scale from individual classrooms to nation-wide assessments. The eExam System provides this range using free and open-source software whilst re-using USB sticks for each test.

In other subject areas, teaching topics and skills using school computers which will be assessed without them may be discordant to many teachers. One of the authors has personally witnessed the distress for both teacher and Year 5 student when the latter requested the use of a computer 'like I normally do' at the commencement of a NAPLAN literacy test.

Our speculation is that the introduction of a method for conducting assessments on student computers in a fair and secure fashion will provide a useful lever for transforming curricula in the future. Our project and its future extension should change high stakes testing and by implication give students a wider range of contexts for assessing new digitally-based skills. These skills have been shown in the parallel 'Calculus for Kids' project as outpacing chronological age by many years (Fluck, Ranmuthugala, Chin & Penesis, 2011).

This is important because of the tension between the high rate of innovation in the information industries, and the slow rate of technology adoption in education. Computers are rapidly changing our world. But school curricula change slowly, at the mercy of politics, restricted resources for teacher professional development, and well-intentioned social inertia. An individual teacher desiring to innovate by presenting newly discovered knowledge in the classroom has to provide evidence of student achievement at the end of each year according to pre-ordained accountability frameworks, mostly using pen-on-paper techniques. There are tensions between information technology and school use as expounded by the former prime minister of Australia:

While ICT has fundamentally reshaped whole industries, revolutionized production processes and generated massive improvements in productivity in our workplaces, our education systems have been slower in adapting. (Gillard 2008)

Previous work

Paper-based exams in the UK are a major barrier to curriculum change (Ripley 2007, p.10). This helps to explain why the recent revision of the English National Curriculum, which schools have to implement from September 2014, makes almost no reference to digital technology. To tackle this deficiency, three ministers (Education, Skills and Enterprise, and Higher Education) have set up the Educational Technology Action Group (ETAG) in order to advise government on how to overcome barriers to transformation of the education system through the use of digital technology (Hancock 2014).

There is extensive work on educational transformation, and widespread agreement that assessment is a major barrier to, or enabler of, change in education. We need to develop new ways of assessing people, to better reflect the knowledge, skills and personal attributes that are needed in the Information Age (Heppell 1994, p.154; Twining et al. 2006). There is a significant mis-match between current assessment practices and new learnings like computational thinking that digital technology facilitates (e.g. Ridgway & McCusker 2004, p.38; Venezky & Davis 2002, pp. 11-12). Computational Thinking (Wing 2006) is at the heart of the new subject released by Australian Curriculum, Assessment and Reporting Authority (ACARA) in February 2014. This project works to make this kind of thinking evident in many other subjects. There is strong support for the need to change how we assess learning in order to rectify this mis-match (for example Lemke and Coughlin 1998, p.18; Lewin et al 2000; McFarlane et al 2000; Barton 2001 pp.27-28; ICTRN 2001; Trilling and Hood 2001). Newhouse (2013, p.15) writing on computer-based transformational assessment identified the “lack of experience for students and teachers [as] a constraint in using ICT to support summative assessment, particularly where the stakes are high”.

As indicated above, accountability and assessment are strong levers determining the nature of skills and content in educational curricula at all levels. The qualities of e-assessment (if and how computers are used in the assessment process) and the extent of e-assessment are important determinants of the relationship between rapid technological innovation and socially conservative education. Ripley (2009) presents two ‘drivers’ of e-assessment: business efficiency and educational transformation. Drivers emanating from the business efficiency have focussed upon computer-based assessment. This is often implemented as multiple choice questions (MCQ), as is common within learning content management systems, and have the advantage of automated marking. There is extensive literature on the business efficiency aspects, but the eExam System is a new approach that aligns well with the need for educational transformation. Candidates start up their own personal computers from a specially crafted USB drive in an eExam.

The USB drive controls the computer throughout the exam, providing a secure operating system which prohibits access to any other drive or communication function. By putting the computer into the hands of every examination candidate, assessors can leverage educational transformation and include the use of professional software tools into the curriculum. Knowing candidates can be asked to undertake highly complex investigations or engineering design work in the exam hall can boost expectations in the classroom.

The technology for implementing examinations on computers is developing. Some systems rely upon institutional equipment and 'thin client' (dumb computers) with networking connections to a central server. These are reliant upon all elements in the communication link remaining operational throughout the critical period of the exam; if any one element, such as a wireless access point, should fail, the examination has been jeopardised. Also, each candidate is restricted to questions of a very simple nature within the confines of a web page window. Typically question material relies upon pre-set text stimuli, or diagrams, video or interactive elements at successively rising cost making them viable only for very large cohorts. Multiple choice question types are popular within this paradigm.

Fluck, Pullen and Harper (2009) in explaining the eExam system, described how candidates boot their own personal computers from a live operating system USB and complete short and essay style questions while preventing access to unauthorised networking or other data sources. They are also able to run specialist software (beyond Office tools) within the secure eExam system. The specialist software can include Windows programs running under the Wine compatibility layer or any other program chosen by the assessor which runs in a native Linux/Ubuntu environment. Examples include educational software (which candidates have critiqued in the examination, or digital multi-media products from school pupils which candidates have assessed). This goes beyond the limited MCQ aspects of previous systems.

The eExam System is therefore scalable (not reliant on institutional equipment limitations), resilient (communications infrastructure is not essential), fair and unbounded (every candidate gets the same full operating system environment; no-one has personal access to software unavailable to other candidates). The eExam System provides a unique opportunity to transition to paper-replacement exams on computer, and then beyond to post-paper exams. This simple pathway for adoption is possible because existing exams translate easily to the new computer-based environment (in the paper-replacement stage), whilst laying the foundation for running complex software applications as part of the exam in post-paper tests. The technological advantages with this implementation pathway are a winning combination. The icing on the cake is the free and open source nature of the system, eliminating licencing costs and extra fees for students.

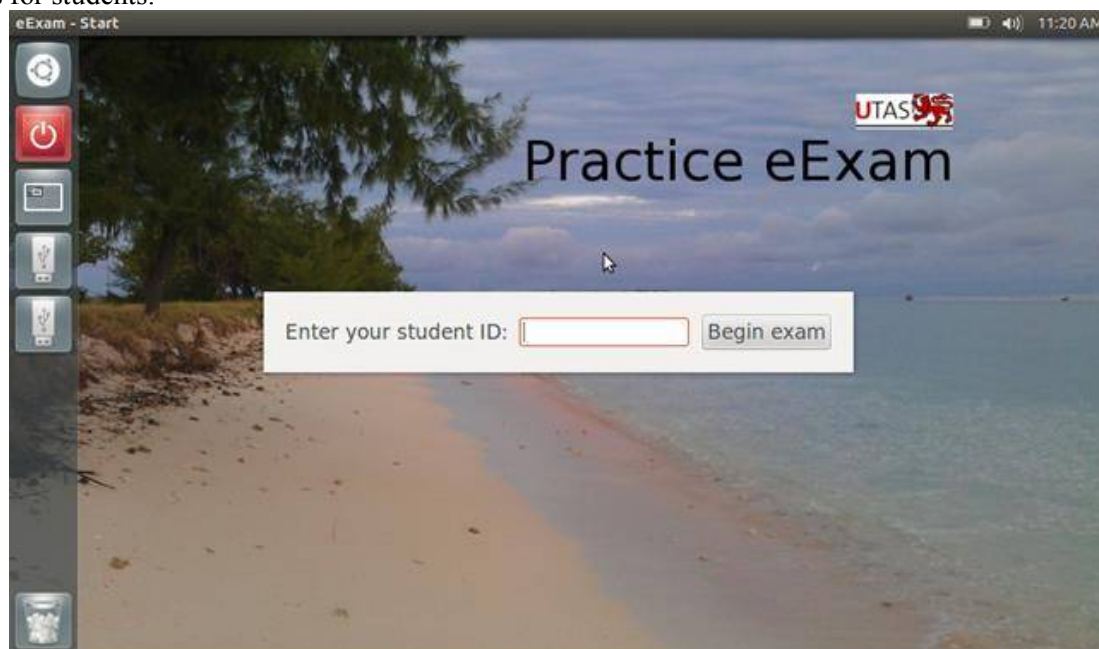


Figure 1: Example security image on desktop of student personal computer booted from eExam USB.

Deciding upon an eExam Platform

The idea of using word processors for text production appears un-controversial; but improving academic performance through the use of advanced software is far rarer in other fields such as mathematics or

science. Yet important discoveries are being made in the latter, for instance the award of Nobel prizes for computational chemistry in 1998 and 2013. This symbiosis of human endeavour with computational techniques generates important new knowledge to which students need access. By allowing examination candidates to demonstrate proficiency using software tools, they will be able to perform more complex tasks which will also be more authentic in relationship to the real world and professional practice. We argue the use of computers in final exams (as a component of balanced assessment methods) will remove hurdles to curriculum transformation.

There is fierce competition from proposers of various exam-on-computer vendors. At the heart of this contention are key philosophical debates relating to costs, the ideal format, and technological delivery platforms. Who should pay – should the candidate, teaching institution or qualification authority pick up the cost? Would a free, open source (FOSS) method be better (compare Microsoft Windows – a commercially available operating system, with Ubuntu, a FOSS equivalent). Beyond this debate is that of reticulation. Is the current internet infrastructure reliable, resilient and sufficiently capacious to be trusted with people's lives as determined by the outcome of a high stakes assessment? Finally, in this tense area, can all assessment questions be sufficiently well posed within the confines of a web-window as part of a locked-down test oriented software application; or should we be looking to assess student ability within an unrestricted computer operating system where specialist software of any complexion can be run? Is there an implicit cultural bias embedded in a particular system? Would Australia be better to adopt a system devised locally, or to import a commercial system from the USA, or a FOSS system from Finland?

This area of intellectual enquiry is new ground. It is particularly important we gather impartial, unbiased knowledge in this area because adoption of particular strategies can have a knock-on effect. Thus, when a state university adopts an eExam strategy, there is huge incentive for feeding school systems to adopt the same eExam approach with its associated benefits or restrictions (Fluck & Moge, 2013).

Current status of eExams

eExams have been used at the University of Tasmania since 2009, and with official sanction in the formal exam halls since 2011 following their acceptance by academic senate in March of that year. A parallel adoption was made by the Tasmanian Qualifications Authority in 2011, when a paper-replacement eExam was used for Information Technologies and Systems at Year 11/12 pre-tertiary level statewide. This was followed in 2012 by a post-paper eExam, where candidates were required to view a web-site on screen – patently not possible on paper. In 2013 the Authority went further and held an open internet-accessible exam, which pushed the boundaries yet again.



Figure 2: An eExam USB.

Since that time, eExams have been held in a wide range of disciplines, ranging from educational technology, constitutional law and history. They have also been held in a wide range of places – in the conventional exam hall alongside candidates using pens; in formal computer laboratories; in public libraries in Amsterdam (for students enrolled by distance).

Three key security features make eExams fair. All communication ports are blocked or monitored by the modified implementation of Ubuntu, as are all accesses to data storage devices other than the USB boot device. The last feature is purely visual. Assessors are asked to supply a unique image to be placed on the desktop at bootup; one which candidates could not acquire elsewhere. For non-technical exam supervisors, this image assures them each candidate has booted up into the exam environment rather than using the operating system on their own laptop hard drive. This guarantees every candidate has access to precisely those software applications permitted for the exam.

In most cases, assessors begin by offering their students the choice of pen or keyboard for the examination. This makes a low-impact change which individuals control their rate of adoption. We refer to this stage as paper-replacement exams, because to all intents and purposes the nature of the assessment is unchanged. Over various cycles, more and more students select the keyboard, and when a sufficiently large proportion do so, the next stage can begin.

This is the post-paper exam. This kind of exam contains elements which are difficult, if not impossible to present on paper. It may be something as simple as a full colour photograph; or perhaps include a video file to be viewed as a stimulus. For instance, a mathematics education exam contained a video of a teacher introducing a fractions topic – candidates were invited to comment on the pedagogical techniques used in the lesson. These two examples could still have been delivered via a web-page, but using current wireless network access point standards there would be great difficulty simultaneously downloading a movie to several hundred candidates.

Table 1: Changing aspects of eExams

From 2007	To 2013
120 candidates	Over 1000 candidates
Paper replacement	.. to full multimedia and questions requiring software operation.
Institutional equipment	..to personally owned computers
Educational computing	UTAS Law, Mathematics pedagogy, TQA Information Technology & Systems
Launceston campus	Statewide, interstate and overseas

One of the authors trains teachers to assess digital products created by schoolchildren. These can include narrated powerpoints with animation. This is an example it would be difficult to embed into a web-page. The digital product could be a file from almost any program – not just from an Office application. Therefore the full operating system available to each candidate becomes more important. Another skill taught is that of evaluating digital educational resources. Using the eExam System, candidates can be asked to review a novel piece of software against pre-set criteria. Another post-paper examination could ask candidates to use a particular software tool to accomplish a professional task and submit the output file (a bridge design, an evaluation of a new molecule, a statistical analysis of two very large datasets) as part of their response.

In this way the eExam System allows a transition to a testing environment which is far more sophisticated than pen-on-paper. This facet provides strong support for curriculum transformation, making it possible to assess new skills far beyond those which can be demonstrated using pen-on-paper. Figure 3 illustrates the kinds of question we anticipate:

Watch the video [Complex DNA](#) [95 seconds] and use the [enzyme replication simulation software](#) to construct a molecular junction inhibiting the binding process.

Figure 3: Example of a possible future post-paper examination question

As at 2014, eExams are extending into several subjects at the University of Tasmania, whilst trials are commencing at the University of Queensland.

Conclusion and future

The adoption of eExams by different bodies, even in the same state, has not led to uniform standards or procedures. This is not intrinsically a bad thing. It surely indicates vibrancy and a range of experimentation with an innovation. However, this diversity has illuminated some areas for discussion and resolution of important new social issues.

For instance, university lecturers have accepted the idea of a graduated progression into eExams with the initial foray being a paper-replacement stage. This means each candidate can be given the option of using keyboard or pen, making individual choices up to the last minute (and sometimes beyond). In this environment, 'equity' has been interpreted as 'an equal chance to choose a suitable text-production tool'.

However, in the Year 11/12 context, with high-stakes testing leading to major life-forming educational opportunities, the definition of equity became 'one in, all in'. All candidates in this sector were required to use a computer for the whole examination. No student could argue they were disadvantaged through the use of a different assessment environment to any other.

Working through these divergent understandings of 'equity' will take some social adjustment and open discussion. It's especially important this happen, otherwise the paper-replacement stage will become a hurdle preventing the more strategically vital post-paper stage emerging.

A similar project in Finland, the DIGABI project, has gone one step further. The focus of a hacking competition to identify shortcomings of the original open-source core code, the Matriculation Examination Board of Finland has published a schedule for the conversion of all examinations (presumably for Years 11/12) to eExams by the year 2020. This international adoption of the technique is instructive for other societies wishing to find some consistency in high-stakes assessment 'going digital'.

The future of the eExams project will build upon the current funding provided by the Australian Government Office for Learning and Teaching. It will incorporate Moodle, an open-source learning management system which facilitates automatically marked questions of several complexions. Trials for this are expected in late 2014.

There is also discussion around the concept of establishing an 'eExams Foundation' analogous to the Moodle Foundation, to promote further development of the open-source code base and underpin related commercial services. This will provide a governance model for eExam development, a forum for inter-institutional sharing of ideas and a launchpad for supportive relationships with operational services commercial entities.

The eExams project will continue to develop complementary research capabilities across the social and economic sciences that can connect data-driven and analytical models to promote evidence based policy

development. This project has the potential to generate student assessment material in digital format in vast quantities, opening up the possibility of applying big data techniques. Providing ethical clearance is obtained, we will use such data to answer questions such as ‘how much more text do students type compared to handwriting?’ and ‘do candidates achieve at higher levels when using computers in a paper-replacement examination?’ Answers to such questions will provide the evidence to drive curriculum transformation policy adoption.

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REDEFINING EDUCATION: 1 TO 1 COMPUTING STRATEGIES IN TASMANIAN SCHOOLS

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Abstract

The Digital Education Revolution (DER) faced significant challenges in Tasmania because of its distributed regional population. This resulted in the Year 9-12 DER funding being diluted in high schools to support Years 7-8, outside the scope of the policy intention. In addressing this challenge, two Tasmanian high schools adopted different strategies to introduce, maintain and integrate 1:1 computing. The first school took a strategic and informed decision to provide netbooks to all students in 2008 (prior to DER). These netbooks subsequently percolated through the entire school and all curriculum areas. The second school saw the potential in user-owned equipment at an early stage, and negotiated administrative hurdles. These related to the security of the equipment (and potential breakages) and access to the institutional wireless network. Students were allowed to bring their smartphones, netbooks, tablets and laptops to school. Both schools were visited to gather data through questionnaires, observations and interviews. This paper illustrates the differences and commonalities between these two schools, exploring the decision-making around 'all the same' and 'Bring Your Own (BYO)' policies. The learnings from these schools should inform future practice and link with emerging trends emanating from related studies in other Australian and UK schools.

Context

Some schools in the island state of Tasmania adopted one to one laptop policies as early as 1996. St. Michael's Collegiate School (for girls) introduced such a policy for Years 5-12 in that year. The Friends School (co-educational and also situated in the capital, Hobart) introduced a similar policy based on Apple Macintosh laptops in 1999 (Westwood & Dobson, 1999). In a state with a small but distributed population, these examples became known and accepted quite quickly. Inevitably, such policies can evoke disparate reactions from parents. Rosemary Sargison, a key figure in establishing the Collegiate policy, told of one family withdrawing their child from the school because of the policy; but an entire additional class of children enrolling for the same reason.

An Australian Research Council Linkage Project (LP0210823) investigated the possibility of one-to-one provision in government schools (Fluck, 2008). This used cheaper handheld computers (e.g. HP Ipaq & Palm Zire) in conjunction with offline versions of online learning materials for health education in Year 8. A critical part of the project was to equip whole classes with individual handheld computers. One such class was in School 1 (see Table 1 below). A key finding of the project was that 'trust' was a key ingredient for successful one-to-one implementation. Interviews with school staff at the end of the experimental period made it clear they did not expect the handheld computers to survive or be returned. However, by entrusting them to individual students, and condoning personalization, the researchers demonstrated this assumption was incorrect. School 1 adopted a one-to-one netbook program in 2009 to counter intense competition for enrolments when the competing school in the city was rebuilt. This strategy successfully countered the new buildings, and the school successfully leveraged the netbooks into subsequent years. Initially based on school-provided equipment, this morphed over the years to an optional BYO program.

Meanwhile, at the national level, the incoming Australian government of 2007 swiftly implemented its undertaking for a Digital Education Revolution to equip all students from Years 9-12 with computers throughout every school day (Department of Education, Employment and Workplace Relations, 2008).

However, this policy was put into practical effect by state governments in different ways. New South Wales, for instance, lobbied and won additional funds to commit an individual netbook to every student in the age-range, and contracted with IBM to install wireless networks in all affected schools. Tasmania by comparison chose to replace old desktop computers with new ones, and considered equity issues in schools where only half the students fell into the designated age-band. This diluted the impact in government schools.

Looking again at a single school in Tasmania, the role of individual staff can be seen as crucial. An internationally acclaimed key teacher at School 2 built upon her reputation to achieve a BYO policy by 2009. This was not achieved easily, in the face of organizational inertia. Understandably, cyber safety is a topic to which administrators are sensitive (Department of Education, 2013), and therefore permitting access to the Internet via government-provided wireless networks was contentious. Despite this, a 'DoE Guest' virtual private network was created in School 2 (and subsequently state-wide) which allows students and staff BYO Internet access but not peer-to-peer connections.

These individual actions, school histories and state-wide policy implementations made up the background to these two case studies.

Methodology

The two cases reported in this paper form part of a series of 13 studies carried out in Australia between September and December 2013, which are referred to as the Snapshot Studies (see http://edfutures.net/Technology_Strategy_Case_Studies#The_Snapshot_Studies). These complement 22 studies carried out in England between September and December 2012, which are referred to as the Vital Studies (Twining, 2014a).

The Snapshot Study schools were selected based on the researchers' local knowledge of schools that were engaged in the implementation of mobile device strategies. Table 1 provides a summary of these two Snapshot Study schools.

Table 1 Summary of the Snapshot Study schools reported here

	<i>School 1</i>	<i>School 2</i>
<i>Type</i>	State	State
<i>ICSEA*</i>	between 950 and 960	between 1097 and 1103
<i>Phase</i>	Secondary	Secondary
<i>No. students on roll</i>	between 550 and 630	between 770 and 820
<i>Digital technology strategy</i>	1:1 netbook strategy, but in January 2013 moved to a BYO approach	BYO strategy since 2010, gradually extending it from Year 7 to all year groups
<i>Year group(s) observed</i>	7 & 8	7

* The ICSEA value measures the socio-economic background and rurality of the school: the norm is 1000, with lower values indicating disadvantage.

The Snapshot Studies used a cut down version of the methodology used in the Vital Studies (see http://edfutures.net/Research_Strategy). The Snapshot Studies involved data collection prior to and during one day spent in school by the researchers. As one might expect given the practicalities of doing research in schools, there were minor variations from the standard methodology in each of the Snapshot Study schools. These are summarised in Table 2.

Table 2 Variations in the methodology

School 1	No SLT questionnaire or interview 2 Teacher questionnaires (rather than 1) 2 Student portfolios (rather than 4) No parent interview 2 observations (rather than 1) 2 Teacher interviews, one was very short (rather than 1) No student focus group
School 2	2 Teacher questionnaires (rather than 1) 3 Parent questionnaires (rather than 1) No Parent interview 2 Observations (rather than 1) 2 Teacher Interviews (rather than 1) No student focus group

Ethical approval for the Snapshot Studies was obtained from the Human Research Ethics Committees (HREC) in all of the researchers' universities. This ensured that the Snapshot Study research complied with the British Educational Research Association's guidelines for educational research (BERA, 2011) and with the Australian National Statement on Ethical Conduct in Human Research (Australian Vice-Chancellors' Committee, 2013).

Data analysis

Emergent Themes Analysis (based on Wong and Blanford, 2002) was used to identify 'emerging trends' from the 22 Vital Case Studies (Twining, 2014a). This analysis was then extended to include the 13 Snapshot Studies.

School 1

School 1 had institutionalised the processes for parents to select a school-provided netbook or choose to send a BYO machine with their child. Most (about 90%) still opted to have a school-provided netbook. This was an ACER TravelMate B113-M, priced at \$590 (not a cost to parents except in the case of loss or damage); parents paid a \$60 levy each year as a contribution towards software licencing. Students signed a care agreement, which included a requirement that devices are always charged overnight. The most significant potential damage to these machines was a broken screen: hence the decision to provide a hard clam-shell case (Figure 1) and an automatic procedure to bill parents for this kind of breakage. Insurance costs were prohibitive, so the school used its own technical support staff to replace shattered screens.

Students were permitted to bring their own devices (BYO) but the school asked that the device complied with the following standards:

- i) Windows 7 or 8, Apple MacBook or iPad
- ii) It must be able to create files in Microsoft Office format – Word, Excel and PowerPoint (Pages, Numbers and Keynote for iPad).
- iii) It should be easy to carry, easy to secure, have a minimum 6 hours battery life, and WiFi.

The school documentation stated "*mobile phones do NOT count as a device*".



Figure 6: School 1 netbook in hard shell case



Figure 7: School 1, Year 7 History class

The observed class was undertaking a Year 7 History lesson focused on ancient Chinese dynasties (see Figure 2). The teacher had prepared a WebQuest, which the students accessed from the learning management system (Fronter) using their computers. Responses to the questions posed were to be written up in a Word document, then uploaded into Fronter for teacher review.

The students encountered several problems, but were mostly able to accomplish the task. Some had password problems, which indicated a lack of embedding into the curriculum; if computers were used all day, every day, this issue would be minor because students would have solved it much earlier (this was half-way through the final term of the school year). Some of the links provided on the WebQuest worksheet were barred by the cyber-safety firewall filter, so students were not able to access the content. This was a surprise to the teacher, and points to the need for teachers to be able to access the Internet (at times, and even from home where a lot of preparation is done) just as student would. Without this strategy, such barriers come as a complete surprise to the best-prepared teacher. Finally, the bandwidth available for seeking information can limit the speed of access, and for this class, it was sometimes quite slow. The wireless network appeared to be quite congested, and the off-site VLE server was a critical element in slowing learning for this class. However, when students accessed third-party learning resources, this increased their motivation and capacity to engage with the differences between the

mindsets of various Chinese historical emperors.

Examples of the question students worked on (and responses) are shown in Figure 3.

You have been asked to research either the Shang, Zhou, Qin or Han Dynasty. Name of the Emperor: The first Emperors name was Shi Huangdi. How did he rule? What was his style of leadership? Shi ran his dynasty under absolute control and punishment. What were some of the rules during this dynasty? One of his rules was that people had to spy on each other at work, at home, Etcetera. If people turned in lawbreakers they were rewarded if they didn't they were executed. Another rule was that if people or peasants slacked off when they were working they were sent to the Great Wall to work. Philosophies and beliefs: Shi was a legalist he believed that all people were bad. He believed that you had to control and regulate everyone's lives. Inventions/discoveries/major achievements: He introduced a currency. He also introduced a written language for all of China to learn. He introduced a law group similar to the police we have today. He also introduced a way to measure lengths and weights.

Figure 8: Chinese Dynasties worksheet with student responses

Students reported using devices in around half of their lessons. Generally this was for research (in history); for solving mathematics problems; or for taking notes in other lessons.

A subsequent Year 8 class used Fronter in a similar way. Their task was to prepare “a creative product, which could be a newspaper article, interactive PowerPoint, etc. Write it from the perspective of a little Aztec boy.” One student had not charged up their netbook (perhaps because of shared parenting arrangements) and was required to use an exercise book instead – a natural consequence of being unready for the class. Off-task behaviour was easily hidden: one student was on a quiz website when questioned, but quickly flicked the screen back onto the classwork. In explanation, the student claimed schoolwork could always be finished outside school. However, just as off-task behaviour was easily undertaken, about half the students worked independently on the set task.

School 2

School 2 had a more advantaged background with virtually all parents providing computers for their Year 7 students. From 2011 the majority (~80%) of students brought their own Windows notebook to school, with Macbooks (~15%) and iPads making up most of the remainder. Some students brought more than one device (see Figure 4), and selected whichever best fitted the learning activity at any particular time. The learning area leader - Digital Technologies noted that “parents are encouraged to not spend too much (\$400 - \$600) and to get something small so that it is light, easy to carry and can fit on the desk with their books. We make use of open source to help reduce costs (e.g. OpenOffice instead of [Microsoft] Office).... Cloud storage is a valuable way to stop students not being able to continue

work because they have not got their device" (personal communication, December 6, 2013). School 2's acceptable use agreement was quite explicit about the breadth of choice for students: "*Student Owned Devices = any ICT device that a student owns and brings to school e.g. iPod, tablet, netbook or laptop, personal data assistants (PDAs), cameras, mobile / smart telephones, etc.*".

In the first observed class, Year 8 students were undertaking a negotiated task at the end of the year, to be assessed against English and History curriculum criteria. Most students appeared to be on task, and when asked, thought that off-task behaviour was generally minimal throughout the year when using computers for lessons. Once again evidence suggested self-directed 'flipping': where students claimed to finish classwork at home after the end of the school day. As the school had an open BYO policy, there was a much greater variety of devices in use. One student had a Windows tablet, and reported that text could be input almost as quickly as when using a standard keyboard.



Figure 9: School 2 - "I'll just charge up my phone this lesson"

The last observed class was in a science laboratory. The teacher used the interactive whiteboard to administer a short multiple-choice quiz at the start of the lesson, and reviewed answers at the end. The focus of the lesson was the effect of Earth's rotational axis on the seasons, using a worksheet located in Fronter (but paper copies were given to students who had no device, and who also wrote on paper). Students in this class regarded Fronter, Google (search) and Wikipedia as the most used 'applications' across the curriculum.

Student portfolios from this school illustrated a wide repertoire of applications, such as PowerPoint for demonstrating knowledge of solar energy in science; BAMZOOKi for creating an attractive 'creature'; and Word for writing up an essay. This dovetailed well with the school's vision to be a centre of excellence for innovative creativity and excellence in teaching and learning.

Discussion

As with any of the Snapshot Studies, it is important to realise that most schools will have presented a best possible face to external investigation. The leaders in these two schools appeared to be realistic about the vital role of teachers in the implementation of their mobile technology strategy. Teachers reacted to technical aspects of the computers actually in the classroom for each lesson, being more likely to use computers in subsequent lessons if things went well. On the other hand, if students were unable to access Fronter (because they had forgotten their password or their device was not charged) then teachers were unlikely to rely upon this method of handing out worksheets. This increased their workload, since paper copies were still needed.

Both schools offered a form of BYO. One still offered a subsidised choice for parents, and had an historical policy of institutional provision to individuals, from which it was difficult to retreat. The other had never made this kind of subsidised provision, and after just two years had created a culture whereby most students brought a parent-funded (and maintained) computer to school. This reflects different

funding models that were evident in the Vital Studies (see Table 3).

Table 3: Funding model

<i>School funded</i>	The school pays for all the digital technology used in the school. This funding might come from specific project funding or commercial sponsorship, but not from parents.
<i>Subsidised</i>	Parents make a (voluntary) contribution towards the cost of digital technology that is used in the school, often in the form of monthly payments over several years.
<i>Hybrid</i>	Parents make a (voluntary) contribution towards the cost of a mobile device for their child, or if they already have a suitable device at home then their child uses that.
<i>Home</i>	Parents buy a mobile device that their child uses in school.

With the ending of the DER funding, schools are inevitably moving towards BYO models. In order to inform their decision making, an initial step should be to audit the Internet-enabled mobile devices that their students have at home, and which they could use in school. This could be done using a free service such as that provided by *Your Own Technology Survey* (YOTS) – see <http://www.yots.org.uk>. However, a BYO approach may mean that students bring in a wide range of different devices. The breadth of choice of devices in School 2 had the potential to make further difficulties for teachers. Alongside ‘planning for failure’ (which means paper copies of worksheets were sometimes needed for students without a compatible or working device), there was the additional worry of digital materials not working on a student’s device. A good example was the highly valued *Scootle* repository of Australian online learning objects. Many of these interactive resources use Flash – a technology that is not well supported on Apple iPads unless a third party browser like *iSwifter* is installed – for a cost. Form factor was another significant issue to be considered, with schools navigating between smaller screens on mobile phones and larger ones on full-size laptops. Aligned with this could well be the physical inactivity and posture implications of day-long use of particular computing devices. This complex territory is just beginning to be charted.

In School 1 there was an advisory framework around parent-supplied computers, which provided a modicum of file-format compatibility between students’ and teachers’ devices. School 2 had a much looser specification with a high emphasis on adoption of open source software. Given the higher socio-economic status of the School 2 community, this seems counter-intuitive, but makes sense given the breadth of equipment choices available. These differing approaches to BYO aligned with work in Queensland (The State of Queensland, 2013), which introduced the notion of BYOx, as explained in Table 4.

Table 4 Approaches to BYO

<i>BYOD</i>	Students are allowed to bring their own devices from home to use in school. Students have to register their devices (e.g. provide the MAC address) so that the school can manage access to and use of the school network.
<i>BYOT</i>	Students are allowed to bring in their own devices from home to use in school. They do not have to register their devices and can use the school network to access the Internet (usually using their individual username and password).
<i>BYOx</i>	Students are allowed to bring in their own devices from home to use in school, so long as they meet school requirements. These requirements might specify a specific device (e.g. an iPad), a whitelist (e.g. any one of a number of specified devices), or a technical specification (e.g. the device must be able to create and edit Microsoft Office format documents, access the Internet via WiFi and a browser).

In both schools there was an operating wireless network. These were essentially the same state-wide offering for guest access to the Internet via government filters. However, the local implementations appeared to be somewhat different, with no perceived congestion at School 2. The speed of Internet access in School 1 negatively affected the observed lesson, and if replicated school-wide would reduce learning opportunities, providing a(nother) reason for teachers to avoid using the technology. Managed WiFi networks appear to be the answer to load balancing and mobile users, so the correct kinds of

wireless access points with compatible management software may be the solution here. Schools provide a rather harsh environment for this technology since the timetable forces large numbers of users to load and save files simultaneously. This requires the network to handle huge peak flows of data with ease, rather than traffic distributed evenly over the day. It is clear that having an adequate wireless network is critical to maximizing the educational potential of mobile devices in schools (Twining 2014b).

In summary, these two schools were blazing a trail for many other Tasmanian government schools. Catholic and independent schools have a much easier governance process for putting computing devices onto the annual booklist for students, whilst government schools need to provide support mechanisms for all parents. Perhaps the most significant impact for these schools will be the long term effects of trusting students to care for equipment and the introduction of a state-wide guest wireless network.

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INTEGRATION OF TECHNOLOGY IN HIGHER EDUCATION: TRANSITIONAL FRICTION IN THE IMPLEMENTATION OF UDL

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Abstract

Universal Design for Learning (UDL) has gained momentum in post-secondary education over the past decade in North America as a framework for the management of Disability issues. It is increasingly attractive as it aligns service provision with the social model of Disability, and shifts the discourse away from diagnosis. It is also conducive to an inclusive educational setting. UDL however often requires and encourages the adoption and integration of technology into curriculum development, class delivery and evaluation. This is not always as smooth a process for instructors as the UDL literature lets us anticipate. This paper seeks to examine the nature of the friction which occurs during the implementation of UDL, more specifically as it relates to mastery and use of educational technology. It highlights several variables which need to be taken into account, both globally and individually, when devising UDL implementation plans on Higher Education campuses. This study is unique in the sense that it examines IT integration into curriculum and evaluation development under the lens of the Human Rights imperative for inclusion; this is a shift, it is argued, which moves the discourse from mere best practices with IT to the realm of pedagogical policy and urgent pragmatic implementation.

Introduction

The campus examined in this paper began dynamic Universal Design for Learning (UDL) implementation in summer 2011. This effort has been recorded and examined from a variety of angles ranging from student reactions to instructor feedback, without forgetting the administrative staff perspective and the systemic perceptions of other campus stakeholders (Mole & Fovet, 2013; Fovet, Beck, Mole & Noga, 2014). The paper carries out, more specifically, the analysis of qualitative data collected from instructors in this three year drive to see implementation translate to metamorphosed classroom practices. Previous exploration has allowed the author to distinguish a spectrum of variables which are likely to impact this process and eventually lead to either enthusiastic adoption or rejection of the model by teachers (Fovet, Mole, Syncox & Jarrett, 2013). One of these variables is explicitly the instructor's mastery and competency with technological tools. Qualitative analysis of the data collected over these three years, quickly indicates that there is in fact an information technology (IT) dimension related to each of the variables collected from the instructors participating.

Literature Review

Friction in the integration of technology in instruction is not a new topic per se. There has been abundant research in this field, though the findings are much more abundant in K-12 than in post-secondary education. The new dimension explored in this study consists of approaching instructor perceptions from the angle of access to learning and Human Rights, rather than from the more personal criteria of inclination, choice or curiosity. Before proceeding, this literature review must therefore briefly summarize existing collective knowledge on IT integration in teaching, as well as UDL literature, and motivational theory as it relates to post-secondary instructors. The term 'instructors', for the purpose of this paper, will have ascribed to it the meaning it carries in North American education literature, that is to say post-secondary teacher (irrespective of college or university setting).

Universal Design for Learning

Universal Design for Learning (UDL) is a framework which is increasingly appealing as it allows for legal imperatives surrounding access to be addressed seamless in a manner that is sustainable and inclusive (Howard, 2004). Design and conception are the focus, rather than the individual or any specific impairment (Rose & Gravel, 2010). Universal Design is originally and historically an architectural framework which includes 7 principles (Centre for Universal Design, 1997): equitable use, flexible use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, size and space for approach and use. It has however later been applied seamlessly to the learning environment. If, indeed, buildings can be designed in such a way that access is widened to the greatest possible number of users, so can the classroom experience (Gradel & Edson, 2010).

Universal Design for Learning (UDL) more specifically is a teaching approach which considers how curriculum, instruction and assessment can meet the learning needs of the greatest number and address the diversity of students, while maintaining academic rigour (Rose & Gravel, 2010). UDL, in its three core principles, encourages multiple means of representation, expression and engagement at all levels of the course, be it instruction, resources or evaluation (Rose, Harbour, Johnston, Daley & Abarbanell, 2006). Once again, just as was the case with the architectural interpretation of UD, the Social Model of Disability (Barnes, Mercer & Shakespeare, 1999) is integrated as a canvas and it is argued in that framework that it is the environment that becomes disabling for the student, when badly designed, rather than any characteristics that are inherent to the individual (Howard, 2004). The experience of students with ADHD, for example, finding Higher Education alternatively oppressive or congenial, depending on the teaching style of their instructor and the tools used in classroom delivery, is an eloquent illustration of the potent lessons the Social Model has to offer us with regards to post-secondary teaching practices (Allsopp, Miskoff & Bolt, 2005), and of the relevance of the UDL principles as a tool for pedagogical change.

There is some research emerging on the topic of resistance in the UDL implementation process (Spencer & Romero, 2008) but little of it at this stage relates specifically to IT (Harrison, 2006; Yager, 2008; Thomson, 2008). When UDL literature focuses on IT at present, it tends to examine web accessibility (Thompson, Burgstahler & Moore, 2010), or the use of IT by students (Burgstahler, Anderson & Litzkow, 2011), very specifically, but rarely does it purport to analyze instructor motivation towards IT within the UDL implementation effort.

Instructor motivation

This is a vast topic, and one that the study cannot purport to review extensively. It may however be useful to highlight the gap which exists between the current UDL outlook on teacher buy-in and management of change, versus motivational theory as it appears in the industry and the private sector. UDL literature seems indeed to conceptualize instructor buy-in as a positioning that is rationally selected, unambiguously chosen and adhered to without ambivalence (Harrison, 2006; Gradel & Edson, 2010). In the light of this interpretation of instructor motivation towards inclusion, awareness and professional development merely requires the presentation of evidence, facts and know-how.

The Human Resources literature, outside the field of post-secondary education, has long moved away from such a uniform and simple vision of employee motivation in the management of change process. The 'personal reward-cost' analysis that have become popular in social psychology when exploring philanthropic desires, and more specifically prosocial behavior such as public willingness to be a good Samaritan in emergencies (Amato, 1990; Bennett, 2003), have now been borrowed by Industrial Relations literature to explain varying employee positioning towards change and adaptation to new objectives (Borman, 2004).

In such a construct of motivation, individuals are influenced by multiple and complex variables that can

encourage them or deter them from embracing a proposed change or an innovative situation; variables that encourage a positive attitude towards a proposed change can be seen as ‘facilitators’; other variables will have a negative impact on individual decisions towards change, and can be seen as ‘stressors’. It is the sum total of these stressors and facilitators that can lead a person to embrace change or contest it. Such a lens on motivation has two distinct advantages: first of all it allows for a more subtle and complex understanding of personal decision making in an institutional context of change; secondly, it readily provides the researcher with a variables analysis that allows for the facilitators to be targeted in professional development, training or awareness in order to secure a positive positioning towards change (Finkelstein, 2006). The ‘personal reward-cost’ analysis is integrated in this study’s analysis of instructor motivation in the UDL process of change.

Instructor’s integration of IT

Integration of technology into pedagogical practice (particularly delivery and evaluation) has given rise to much exploration in K-12 instruction both with regards to pre-service (Kay, 2006; Mishra & Koehler, 2006) and in-service (Koehler, Mishra & Yahya, 2007) dimensions. It is, in particular, now well established that there are several stages of IT integration in teaching and that teachers need to reach an advanced level of integration and mastery before they truly start being creative about IT use in instruction (Inan & Lowther, 2010).

While the use of technology in distance education is researched extensively (Rao, 2013; Wallace, 2007; Southworth, Knezek & Flanigan, 2003), there is a relative paucity of findings when it comes to instructor resistance and friction in the integration of IT in Higher Education teaching, in traditional, non-virtual classrooms (Elzarka, 2012). Research is abundant with regards to virtual classrooms, hybrid classes and other alternate virtual delivery formats (Tabata & Johnsrud, 2008).

What the study is concerned with is, however, integration of IT in traditional live classrooms, particularly classrooms functioning within a regular setting, devoid of complex technical gadgets or exceptional hardware resources. This is indeed the terrain in which access, for students with Disabilities, must often be currently negotiated. There is nothing to lead theorists to hypothesize that the factors creating resistance with regards to IT integration should, in essence, vary greatly in this context (Taylor, Parker, Lenhart & Patten, 2011). On the other hand, it must be considered that the stakes are likely to be different here, that the resources and leadership could be of a different nature altogether, and that there may exist more factors of resistance amongst instructors who have to date not ‘taken the leap’ and experimented or encountered virtual delivery to date.

Methodology

This study presents the analysis of qualitative data collected amongst instructors in an 18 month period (phase 2) of UDL development with Faculty, which followed the initial 18 month period (phase 1) that had triggered the original implementation effort on campus – amongst senior administration and campus partners. With initial awareness in place, Phase 2 focused on progressively altering the model of delivery and assessment used in this university through the integration and adoption of the three UDL principles.

Qualitative data was collected from students, faculty, administrators and employees at large through the delivery of UD implementation workshops of various formats over a period of three years (Collins, 1998). By their very nature, these interactive workshops presented a perfect forum to collect qualitative data in a semi-directive frame (Barbour et al., 2000). Data was collected both orally through the verbal interaction, and through Quality Assurance surveys used systematically after each of these workshops (Bogdewic, 1999). Instructor data was collected from the start in 2011, but it became more systematic, and more detailed, as the implementation drive progressively focused on in-classroom integration through Phase 2.

The implementation of UDL on this campus is still ‘work-in-progress’ and the process has not been completed. There seemed, however, to be enough tangible findings registered already, to draw some

conclusions on the impact of this initiative for faculty and learners at large on the campus.

A considerable amount of triangulation occurred through the data collection (Patton, 2001); systematic feedback was collected from participants in the workshops and presentation, as the presentation material evolved in order to progressively integrate feedback. Originally, for example, the content focused primarily on the social model of Disability and the imperative for inclusion. As presentations were delivered and feedback came in, it became pressing to also discuss the changing demographics of Disability, the classroom management issues encountered by instructors and notion of sustainability in teaching practices.

This triangulation constitutes a cornerstone of the qualitative processes used here: the UDL material itself has substantially evolved over the three years of this promotional drive, in light of continuing faculty feedback and reactions from participants. Although semi-structured interviewing and questionnaires were used for the data collection (Mays & Pope, 2000), the bank of questions was widened and changed as the data collection process evolved and become more systematic. Different variables and thematic trends were explored as a result of participants suggesting their inclusion in the data collection process: sustainability, relevance of buy-in from the unions, availability of IT support were for example all presentation items introduced by participants. There was therefore an explicit ethnographic dimension to the data collection, where participants themselves molded and framed the direction of the process in order to reflect their own preoccupations (Hammersley & Atkinson, 1995).

Manual coding was used systematically to analyze the raw qualitative data collected from participant feedback, as well as the comments and suggestions received through triangulation (Denzin & Lincoln, 2005). The manual coding was refined through the use of two independent coders in relation to an initial sample during the first six months of the UDL implementation drive (Given, 2008). The categories emerged through the initial coding and were later consolidated through the ongoing analysis of the data. The frequency and relevance with which each theme appeared in participant feedback was assessed in order to determine which themes were major or minor and ought to be selected for the rest of the analysis. Some themes were set aside because they did not occur sufficiently frequently in the size of sample; their existence must be acknowledged nonetheless, as it is possible that some of the more ancillary themes may become relevant in further larger scale studies.

Findings

The data analysis sought to highlight stressors and facilitators emerging in the feedback obtained from instructors, as these might explain the variety and ambivalence of reactions generated amongst them towards UDL. This interpretive lens is immediately helpful as deconstructing reactions in terms of variables empowers researchers to suggest possible hands-on solutions, based on the accumulation of facilitators and the elimination of stressors.

The categories identified through the data collection and the analysis are here classified as stressors or facilitators, depending on the association that is made in the eyes of the participants interviewed; this association is specific to the process of IT integration for purposes of UDL implementation. Such a reward-cost analysis and a presentation of findings are immediately useful as they enable researchers to move away from a view of instructor behavior as falling neatly between supporters or opponents. Participants discussed a variety of variables and it can therefore be hypothesized that an eventual decision to buy-in or push back, when faced with UDL material, operates through an individual 'reward-cost' assessment: if the individual in questions sees more stressors than facilitators, he or she might be more likely to push back and vice-versa.

The categories which were identified with sufficient frequency to be retained appear below. They are classified in two successive sections, as stressors or facilitators, depending on whether the participants perceived them as either, within the context of UDL implementation, in their current personal

circumstances. Familiarity with IT is a variable in itself, but it is argued that, in the case of each variable, a separate and clear link with IT integration can be made.

Stressors

The variables appearing below are themes which were identified in instructor feedback, or at times in the feedback of campus partners working closely with instructors; these were perceived by the participants as having a negative weight in the individual decision of adopting or not UDL methods and principles in course delivery and evaluation. On each occasion, the stressor is identified and a link with IT integration is highlighted:

(i) Lack of time and budgetary concerns that UDL implementation might be overly onerous on instructors: this concern was palpable when discussing the curriculum revision and planning that would be involved in UDL implementation. Integration of IT appeared prominently in these remarks, and was seen to be particularly time consuming and resource heavy. The instructors interviewed reported the need for assistance and had the perception that the level of technical support available to them was low.

(ii) Lack of leadership support in UDL implementation: it was felt by instructors that UDL implementation is not worthwhile if it is not explicitly valued by their department leadership. IT features squarely in this assessment, and participants tended to think it was not worth investing in IT implementation if this did not receive departmental recognition or support. Tenure portfolio was a central concern and it was felt, by instructors, that unless UDL implementation and the IT integration that went with it were explicitly rewarded in tenure portfolio, it was simply not worth the career investment.

(iii) Myths and fears concerning the widening of access: participants were quick to equate widening of access with lowering of academic standards. There were very noticeable misconceptions amongst participants equating widened access with lowered academic expectations. These myths often bear a direct relationship to IT integration: instructors often have the perception that a podcast for example requires less work than a class presentation, or that exams done on computer somehow require less skills; some instructors felt that class recording software lowered student attention by removing the need to take notes.

(iv) A core skills analysis is often absent from curriculum design: it is often difficult for instructors to make assessments as to how to widen access as the core skills being taught and evaluated are not clearly identified from the start. They may be resistant to the integration of alternate means of presentation or expression because they feel this narrows the impact of the skill being assessed. This is particularly apparent when discussing the possibilities of a differentiated range of assessment methods. Many instructors feel that e-portfolios, for example, are less academically challenging than written assignments, even when this positioning seems to contradict the skills purporting to be evaluated. IT therefore features in this personal assessment as instructors are fearful of taking emphasis away from content by over-focusing on IT implementation.

(v) Misconceptions about UDL amongst instructors: instructors perceive UDL as a new concept, when in fact it is not. They associate it in their feedback with the recent push for interactive, IT rich teaching. UDL was created before the IT revolution in education and it is perfectly possible to be UD without using technology. In its theoretical grounding, UDL synthesizes the literature on inclusion (), differentiated instruction () and multiple intelligences (). It is not a contemporary 'fad' arising from the push for IT use. Obviously, IT development has given UDL momentum but it is not a recent framework; nor is it an isolated pedagogical model.

(vi) Fears and insecurities with regards to IT competency and its use in teaching styles, previously documented in literature (Rose, Meyer & Hitchcock, 2005). Teachers are often reluctant to use innovative tools and to integrate them into their teaching practices for fear that their poor mastery of the tool will make them appear unprofessional. UDL seems to exacerbate these existing insecurities amongst instructors when they are first confronted with them.

(vii) The question of ‘ownership’: Instructors are also fearful to take charge of UDL implementation as they feel that they have no ‘expert knowledge’ in the field of disability; they would rather shift the responsibility back to a support unit, such as a Disability service provider within the campus. IT is centrally features in this concern as it remains shrouded for many participants in relative mystery. Instructors often mistake education IT and assistive technology, assuming they will need training on specific remedial IT to widen access through UDL (Englert, Zhao, Dunsmore, Collings & Wolbers, 2007). This perpetuates the culture of referral (Collier, 2002), when in fact UDL implementation does not rely on the use of assistive technology. IT, on the contrary, encourages the use of technology that is non-specialized and usable by all students.

Facilitators

The variables appearing below are themes which were identified in instructor feedback, or in the feedback of campus partners working closely with instructors, and were perceived by the participant as having a positive impact on the individual decision regarding eventual UDL adoption in daily pedagogical practices:

(i) Pre-existing core skills analysis within a faculty or department: the existence of such an analysis greatly increases the likelihood of a constructive dialogue between the instructors and the various partners concerned with access (Boud & Falchicov, 2006; Brennan & Osborne, 2008). It also eases the integration of IT into the teaching model, as it reduces fears that the technological use may detract from content or competency acquisition. Core competencies or skills can remain untouched if the core competency is already in existence; the skills that are not being assessed or evaluated can then benefit seamlessly from whatever means are available to widen access; this often means that technological gadgets, software and support tools can then be applied without fear to the learning and teaching in order to widen access for the greatest number of students;

(ii) A rich personalized dialogue with key students often leads to an increased awareness amongst instructors and to a willingness to explore UDL; privileged relationships with students affected by disability seems to sometimes radically modify these individual’s approach to the widening of access; often these students will mention technological use as a tool to widen access and maintain their engagement in the course (Hargreaves, 2004). Such personal exchanges create awareness amongst instructors and are likely to speed up the process (Flanagin & Metzger, 2010). The connection with IT integration is perhaps less apparent in this observation but it is there nonetheless. It is often clear in the narrative of the instructor that it is a student’s use of and reliance on technology that usually makes the instructor realize the exist of a barrier in the student’s access to learning; it is often anecdotally over a discussion related to technological strategies that the instructors found out the students in question were affected by an impairment.

(iii) Access to user friendly and time effective tools kit. The UDL literature is large to the point of being daunting for all but the most committed of instructors. The availability of bite size tools significantly increases the likelihood that the framework will be tentatively explored. Technological integration is particularly daunting and seems insurmountable without induction tools that are user friendly and simple. In this implementation effort, 2 minute videos were the format chosen for all instructor tools. The ability of support staff to provide tips regarding IT integration, amongst other UDL strategies, in a ‘grab and go’ format was perceived, by participants, as essential in the decision to begin UDL

implementation.

(iv) Ownership of the UDL principles: this appears, in the analysis of raw data from instructors, as essential from the very start of the UDL implementation if there is to be any likelihood of success in UDL classroom implementation. It therefore seems extremely important to be able to create, support and promote a phenomenon of modelling by faculty for faculty; using instructors in the campus' UDL videos was perceived as crucial in terms of impact; succeeding in featuring instructors discussing their own integration strategies with regards to IT, at the heart of their UDL implementation, was a key recipe for success. The use of clickers can be modelled and promoted in this way, so can the use social media, such as Twitter, in the classroom as a tool for student on-screen participation.

(iv) Validation and positive reinforcement: The acknowledgement and recognition of inclusive pedagogical practices already in existence provides increased momentum amongst instructors and leads to quick adoption from those still hesitating. It transpired from instructor feedback, that if training and discussion sessions on UDL began by seeking out existing practices from participants and highlighting that many of these are already aligned with UDL principles, buy-in was immediate and very likely to create a positive on-going momentum. Validating the practices that are already in accord with UDL and that widen access for all students makes instructors less defensive; links are then quickly established between the UDL model and other teaching theories which inform course design (differentiated teaching, interactive learning, flipping the classroom, to name a few). This observation is particularly true for IT integration already in place that facilitates a widening of access: it might be something as simple and symbolic as an interactive use of laptops, the speedy dissemination of PowerPoint presentations on web portals, or the creation of online chatrooms for questions. Similarly, what goes for UDL workshops applies to wider in-department acknowledgement too. Once IT implementation is valued explicitly – be it in tenure process, teaching portfolio, departmental policies, etc., the process is speedy.

(v) Availability of UDL implementation tools that are subject-specific: this is immediately relevant in the implementation discussions taking place with instructors. Even when the framework was globally appealing, it failed to generate proactive momentum if subject specific resources were not available to tackle issues such as: UD in labs, UD and graduate supervision, UD and real world learning such as modern language acquisition, or evaluation of music performance, etc. Concerns relating to IT integration in the UDL implementation process did not escape this rule: instructors did not just want support and guidelines with IT tools, software or strategies; they expected IT solutions that were specifically tailored to their field and content specific for their teaching domain (Gray, Thomas & Lewis, 2010).

All of the facilitators and stressors identified in the study have an immediate IT dimension. Although UDL implementation is not conditional on IT use, both agendas are intimately linked in pedagogical practice (Groff, Haas, Klopfer & Osterweil, 2009; Barajas & Higbee, 2003); both discourses – IT integration and UDL implementation – give rise to a similar questioning with regards to the sustainability of teaching practices and the future of pedagogy; it is not surprising therefore that the researchers observed that attitudes to both processes were similar and created reactions of an identical nature amongst instructors. The data collection, analysis lens and interpretive breakdown have jointly been very helpful in setting the stage for the creation of successful UDL professional development material that is able to focus on the facilitators identified. Equally this analysis becomes valuable in highlighting the fact that instructors' decision to commit to an inclusive framework such as UDL is not unambiguous or straightforward. It is in fact the result of an individual reward-cost assessment; the facilitators in this reward-cost analysis, if they outweigh the stressors, are likely to lead a Higher Education instructor to embrace IT integration in teaching as part of UDL implementation.

Outcomes

The analysis indicates with a good degree of precision what aspects of technological use act as a

motivator or a stressor for post-secondary instructors. It distinguishes factors that are personal (such as familiarity with technology, support with integration, time and resources available), as well as factors that more systemic such as departmental leadership, focus on student centeredness and institutional valorization of pedagogical growth). The factors which emerge from the analysis are detailed enough to have the appeal of immediate transferability to other contexts and other campuses. They provide a concise and user-friendly road map for the analysis of resistance encountered on any post-secondary campus with regards to the use of technology to craft pedagogy that meets the needs of a diverse student body.

These variables are perhaps too limited in scope to provide the full picture of the variables that come into play in the reward-cost analysis occurring for each individual instructor. The study was limited in time and resources and ancillary themes were eliminated during the coding. On a wider scale, some of the more minor stressors and facilitators might become relevant and earn a place within the list the study has drawn; this list may in time become much more extended as a result of further findings. The results may also to some extent be specific in some ways to the institution in question. Further studies of this nature in other universities, but also in different types of post-secondary institutions such as community college for example, may identify further variables that come into play in the reward-cost analysis.

The interesting dimension of this study is that it not only examines resistance but suggests solutions in tackling the resistance observed. In this respect it stands apart from past studies on IT integration in Higher Education as these merely recorded the pitfalls, difficulties and eventual successes. The IT implementation examined here comes into place because of a wider desire to see the three principles of UDL rapidly implemented in teaching practices (Rose, Harbour, Johnston, Daley & Abarbanell, 2006). That drive itself is fed by a legal imperative to see access to learning widened in Higher Education. It is perhaps the first time IT integration has been examined from a Human Rights perspective and this gives unprecedented momentum to the search for solutions. It is interesting to see for instance how the existence of the Americans with Disability Act has sped up UDL implementation in the United States, and similarly accelerated IT integration (Fuller, Bradley & Healey, 2004).

There are wider implications to be considered too when examining UDL implementation with regards to social justice and, more widely, inclusion as it relates to student retention, diversity and social justice (Gorard, Smith, May, Thomas, Adnett, & Slack, 2006; Howard, 2004). Widening access is not just about eliminating barriers for students with Disabilities. UDL has other ambitions, such as removing barriers for students from other cultures and from socially and economically deprived backgrounds (Tegmark-Chita, Gravel, Serpa, M. deL. B., Domingos & Rose, 2012) Using the Universal Design for Learning framework to support culturally diverse learners, *Journal of Education*, Vol. 192(1), pp. 17-22). These dimensions of UDL implementation will also create resistance amongst instructors, but nevertheless – just as was evidenced here – equally create opportunities for instructor buy-in. Further research is urgently needed to explore the social and cultural dimensions of UDL implementation in Higher Education.

The impact of the findings on the strategic planning of professional development for instructors also needs to be examined in its systemic complexity (Garner, 2008; Hockings, Cooke & Bowl, 2008). Identifying key variables is the first part of the process, but it is the successful integration of the key facilitators into professional development that will achieve the sought out goals. The successful integration of the facilitators into professional development packages presents its own challenges which was beyond the scope of the study; this urgently requires further research (Hegarty, Bostock & Collins, 2000; Hall & Stahl, 2006).

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USE OF THE 'THIRD SPACE' IN INTERVENTIONS WITH STUDENTS WITH SPECIAL NEEDS

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Abstract

This paper analyses possible uses of virtual interactions towards the emotional wellbeing of students with special needs. It uses ethnographic methodology to explore the reasons why virtual environments are of such appeal to 'at risk' students; it explores in particular notions of 'third space', such as social media site, massive multiplayer online games (MMOGs) and other online synchronous and asynchronous virtual platforms. Drawing on the literature on 'third space', the study explores parallels between traditional understanding of this notion and its recent incarnation as a virtual experience. Findings indicate that students with special needs, particularly those with Social, Emotional and Behavioural Difficulties (SEBD), behave very differently when they enter third space. Many of the interactions they engage in virtually are school-related and involve peers from their school cluster, even though they occur after school hours. It is argued that, in many ways, the interactions in third space may possess a remedial quality and assist in the inclusion process. The discussion section examines how these findings may be relevant to educators in maintaining engagement with this specific student population, when conventional practices fail.

Introduction

Interventions with students with Social, Emotional and Behavioural Difficulties (SEBD) traditionally tend to focus on classroom management. The literature on virtual engagement however indicates that individual entering third space behave very differently than they do in real life; the need to explore this virtual dimension – and perhaps this other student persona - when attempting to reach these at-risk students therefore seems imperative. The potential for development of social capita, in particular, is significant. In parallel, evidence shows that students with SEBD are formidably attracted to virtual environments such as social media, massive multiplayer online games (MMOGs) and other online synchronous and asynchronous virtual platforms. The hypothesis of this paper is that this appeal may be particularly useful in establishing successful interventions and facilitating school engagement with this otherwise difficult to reach population.

Literature Review

The literature touching on the topic of SEBDs, third space and technological use is wide and far reaching and informs the hypothesis put forward in this study.

Students with SEBD

Traditionally studies exploring online engagement of students with special needs have limited their samples to students with learning disability and have focused solely on assistive technology. This paper chooses to widen the scope of the investigation by considering the online needs and practices of students with Social, Emotional and Behavioural Difficulties (SEBD).

Social, Emotional and Behavioural Difficulties is a working definition commonly used in British literature (Travell, 1999); children with SEBD are children “who, as a result of hitherto undefined factors,

require additional resources (as defined in the 1996 Education Act) to meet their social, emotional and behavioural needs". It covers a spectrum ranging from unacceptable behaviour to mental illness, serious mental illness being excluded from the definition (Department for Education and Skill, 2005).

The revised SEN Code of Practice (DfES 2001) Section 7:60 provides a protracted definition including the terms withdrawn, isolated, disruptive, disturbing, hyperactive, lacking concentration and presenting challenging behaviour arising from other complex special needs. It also creates new terminology by naming Behavioural, Emotional and Social Development as one of the four areas of Special Educational Needs. For the terminology EBD or SEBD to be used in their generally accepted definition, quite severe recurring emotional or behavioural problems must occur in home, social or school situations. Perhaps the best definition that is applicable to most children with EBD would be that, owing to an emotional difficulty or disturbance, they refuse or cannot make full use of the educational opportunities offered to them and are consequently difficult or challenging to manage. The usefulness of this concept is that it removes the emphasis from diagnosis and focuses instead on behaviours and class dynamics that are a common denominator amongst a variety of our students.

SEBD is not a concept which is limited to the UK educational legislative framework. A similar definition is used in US educational legislation (Kauffman, 2010). In Australia, the concept is used as well, but often within a much looser terminology which includes references to 'at risk population', 'conduct disorders' and 'anti-social behaviour' (Hourihan and Hoban, 2004). It is a term which unfortunately, and rather unfairly, has rather specifically come to be associated with the sort of behaviour difficulties observed in indigenous schools and communities (Blair, Zubrick and Cox, 2005). Gulchak and Lopes (2007) stress that the concept of EBD is recognized and observed internationally, but they also highlighted the paucity of quantitative research determining effectiveness of EBD interventions currently used in schools worldwide.

There is obviously an element of subjectivity to such a definition (Mortimer, 2002). SEBD students often have a perception that their behaviour is in fact normal (Jackson, Whitehead, & Wigford, 2010), and often an appropriate response to bad teaching and uncongenial school conditions (Sacks & Kern, 2008). Teachers themselves in fact often disagree as to what is acceptable or unacceptable behaviour (Poulou, 2005) and this, even when DSM-IV checklists and diagnostic instruments are used (Mattison, Gadow, Sprafkin & Nolan, 2001). There is also rarely agreement between characteristics reported by teachers and children (Soles, Bloom, Heath & Karagiannakis, 2008).

The display of anti-social behaviour is, in summary, not rare in itself and will not be sufficient to define a child as being affected by SEBD. A large number of children and teenagers, 60 to 85%, will take part in difficult behaviour before the age of 20, while 40% of youth will display long lasting anti-social behaviour (Moffitt, 2006). It is therefore not the behaviour itself that identifies SEBD students, but the severity of the behaviour and the length of time during which it manifests itself (Jones, Dohrn & Dunn, 2004)

Technology and interventions

There is a large body of literature focusing on the creation of an online persona in chat rooms but this has mostly focused to date on gender (Huffaker & Calvert, 2005) or ethnic differences (Korgan, Odell & Schumacher, 2001). The more recent phenomena of Facebook (Boyd & Ellison, 2007) has also been investigated with respect to persona development within the context of in-faculty use (Hewit & Forte, 2006; Roblyer, McDaniel, Webb, Herman & Witty, 2010), but not with respect to social contact between peers – even though it advertises itself primarily as a social networking tool. Studies are beginning to highlight the positive academic outcomes related to social media use, particularly in Higher Education (Irwin, Ball & Desbrow, 2012), but they are yet to gauge in any detail the impact on emotional well-being.

Research has shown furthermore, interestingly, that Facebook use is closely clustered around school affiliation for teenagers (Golder, Wilkinson & Huberman, 2007). Explorative studies into the use of

other popular platforms, such as Twitter and WhatsApp, indicate similar patterns of use (CSM, 2012; Yeboah & Ewur, 2014). The close parallels existing between school clusters and social media interaction defy initial adult perception around the anonymity of internet exchanges. This observation in itself increases curiosity as to the potential impact of virtual dimensions on the schooling of users. The impact of social networks used at home on professional environment has been documented in this way (DiMicco, Millen, Geyer & Dugan, 2008), but researchers have thus far been reluctant to see home use of social media and in class interactions as related.

The creation and development of an online persona in virtual classrooms has also been the focus of a body of literature. This has involved the online learner and usually, more specifically, the graduate student (Annetta, Murray, Laird, Bohr & park, 2008; Fovet, 2008). The lesson drawn from this research has been mostly that some face to face engagement remains indispensable within a hybrid format for this online persona to appear (Boyle, 2008). Short of this, online chat rooms and bulletin boards offering virtual meetings or interactive discussions seem to be the next best thing when it comes to encouraging online presence (Gunawardena, Plass & Salisbury, 2001). This format has proved tangibly successful in the field of acquisition of languages (deHaan, 2005).

There are research findings focusing on the broader relationship between the social and emotional wellbeing of teenagers and their use of online networking tools (Cummings, Lee & Kraut, 2006; Haase & Wellman, 2004), outside the field of education research. Some studies have looked more specifically at self-representation within social networking sites. There seems to be evidence to support the idea that the personality created online on these platform differs from their social image in the daily context (Acquisti & Gross, 2006).

Research also seems to imply that the availability of this different platform for self-representation may be therapeutic for some (Lo, Wang & Fang, 2005; Ellison, Steinfield & Lampe, 2007). Mazer, Murphy and Simonds (2007) have explored in particular the potential benefits for at risk students, and studied the impact teacher self-disclosure on Facebook has on student motivation, learning, and classroom climate. They believe that the use of Facebook in the educational context can have a positive effect on the student-teacher relationship, which can in turn lead to positive student outcomes. Teachers using Facebook are indeed perceived by students as attempting to develop positive relationships. Use of Facebook as part of the student-teacher relationship was seen as creating a higher level of motivation and a more comfortable classroom climate. There appears to be evidence in such studies, of relationships – particularly school relationships – improving through online interaction (Drussell, 2012).

Third space

Innovative learning spaces take on an increasingly subjective nature in the 21st century and tell us more about their users than about any specific inherent characteristics they may possess (Dagkas & Stathi, 2007). This observation is extremely important as marginalized students may display marginalized and unconventional use of these spaces (Lomas & Oblinger, 2005) and hence model them to their specific needs and situations (Clark, 2005). The importance of exploring these students' use of innovative pedagogical space hence is not a quest focused on the nature of the 'third space', or innovative pedagogical spaces generally; instead it represents an uncharted and innovative exploration of the characteristics of students with SEBD that will lead to fresh approaches concerning their potential. Understanding what these students seek in virtual interaction will, in turn, lead us to understand what these adolescents understand by least restrictive environment (LRE) (Howard, 2004); it will revolutionize best pedagogical practices in SEBD, and remove some of the misconceptions that surround them as learners.

Much of the research on third space and innovative pedagogical spaces is anchored in overly narrow participatory action research (Flutter, 2006), or very heavy critical theory (McGregor, 2004), examining wealth and privilege (Leander & Phillips, et al., 2010) or yet again a Post-Modernist angle (Foucault & Miskowiec, 1986; Jacklin, 2004). These are frameworks which offer very little subtlety in analysis when it comes to adolescents with SEBD, repeating steadily fairly pre-established views on traditional 'space'

and the values and references they carry with regards to power, privilege, sanity, etc. In many ways such frameworks see marginalization as an identity and a constant, whereas the difficulties experienced by teens with SEBD now distinguish themselves very vividly from life-long dysfunctions in contemporary research findings; spontaneous remission is indeed a topic widely discussed in SEBD (Fovet, 2011) and for many of these adolescents, marginalization remains a transient state as they seek alternative paths to functionality. The most visible of these trends has been the application of critical theory to teaching space, and the creation of a critical pedagogy of space (Morgan, 2000). In opposition to such over-focus on classroom space, this study will, in many ways, interpret space as a mere metaphor, and focused on what it might represent for users rather than as an entity with inherent attributes (Paechter, 2004).

‘Third space’, in its ethnographic use, has indeed little to do with the traditional conception of “space”. Traditionally in literature it is characterized by a distancing of self from routine roles, than necessarily by a physical movement or location (Oldenburg, 1999). It refers, when used by the population and age group the study targets, to a dimension of interaction (Kolb & Kolb, 2005), sharing (Razavi & Iverson, 2006), an encounter (Attwell, 2008), or a new way of defining self and others (Paechter, Edwards, Harrison & Twining, 2001). Increasingly, ‘third place’ is actually described by users as a ‘non place’ (Augé, 1995), immediately evoking and suggesting a multitude of reasons this dimension might be so attractive to these specific students (Steinkuehler & Williams, 2006).

Methodology

Both the epistemological value of focusing on the discourse of the subject (O’Connor, Hodkinson, Burton & Torstensson, 2011) and the impact of this method on empowerment for the subject (Bathmaker & Harnett, 2010) lead us to exploring life narratives (Ungar, 2011) as a tool to examine the perceptions of students with SEBD. Life narratives have been popular in Social Work for some time (Hartman, Little & Ungar, 2008), but have only recently started being explored and applied in the field of education (Theron, Cameron, Lau, Didkowsky, Ungar & Liebenberg, 2011). Narratives have been of particular appeal from the ethnographic perspective, and the outcomes recorded in the anthropological field apply equally well to the field of marginalized youth. The original process of ethnography is to query the validity and usefulness of using rigid interview and data collection methods, even when these bear little relevance to the subjects being studied (Smith, 2005). From a purely anthropological perspective, this has progressively been applied to a growing body of social contexts, in situation where – by analogy – individuals might be unwilling to share their experiences, feelings and perceptions (Roberts, 2004) through traditional data collection methods (Atkinson & Pugsley 2005).

Youth at risk and marginalized youth, equally, can be assumed to be unreceptive to traditional methodological approaches, particularly when the researcher is perceived to be part of an institutional framework – formal education in this instance – with which interactions are tense, if not frail. Even the marketing field has long accepted that in fact youth culture in general would not yield relevant information with regards to trends, patterns of usage and perceptions, unless it were approached with an ethnographic lens (McCracken, 2006). There is little surprise therefore that similar methods (Goodley, Lawthorn, Clough, & Moore, 2004) should be appealing to the researcher interested in exploring mechanisms as subtle as technological usage patterns; it is essentially subject centered. Life narratives have tentatively been applied methodologically to students with SEBD (Bailey, 2009; Dunne & Moore, 2011).

An ethnographic process was therefore adopted in this study. The data collection consisted of non-structured interviews with students aged 16-18 in secondary education. Ten interviews were carried out, as well as two focus groups with 3 participants each. The interviews were recorded, transcribed, manually coded and analyzed qualitatively (Bernard & Ryan, 2010; Glaser & Laudel, 2013).

Findings

The most crucial observation with regards to the use of social media was that students who experienced fairly major set-backs at school and were experiencing academic difficulties were never mentioning this information during social net-working. According to the students' self-perception, they never or rarely published profile information that allowed difficulties at school to transpire. There existed therefore a very systematic process of information selection when entering social networking. An intentional decision was made by all participants to censor information reflecting their difficulties at school. As a result and as a general rule, the 'published' state of mind seemed, for the great majority of participants, to be in opposition to the climate at school or mood displayed in that context: their online activity might suggest happiness and well-being when the reality within the school or the class was at times quite the opposite.

Peer relations can be a source of great stress and unhappiness for SEBD students. It appears from the data collected that social media is being used a platform to rectify these shaky peer relationships and repair some of the damage which, it would appear, often occurs in social exchanges due to impulsivity, a lack of verbal control or perceived social clumsiness.

Furthermore, relationships were seen to occur and develop during social networking which had no reality within the classroom walls, according to the corroborating feedback of teachers. Sometimes dialogue and conversations were seen to occur between students who would not actively speak to each other during the day at school. The social networking tool was used to, not only repair damaged peer relations, but to create entirely new ones. Though these seemed to not be entertained 'live' during school hours, they still allowed the child in question to gain a degree of recognition within his peer group and his virtual community. A level of expertise and recognition was gained by these participants through these online relations, particularly if they involved gaming competency or knowledge (related to music, apps, Youtube segments, etc.). It was quite clear that succeeding in obtaining certain key members of the school community to appear on one's 'Friends list', though not equivalent to entertaining an active relationship at school with these individuals, represented a tangible and supportive connection. This in turn was seen to lead to increase self-confidence.

During the interviews, the majority of participants was monosyllabic and volunteered little information. The students value social media platforms as a networking tool, but were not conceptual or analytical eloquent about its function in their life. They could rate its importance and relevance to their life and ability to function, but did not as a rule understand how and why it complemented their social interaction at school. Importantly, the subjects were seen to be making no differentiation about social media use at home and its use at school (where tolerated). Both social networking contexts were perceived as mingled and combined.

Findings related to massive multiplayer games online (MMGOs) varied slightly. The relationships existing in online gaming, as described by the participants, were extensive, in depth and careful developed through daily exchanges. Apart from students affected with ASD, who seemed to develop gaming patterns that varied widely from other students with SEBD, all participants chat extensively with their gaming partners. It is also important to note that there is nothing random about gaming cohorts. Gaming partners indeed have to befriend or at the very least accept invitations from players. The 'third' space here is, in this sense, much more tightly regulated than one might initially assume. There are very few occasions when the participants will leave these predetermined gaming groups and cohorts. The findings of literature were confirmed and it became apparent that the great majority of the participants' gaming partners belonged to their school community cluster. There was most usually little discrepancy in the choice of partners: these had the same age as the participant and were usually a member of their classroom, or at the very least their grade cohort.

It was also recorded that the relationships entertained with peers through gaming were fundamentally different than those developed socially in the school community, even when these in vivo interactions

were fairly well established relationships. This echoes the findings of Yee (2006) which focus on wider groups than teens, but stress the fact that online gaming personas differ widely from real life contacts and interactions, even when these links are as close as those of husband and wife. In the gaming 'third space', an individual's popularity, social status and rank are of little importance, just as the findings of Oldenburg (1999) tell us about adult interaction in more traditional, and non-virtual, interpretations of 'third space'.

The chat functions were used extensively and systemically by players; these discussions focus on the game itself and gaming styles or specific maneuvers, but also often bear on other aspects of the players' life. A wide array of topic is touched on – some relating to the school cluster but some going far beyond and including personal difficulties, family situations and other interests. The tone of the interactions, despite what is generally claimed in the media, is informal, jovial and constructive. A gaming etiquette tightly rules exchanges and few deviations are tolerated. Let's remember that despite the current fascination for 'trolling' (Williams, 2012), very little of it occurs in MMGOs because the gaming partners are almost never random.

In this sense, much of what was described by the participants seems to echo the findings of existing literature on the Internet's capacity to connect people across time and space and to foster the formation of personal networks and communities (Wellman & Gulia, 1999; Carter, 2005; Sheldon, 2009) and bridge class and racial gaps (Mehra, Merkel & Bishop, 2004; Ellison, Steinfield & Lampe, 2011). In several cases, the gaming involvement seemed to take on a therapeutic value for the participants discussing it, as it was perceived as having a remedial potential with regards to relationships which were, often, not always as constructive, or solid, in the real life school context. The idea of the 'second chance' was reiterated by the participants, an observation that has been linked to virtual spaces in existing literature (Livingstone, 2008; Sherman, Michikyan & Greenfield, 2013)

Outcomes

There are several issues relating to transferability and scope of outcomes that need to be considered here. There may be widely differing variables involved in the observations made and these must be examined to fully clarify the impact of the study. Virtual reality offers the possibility of quick and fluid change (Mautone, 2005), in opposition to the physical constraints of time and space usually encountered in the classroom setting (Nagelhout & Rutz, 2004) and this is one reason why it might be appealing to students with SEBD. Many students with SEBD display impulsivity or hyperactivity, or more general issues surrounding language and movement control (Azrin, Ehle & Beaumont, 2006) or self-awareness (Bouzaouach, Bellaaj, Jamoussi-Dammak & Bouaziz, 2007). Presence in any form of 'third space' (Oldenburg, 1999) may therefore offer these adolescents an intuitive and congenial form of 'least restrictive environment'.

Similarly, using virtual platforms offers students with SEBD a great level of manoeuvre, autonomy and initiative (Arthur, 2009); this became apparent in the study through the recurrence of discourse on choice, ease and personal control. The format of virtual third space lends itself to fast transitions and easy and quick change when boredom sets in (Whirley, Lorch, Lemberger & Milich, 2003). The relief of students with SEBD when they are allowed on to a virtual platform was tangible through the interviews, and it is possible to hypothesize as to the wider validity of this observation: it is possible that the element of choice, and power, plays a decisive role in the appeal we are observing.

Students with SEBD are also highly sensitive and receptive to flexibility and to the capacity of environments to adapt less rigidly to their needs (Bouzaouach, Bellaaj, Jamoussi-Dammak & Bouaziz, 2007). Research centered on the impact of schedule modification (Antrop, Roeyers & De Baecke, 2005) and adaptation (Brachet & Testu, 2007) for example seems to suggest that students with SEBD will thrive when offered the opportunity to modify conventional scheduling and to mould class requirements to their idiosyncrasies and individual requirements (Gunter, Denny & Venn, 2000). Literature indicates that flexibility has similar productive impact in other dimensions, and is not solely limited to the issue

of scheduling: breaks from physical presence in class (Burnett, 2010), ability to move (Mulcahy & Krezmien, 2009), technological interaction during the class time (Fovet, 2007), creative use of various media (Mastropieri, Scruggs, Cuenca-Sanchez, Irby, Mills, Mason & Kubina, 2010) all seem to lead to increased performance and interaction in students with SEBD; and all these initiatives include an element of flexibility and choice (Jolivette, Stichter & McCormick, 2002).

The appeal of flexibility can be interpreted in terms of 'control' (Conroy, Alter & Scott, 2009) and dynamics of power (Farmer, Farmer, Estell & Hutchins, 2007). However, it would be perhaps hasty to interpret such demands simply in terms of opposition and assertiveness. It seems rather to be due, in practical terms, to a genuine appreciation by these students of their own autonomy in scheduling, initiating, ending and maintaining interaction with others (Sellman, 2009).

Entering third space represents a release from the physical space of the classroom, or from dysfunctional 'live' relationships. The school space is seen as constrictive, while cyber reality offers a form of release. A parallel dimension appears in this release from 'constrictive parameters': virtual networking provides the student with SEBD with an opportunity to renegotiate classroom relationships (Sawka, McCurdy & Mannella, 2002). On the cyber platform, relations with the school cluster - and staff if they are tolerated - are different and richer than they may be in the real world context (Murphy, Rodriguez-Manzares & Barbour, 2010).

Another possibility might be that the student with SEBD finds in this space a sense of renewed competency (VanDeventer & White, 2002): he or she is freed from the patterns of conventional relationships that too often contribute to self-perceptions of low competency or poor ability in the school setting (Thibaut & Riecken, 2006). A regained sense of competency in this arena may then empower the student with SEBD to renegotiate interactions - with both staff and peers - on a new, more productive, basis (Blascovich, Loomis, Beal, Swinth, Hoyt, Boulenson, 2002).

Interestingly the peer relationships entertained and developed by students with SEBD in social networking platforms, such as social networking sites (Stutzman, 2006) or MMOGs (MMORPGs) (Taylor, 2003) are usually more complex, more varied and developed than those observed in class (O'Reilly & Newton, 2002). Classroom relationships are often metamorphosed and, to some extent, nurtured and improved in this new context; these observations are valid with regards to relationships with teachers as well.

This idea echoes theory and research on the 'third space' (Oldenburg, 1999) and the varying nature of the relationships established within virtual third spaces (Steinkuehler & Williams, 2006). According to Yee (2006), occurrences where online relationships are different from real life connections are frequent and SEBD students are no different than the majority of online players: 25% of players engage in games with a romantic partner and 19% with a family member without acknowledging within the game the real life relationships that links them. Yee's interviews also reveal that individuals who game with romantic partners or family find that such joint engagement in the "other world" of online games allows them to redefine the nature and boundaries of their offline relationships, often in more equitable terms than what may be possible in day-to-day offline life.

Another common characteristic of what some researchers call the 'third place' (Steinkuehler & Williams 2006) is that an individual's rank and status in the home, workplace, or society are of no importance (Oldenburg, 1999). This is not to claim that no social stratifications exist within virtual worlds. Such stratifications do exist, the most common observed being a disparity between expert "power gamers" and those who play casually (Taylor, 2003). In general though, one can see how the 'third place' which becomes available to students with SEBD through electronic media, enables them to redefine their relationships and renegotiate social ranking with peers and adults (Delwiche, 2006).

Interestingly one notes that we have now moved away from a cognitive construct of SEBD and have come to examine the challenge of teaching and including students with SEBD in terms of relationships, interaction and quality of exchange, rather than response to pedagogical content or behaviour

(Haythornthwaite, 2002; Thornburg, 2007; Soles, Bloom, Heath & Karagiannakis, 2008). The interesting emerging feature here seems to be social capital and particularly the value that is placed on social capital by students with SEBD themselves (Trainor, 2008). If increasing social capital, as well as involvement in the school cluster, is now the key, it is clear that the virtual 'third space', in which these students so love to immerse themselves, will have to be systematically explored and understood by educators.

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CONCEPTUAL UNDERSTANDINGS OF NOVICE PROGRAMMERS

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Abstract

The need for computer users to have a conceptual, compared with surface-level, understanding of computers has been argued by various authors over many years. Conceptual difficulties are not, of course, specific to the computer programming domain, and indeed are often the focus of Science education practices. This investigation concerns the understanding of secondary school students who are novice users of the Python programming language. A series of different tasks were developed to probe their understandings of relevant programming concepts. As Science education in recent times has often favoured probes of understanding and student-centred representational approaches, we argue for creative teaching and learning strategies which make visible and explicit their understandings, making them open to clarification and elaboration. In short, we contend that there is opportunity for creative pedagogy by bringing some Science education practices into 'Computer Science', thus helping students resolve misconceptions and identifying pedagogical approaches which may have unwittingly reinforced such views.

Introduction

Conversations online

An interest in constructivism since the early 1980s has galvanised an interest in learner's understandings in a range of subject areas. This has led to a paradigm change in the teaching and learning of various school subjects, and the change in Science education practices is particularly notable (So, 2002; Tobin, 1993, p. ix). In terms of a theory of mental and conceptual models (Cardinale, 1991), there is a 'target system', and the 'mental model' is what the user presently has in his/her head about the target system, and a 'conceptual model' is one which is invented to provide a teachable representation of a target system. The interest, therefore, has been with shifts in mental models and leveraging such shifts through student-constructed conceptual models.

In contrast, the interest of Information and Communications Technology (ICT) educators with learner understandings of the technology has been different. Yan and Fischer (2004) have observed that insufficient attention has been given to how people learn to use computers from the perspective of cognitive development. Hammond and Rogers (2007) have also observed the relative lack of research into children's understanding of computers and computing concepts – particularly when compared with the very large literature on teaching and learning with ICT. Ben-Ari (1999, 2001, 2002) has been critical of the widespread application of minimalism, a methodology for designing manuals for software documentation and for using these manuals in training users of the software. Trained in the more behaviorist style of minimalism, he argues, when faced with an unfamiliar situation, the user will not attempt to employ or expand conceptual knowledge, but rather will attempt to find and recycle a task that was 'actively learned'. In short, Ben-Ari expresses concern with an insufficient attention to conceptual understanding.

Nevertheless, practitioners have been steadily implementing more learner-centred or constructivist-compatible teaching and learning approaches. For instance, Chesñevar, Maguitman, Gonzáles and Cobo (2004) have used such ideas to develop innovative approaches to the teaching of highly abstract ideas of theoretical computing and Chen (2003) has done similar with the teaching of computer networking. Whereas the emphasis has tended to be on the conceptions that students construct whilst in the computing classroom, not the conceptions that they bring to the classroom door (Powers and Powers,

2000, p. 1), there are a small number of insightful studies and it is work which take a ‘student first’ approach. Ben-Ari (1999) considered the mental models of word processing of academic staff in a university. Hammond and Rogers (2007) considered children’s perspectives on issues such as ‘What is logging on?’ and ‘How does a mouse work?’. Young student’s perspectives in explaining the ‘behaviour’ of a mechanical, autonomous robot were studied by van Duuren and Scaife (1996) and Levy and Mioduser (2008). Kafai (2008) explored students’ conceptions of a computer virus. Papastergiou (2005) and Diethelm and colleagues (Diethelm & Zumbärgel, 2012; Mesaroş & Diethelm, 2012) investigated high-school students’ conceptions of the internet. The ImpaCT2 and related studies (ImpaCT2, 2002; Mavers, Somekh and Restorick, 2002; Pearson and Somekh, 2003) considered several thousand students’ understanding of ‘What is a computer?’. Across all of these studies, there is little consistency of findings. ImpaCT2 researchers concluded that students had detailed and complex cognitive representations of technologies, whereas Papastergiou (2005) found widespread simplistic and utilitarian mental models.

The authors of this paper are both Science teachers as well as ICT teachers, invested in the conceptual change model of teaching, and to some extent side with Ben-Ari (1999), troubled by the more minimalist approach which seems to often permeate ICT education, and seeking for a more conceptual basis for our work, and give greater respect to the thinking that students bring to the computer classroom. Our earlier forays into this territory (Chandler, 2010; Chandler and Gesthuizen, 2010) considered ‘common place’ computing activities. In this paper, our focus is on the more specialised work of teaching programming.

Focus for investigation

Roy Pea’s (1986) work *Language-independent conceptual “bugs” in novice programming* is unquestionably the early and seminal work in the field. Google Scholar indicates that it has been widely quoted, but readily-located similar studies are not easy to find (e.g. Fleury, 2000; Pane, Ratanamahatana, & Myers, 2001; Spohrer & Soloway, 1986). Amongst them, the focus has not been at the upper secondary level nor in relation to more recent programming languages such as Python. Pea’s investigation identified the following three misconceptions in the work of novice programmers:

- Parallelism - the assumption that different lines in a program can be active at the same time
- Intentionality - the attribution of foresightedness to the program
- Egocentrism - the assumption that there is more of the programmer’s meaning for what he or she wants to accomplish than is actually present in the code

The focus of the investigation is, in the context of programming in Python, exploring the ideas about computing that students present to a teacher about what is happening inside a computing device. Therefore, to contribute to an extension or confirmation of Pea’s work with respect to the specific contact of teaching of programming through Python to Australian upper secondary students.

Methodology

Participants

The participants were students from the second author’s information technology classes in a secondary school in the city of Melbourne, Australia. Whilst there were three classes in total involved, they were small classes and the total number of participants was 29. Both genders were represented and participant ages spanned from 15 to 17. Students had a broadly different exposure to computing varying from no contact, some limited programming with Scratch to some more intensive programming experience with the Python⁴ programming language through the GROK⁵ Programming Challenge. All had some experience using computer applications such as word processing and spreadsheets. Each had their own

⁴ <http://python.org>

⁵ <https://groklearning.com/challenge/>

personal netbook computer.

Probes for understanding

Following the value of Science educators to use visual representations to help students represent abstractions (Tytler, Haslam, Prain and Hubber, 2009), and similar work in ICT education (Kafai, 2008), our earlier investigations (Chandler, 2010; Chandler & Gesthuizen, 2010) took a similar approach. We designed some simple questions to prompt students to draw representations of how variables ‘work’. Only results for one question is considered in this paper:

Figure 1: Sample Question

Here are two variables in a Python program:

X = 16

Y = “Cat”

If you could “draw” what this looks like when this information is stored ‘inside’ a computer, what would your drawing look like? You can annotate your drawing to add some notes that describe the different parts of your drawing. Use your imagination and ideas about what could be happening inside a computer and how these variables might be stored.

Data collection

Students were presented with this questionnaire to answer independently on paper. Their teacher (the first author) provided considerable encouragement to record and submit an answer but not provide any clues or hints about what should be answered. No information technology or programming instruction was given to support or scaffold their answers. Submissions were codified to remove any identifying information then digitally scanned for further analysis.

Data analysis

Whilst Pea’s (1986) research was available as an interpretive framework, we took an approach more aligned with grounded theory (Glaser and Strauss, 1967). Both researchers independently read over the responses. Initial classifications that we made were then discussed, and then we worked together to sort the responses into broad groupings. Our interpretations were then compared with Pea’s work.

Results and Discussion

The responses were group into four broad classifications, which are explained below, which is organised as an approximate taxonomy ranging from least abstract to most abstract.

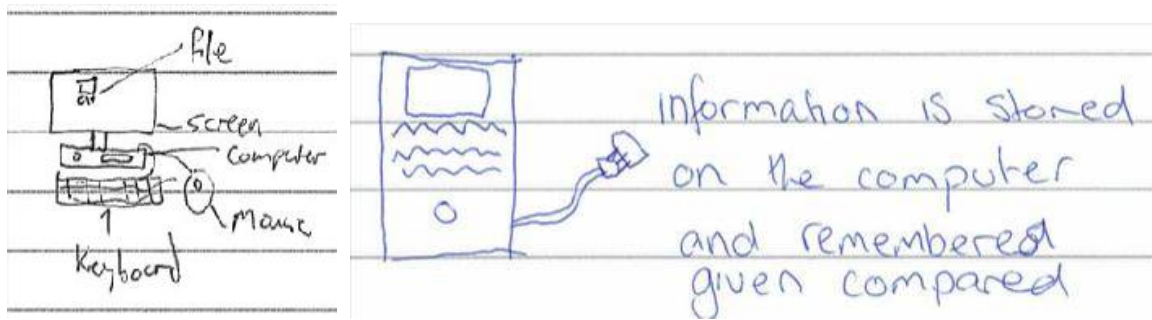
No representation

Two students responded with no answer. They indicated that that had absolutely no idea, even when pressed to use their imagination and despite considerable encouragement to submit an idea what may be happening.

Exterior view of the computer

Some responses indicated a recognition of the computer as a “system”. The diagrams sometimes labelled the parts and indicated that information is entered and stored and perhaps manipulated inside the computer.

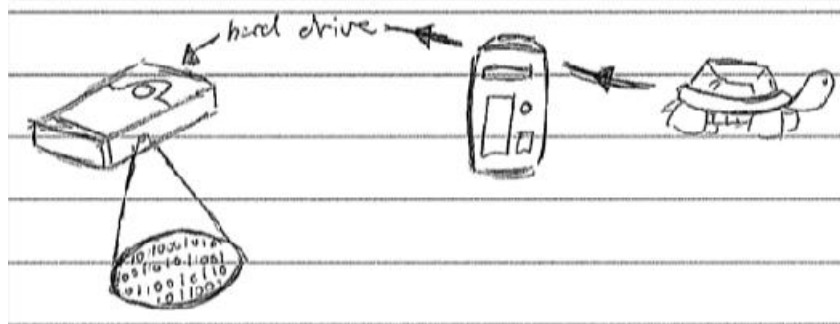
Figures 2 and 3: Student Responses indicating 'exterior view'



Naive symbolic understanding

Some responses suggest a notion of the “inside” of the computer as symbolic. One student describe a Turtle device connected to a computer full of chips that contains binary numbers. There is some sense of Pea’s notion of egocentrism (more meaning attributed than is actually specified) as it is otherwise unclear how the idea of the turtle arose.

Figure 4: Student Responses indicating 'symbolic understanding'



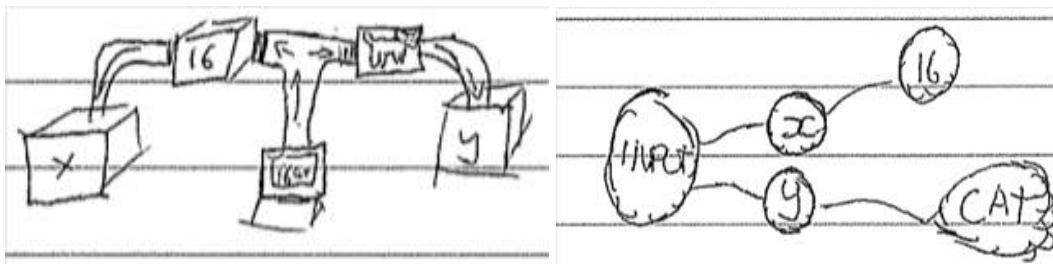
More detailed presentations of the “inside”

When examining the responses that explored what was probably happening at a ‘deeper’ level, there were four broadly different ways of visualising how information could be represented inside a computer. They varied from the fantastical notion of abstract animals, information dynamically flowing from boxes through different paths, static binary code and physical reality of dots of data or magnetic field lines. We will here consider each in turn.

Data ‘flow’

Some students submitted a model that illustrated the flow of information along pipes to different boxes or spaces.

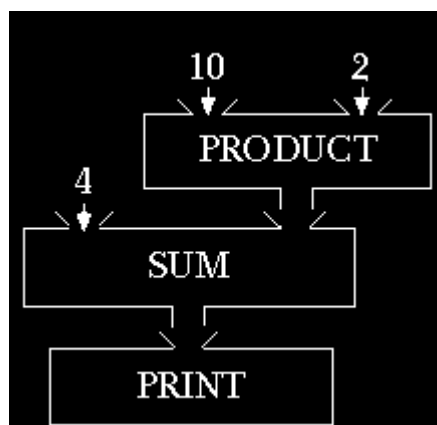
Figures 5 and 6: Student Responses indicating 'data flow'



This is reminiscent of the “plumbing diagrams” used by Brian Harvey (1997) to develop understandings

of variables such as:

Figure 7: Sample 'plumbing diagram'



Notions of “flow” also connect with high-level mathematical thinking such as cellular automata (extensions, really, of Conways ‘game of life’), which have been modelled to represent low-level digital structures such as logic gates (Schiff, 2005, pp. 97-100). It is important to note, though, that students had not been exposed to “plumbing diagrams” in their classes, so their use of this abstract representation is entirely of their own making. It is possible that these responses embody some degree of Pea’s misconception of parallelism (elements of the program being active at the same time), but even so, it can be argued that this ‘data flow idea’ is the principle objective of the programming teacher: that values must be stored in a ‘container’ somewhere that they must be combined with other values in order for computation to take place.

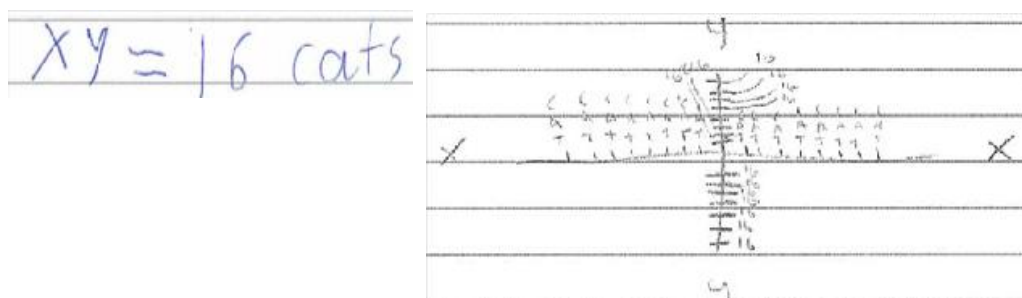
The response is therefore very important as it suggests that those students who constructed diagrams which successfully reinterpret information derived from their teacher and other sources and developed a representation which is highly productive, close to the canonical representation of the field and allied with high-level mathematical thinking. If this was the mental model (or interim mental model) of most students in a programming class, a teacher would have reason to be very happy.

Mathematical

What can be seen from the response below is that students draw upon their prior experience strongly when they interpret the question. For instance, one student produced a response with cartesian coordinates has taken note of the symbols “X” and “Y” in the question and connects that with certain types of mathematical work. Likewise, other students who have produced something which looks like a mathematical equation; one of those students has possibly seen the same symbols and connected that with other elements of mathematical experience.

Some degree of Pea’s notions of parallelism and intentionality is probably present in these responses.

Figures 8 and 9: Student Responses indicating 'mathematical understanding'

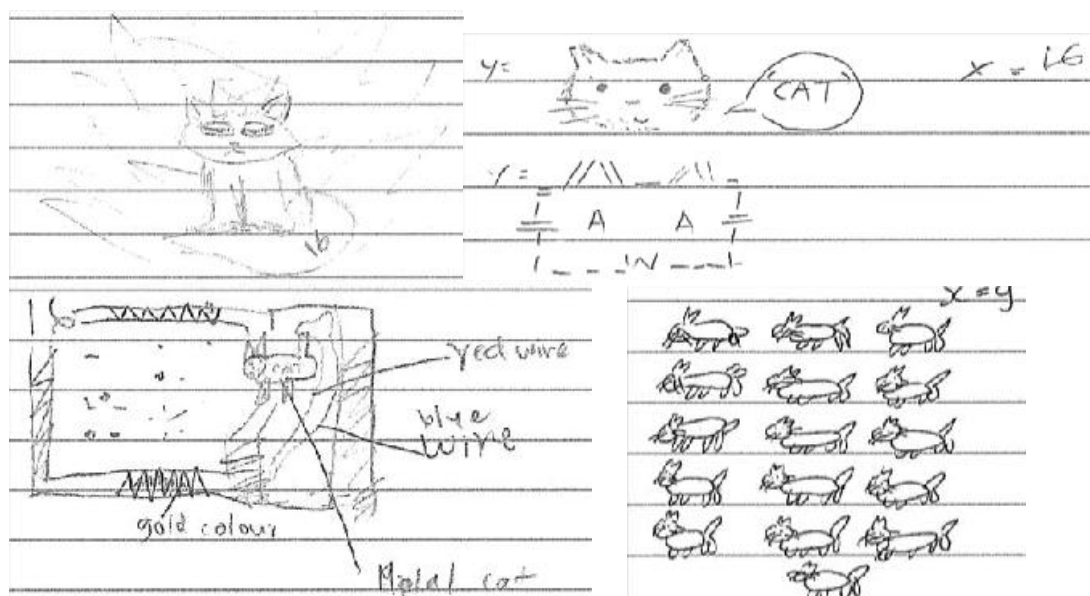


Fantasy

Imagination and fantasy elements are well represented amongst some contributions. The student who has seen $Y='Cat'$ and has envisaged miniature felines certainly has some 'fantasy representation' but moreover has not seen the letters between the quotation marks as simply a sequence of characters but as a real-life object which needs to be modeled in some way.

The fantasy models represented ranged from a smiling young cat with a bow tie and another drawn using ASCII characters. Another drew a small army of marching cats and two tried to physically draw a small cat, hard-wired into the computer circuitry. This supports the conceptual understanding that the cat is both inside the computer and an integral part of the circuitry or perhaps the code.

Figures 10, 11, 12 and 13: Student Responses indicating 'fantasy understanding'



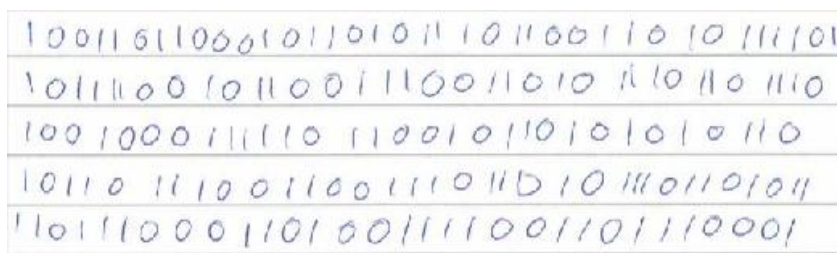
This anthropomorphic representation may draw on a wider culture such as the Internet, books or television shows such as “Nian cat” or “Cyberchase”. “Nian cat” is a YouTube animation and internet meme including a mildly irritating music and flying computer cat. Videos and images of this computer cat are popular and shared between students. The Cyberchase animated cartoon series presents what is occurring within a computer as a kind of miniaturized version of the real world.

It would be drawing a long bow to suggest that that students would believe that a computer would contain an actual miniature model of a cat from the real world, but what is clear is that is that they have interpreted $Y='Cat'$ to be actually indicative of a feline rather than a string of characters. Therefore, their parsing of the line of code is more based on ‘common reading’ of the sentence than a computer-science based one and, whilst ‘cats in the computer’ is probably not actually sensible to them, they do not really have any idea of a representation which makes any more sense than that. This reading of the program probably embeds some elements of Pea’s notions of intentionality and egocentrism.

Unstructured code

Several students tried to represent the data as binary numbers in different ways. One tried to connect the data to each variable, another represented the huge iteration of zeros and ones. A third tried to illustrate that the stored data could be ‘visualised’ this way if you examined the could hold a magnifying glass to a computer chip. It is interesting to note that there was some confusion about how this information is grouped as discrete variables or a wall of data with no discrete boundaries.

Figure 14: Student Responses indicating 'unstructured code'

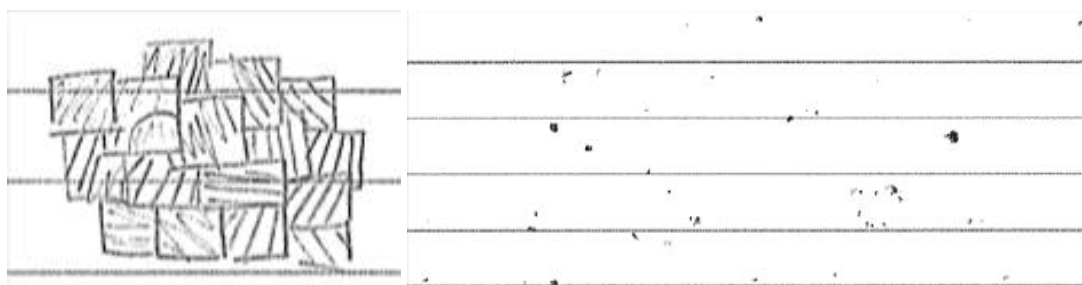


This representation is clearly influenced by prior learning that information in a computer is not stored as native words, decimal numbers or physical objects, rather it is directly converted, codified and stored as a binary number. There was perhaps some doubt with how the computer can tell different 'boundaries' to delineate between the different tokens represented in this binary sequence or where this code would be physically located.

A physical reality

Two students provided an interesting and conceptualisation of how data is stored inside a computer. After a considerable period of time struggling with a suitable answer, one settled on a series of deliberate dots on a surface to represent the information inside, perhaps on a chip. Another tried to represent this not as a series of dots but as a set of magnetic field lines along a surface.

Figures 15, 16: Student Responses indicating 'physical understanding'



These representations may have been influenced by some prior reading or learning about how information is stored on a DVD, compact disk or magnetic tape. The students may have attempted to map this visualisation into their model of how a computer works or looks inside. Whilst this is perhaps the most technically interesting answer at a physical level for information storage, it is worth noting that these students did not ground their representation in the more symbolic and abstract ideas.

In summary, there are not many visual representations which seem to be very viable in terms of explaining the lines of code presented. Whilst not wanting to stray into Pea's misconception of intentionality (the attribution of foresightedness to a program) the majority of representations which are 'static' rather than part of a 'process'. In contrast, to the computer scientist, a computer is a 'busy place', shunting data from one place to another at a fantastical speed. As represented in the order of the discussion above, the classification which we are on a surer footing, though, is abstraction compared with physicality, and it is from this basis that conclusions and recommendations proceed.

Conclusion

In the small amount of data collected, we have seen examples which fit in a range of positions that can be located upon a spectrum which extend from a 'macroscopic, physical' understanding on one extreme though to a 'microscopic, physical' understanding on the other, and with various forms of abstract thinking somewhere between. This is presented in Table 1.

Table 1: Spectrum of computer understandings

Macroscopic, physical	Abstract	Microscopic, physical
External hardware model with physical devices	For instance - naïve symbolic - mathematical - data flow - binary number - fantasy	Internal physical model with data storage elements

The computer programmer typically works in an abstract space, dealing with data, data structures and algorithms. At one end of the above spectrum is the physical infrastructure which makes all of this possible, such as the motherboard circuitry and the design of storage devices is broadly the domain of electronics engineering, but is rarely open to view because it is either hidden in a case or microscopic in size. At the other end of the spectrum is the physical reality of a computer which the user ‘sees’ and interacts with directly, the province of user-interface design. Data structures occupy the ‘middle ground’ between these two extremes, but unlike them is entirely an abstract conception. Where students are able to think abstractly, some elements of Pea’s misconceptions can be inferred. Consistent with our earlier work (Chandler & Gesthuizen, 2010), the challenge seems to be in fostering student thinking at an abstract level at all. An extremely small number of students could be said to be thinking at an adequately abstract level where a deeper understanding of misconceptions could provide direction for productive future teaching and learning.

Given the small extent of this study, there is considerable scope to repeat this activity and compare the results with a larger cohort of students, different ages or amongst adults such as teachers or parents. A larger sample would allow a more careful exploration of the extent to which abstract (compared with physical) conceptions are indeed prevalent and to provide a more careful of the account of the range of mental models.

We came to this investigation as educators immersed in Science education, and that discipline has taught us that it is valuable for teachers to understand the conceptual understandings that students bring to the classroom, viewing these as mental models that are neither right nor wrong. Rather they should probably be viewed as alternative conceptual understandings that students have constructed from prior experiences. As Pea (1984) encouraged us to ask the question “How do inadequate mental models get transformed to better ones?”, it is this perspective that we do not find widely represented in current ICT education, which seems to be more informed by minimalism.

What this brief study has suggested is that the first step towards that is to find ways to encourage thinking at an adequately abstract level. What confronts us is that there is, in a sense, a ‘right’ or ‘wrong’ to naïve understandings because an explanation based on physical realities (at either end of the spectrum) will always be inadequate. It is one thing to suggest that teachers should be aware of the various perceptions so that they can be better placed to diagnose and design activities that challenge this understanding and stimulate learning. But in order for that dictum to be meaningful, we must not only seek a more conceptual basis for our work but to *firstly* reveal the abstract ‘space’ that either implements, or is implemented by, the physical reality.

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TWEECHING: LEARNING THAT IS PERSONAL AND SOCIAL

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Abstract

The use of social media at conferences has changed significantly over the last 6 years becoming a central component to professional conversation and participant engagement. The volume and diversity of micro-blogging participants has increased and the positioning of the 'backchannel' is an increasingly endorsed and expected part of the participatory culture.

This paper tracks the use of Twitter at the 2008, 2010 and 2012 Australian Computers in Education Conferences (ACEC) and analyses how the backchannel conversation has evolved over that time. Our research provides a longitudinal analysis of trends and changes in use at these conferences over time. It expands on previous work of a detailed analysis of Twitter posts from the ACEC 2010 conference (Gesthuizen, 2012).

The nature of the Twitter conversation has moved from a rebellious conversation by a few to an expected component of the conference experience. This professional and social dialogue has gathered momentum, becoming more communal, inclusive, resource rich and extending well beyond the physical boundaries of the event location and its timing.

A small scale survey of conference participants was used to gather reflections on changes in the use of Twitter as a Personal Learning Network (PLN) with a focus on contributions to ACEC conferences. This paper provides recommendations and considerations for engaging conference participants in the meaningful use of backchannel conversations and their value by participants and observers to the conference experience.

Background

Conversations online

Educators use Twitter for a variety of purposes such as: collaborating with colleagues; staying up-to-date with news or trends; participating in a conference backchannel or Twitter chat with a particular purpose; exposure to a more diverse range of perspectives; to test out ideas; to access resources, links and inspiration; self-expression; social connection and peer support (Warlick, 2009; Lalonde, 2011; Stevens, 2008; Gerstein, 2011). In an academic setting, Twitter can be used to foster interaction and conversation about a given topic (Educause, 2007). Twitter is a collaborative tool with a growing interest from educators for developing a Personal Learning Network or PLN (Warlick, 2009; Skiba, 2008; Stevens, 2008; Educause, 2007; Lalonde, 2011; Gesthuizen, 2012).

Most conferences, especially those relating to elearning, are now marked by one or more online conversations in which conference attendees share insights, beliefs, ideas, and emotions in response to each other. With online authoring tools, users can compose, publish and share online a large piece of writing. It is not uncommon to find amongst these social media communications and discussions, educators who are not attending a conference or event but who vicariously experience the activity through these conversations and who actively participate in the discussion (Educause, 2007).

Nature of Twitter

Users of Twitter are restricted to posting brief, online text updates or 'tweets' of just 140 characters using a range of different clients including a desktop computer, laptop, tablet or smartphone device. Information in a Twitter post can be codified and compressed using special initialism of key words such

as RT or retweet, MT or modified tweet, DM or direct message and HT or hat tip (Howard, 2009). Hashtags can be used to bring an audience together at an event, creating a conference “backchannel” discussion (Sopan et al., 2012). It cannot be regulated by the mainstream event but it is increasingly becoming an integral part of any conference.

The nature of communicating with Twitter is not a single distributed conversation. As a backchannel it becomes a series of multiple monologues with a few intermittent, discontinuous, loosely jointed dialogues between users (Ross et al., 2011). These conversations can sometimes appear prosaic and at other times highly personal and challenging. Participants in a backchannel often expand their network of followers within a short time during a live event. Clusters of conversation often form around consistent tweeters throughout the event or for speakers at the time of their presentations (Sopan et al., 2012).

Building a Backchannel

Engaging in a backchannel can help participants make new connections and stimulate peer conversation (Sopan et al., 2012) and can foster deep feelings of connectedness between participants (Lalonde, 2011). Whilst it can appear overwhelming for new users, a backchannel is a complex space where user can share, collaborate, question and stamp out an individual online presence (Ross et al., 2011).

When we consider our real-life and online interactions, the increased use of social media has blurred the lines between our personal and professional relationship. Questions have been raised from studies about the ethical challenges that social media presents when new behaviours or practices are adopted (Taylor, 2012).

The Study

This paper examines a backchannel that evolved and grew at a series of three biannual national ACEC conferences⁶ spanning 2008 to 2012. It starts by examining how Twitter was used by conference participants and then explores some issues and further uses. By tracking conversations using a specific and popular hashtag used at each event we can follow the associated social media interactions. The goal of the study was to identify patterns and trends in the data as well the evolving positioning and value of Twitter as a backchannel tool.

The Events and Participants

General details of the 3 conferences are outlined in Table 1. The participants are considered as the contributors to the Twitter stream at each event, some of participated remotely and were not at the physical event. A majority of ACEC conference delegates work in a teaching or administration or support role in an Australian school or Tertiary institution. Whilst many participants taught a computer science/information-technology based subject, other educators attended because they had an interest in the leadership, integration, teaching or pre-service teacher education.

Method

This research is a non-intrusive analysis of the social and psychological characteristics of how educators work together online. Rather than aggregate or tally all the social media interactions, this study will focus on the posts around the time period when the first and last keynote speakers presented their address in the auditorium, and overall statistics of Twitter use on the final day of the conference. Social media data was assembled from Twitter archives collected by the researchers from a range of different tools using the most common hashtag used by conference delegates at each event. For each year the data imported into a spreadsheet for analysis.

⁶ ACEC (Australian Computer Education Conference) is a biannual conference hosted by state members of the ACEC (Australian Council for Computers in Education) <http://acce.org.au>

Table 1
ACEC conference events profile

Conference	ACEC 2008	ACEC 2010	ACEC 2012
Most popular hashtag used	#acec08	#acec2010	#acec2012
Host association and city	CEGACT, Canberra	ICTEV, Melbourne	ECAWA, Perth
Dates of conference	29 September - 2 October 2008	6-9 April 2010	2-5 October 2012
Approximate number of delegates	250	800	400

The text of the tweets from the final day of each conference was analysed using Textalyser⁷, in order to determine keywords and any overall linguistic trends. Extracting and clustering popular words using a text analysis tool is an unobtrusive window to peoples' concerns. Differential language analysis has successfully used this to analyse Facebook social media posts (Schwartz et al., 2012). A word cloud from each event, where each word is scaled by frequency, was also used for analysis because visualisation is an important way of working with key themes in textual data (Tausczik & Pennebaker, 2010).

Analysis of first day of keynote posts was problematic because of different program schedules for each event. ACEC2012 scheduled their first keynote in the evening after pre-conference activities and analysis of the first #ACEC08 was problematic as it had not been well established as a Twitter hashtag. Fortunately, as the last day of each conference event included a final keynote speaker, it was decided that we would compare the social media stream during this last session and conduct a detailed text analysis rather than a wider analysis of each event.

To gauge early concerns about social media at conference events, an examination was conducted of OZ-teachers⁸, a mailing list used by conference participants. This helped to identify a heated 2008 discussion debating the use of a backchannel and other technologies at conference events. A small scale online survey was distributed in 2014 to this mailing list and other social media channels to determine how these perspectives have evolved and the prevalence of these issues within a more recent setting.

The use of Twitter (and other technologies) at ACEC in 2008 raised some concerns with attendees and others within the education community regarding appropriate protocols for behaviour at conference. Discussion on the OZ-Teachers email list and through blogs, was also used in this study to identify possible issues and perspective on the use of Twitter at that point in time. These issues were further explored by a small scale survey of educators who actively use social media including some who were present at all 3 conferences.

Results and Discussion

This section presents data and analysis based on the tweets from the three conferences and from the survey and briefly examines their implications. A focus on the tweets at the time of the first and last keynote is shown in Table 2.

The average message posting frequency per user is very roughly comparable between events. There is a significant increase in the number of tweets posted during the first keynote and last keynote for each event. There is a considerable increase in the activity of each Twitter stream from an occasional post in 2008 to a many posts per minute in 2012.

⁷ <http://textalyser.net>

⁸ <http://www.oz-teachernet.edu.au/>

Table 2

First and Final Keynote Twitter data comparing keynotes

Keynote Data	ACEC 2008	ACEC 2010	ACEC 2012
<i>First Keynote</i>			
Tweets during first keynote	25	465	99
Tweets per minute during first keynote	0.379	7.750	1.737
Number of contributors to first keynote tweets	3	93	40
<i>Final Keynote</i>			
Tweets during final keynote	11	214	272
Tweets per minute during final keynote	0.177	3.344	5.440
Number of contributors to final keynote tweets	3	80	56

The average message posting frequency per user is very roughly comparable between events. There is a significant increase in the number of tweets posted during the first keynote and last keynote for each event. There is a considerable increase in the activity of each Twitter stream from an occasional post in 2008 to a many posts per minute in 2012.

Table 3

Content Analysis of the Final Day Tweets

Final Day Tweet Data	ACEC 2008	ACEC 2010	ACEC 2012
Number of tweets on last day	52	1454	1179
Number of contributors to tweets on last day	10	222	175
Estimate % of conference delegates	4%	27.75%	43.75%
Tweets per user on last day	5.200	6.550	6.737
Last day average tweet size	91.566	100.465	110.280
Last day # other than ACEC one	2	210	302
Average other # per tweet	0.038	0.144	0.256
Max other # in a single tweet	1	7	8
Last day total http:// shared	5	304	342
Average http:// per tweet	0.096	0.209	0.290
Max http:// in a single tweet	5	4	4
Last day total @	7	923	1302
Average @ per tweet	0.132	0.634	1.103
Max @ in a single tweet	7	5	7
Last day total RT	0	644	701
Average RT per tweet	0.000	0.443	0.594
Max RT in a single tweet	0	6	3
Max tweet size (last day)	140	161	161
Min tweet size (last day)	28	21	25

From table 3, the tweets per user on the last day increased only slightly, despite the significant increase in the total tweet volume. It is interesting to note that the nature of how users engage with the social media has changed. The latter events have Twitter posts that include more hashtags to other topics and

share links to other websites. In particular, there is a significant increase in tweets that cite multiple users and the use of a codified language such as RT for retweet.

The significant increase in the “@ per tweet” measure from 0.132 to 1.103 would be expected as increasingly users cross reference each other’s Twitter username when submitting a post. It also probably reflects a change in the discourse to a more conversational nature.

The increase in popularity to “RT @username” is reflected by the increase in the RT per tweet from zero in 2008 to 0.594 (59%) in 2012. Perhaps this is a measure of the effort of users in this Twitter stream to acknowledge tweets and contributions by another user. It is a crude citation system that is increasingly being adopted by users. This is an interesting illustration of how an online group can identify a community need and create its own social code of conduct.

An overall textual analysis of last day tweets, as shown in Table 4, indicates there is a significant increase in how much participants are saying with Twitter with an increase of total words used. Whilst the sentence length has decreased and the complexity of the language used has decreased, the syllables per word and readability scores have remained relatively constant. This could imply that whilst users are sharing complex ideas with this medium, they are probably better skilled at summarising their ideas or questions.

Table 4
Text Analysis of tweets posted on the last day

Conference	ACEC 2008	ACEC 2010	ACEC 2012
Total word count	526	9768	13893
Number of different words	335	2549	2931
Complexity factor (Lexical Density)	63.70%	26.10%	21.10%
Readability (Gunning-Fog Index) (6-easy 20-hard)	8.6	6.2	5.6
Total number of characters	4959	90198	132497
Number of characters without spaces	3316	60892	89406
Average Syllables per Word	1.74	1.7	1.72
Sentence count	53	1582	2876
Average sentence length (words)	15.08	9.08	7.23
Max sentence length (words)	76	72	58
Min sentence length (words)	1	1	1

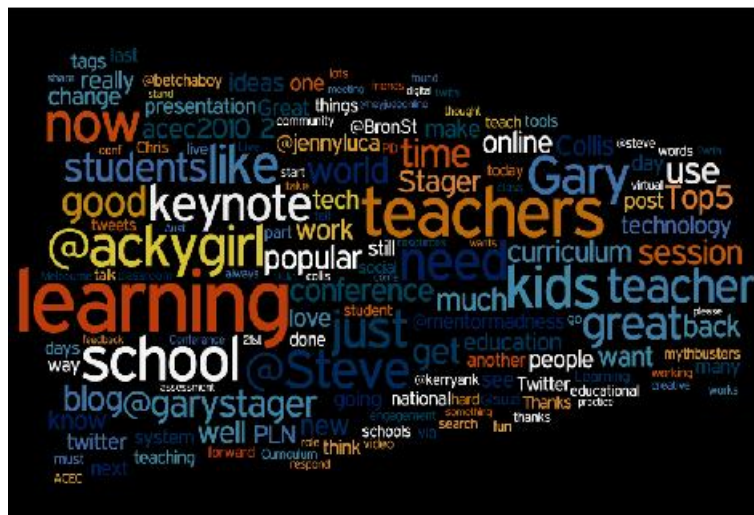
The use of the term HTTP increased from 1.0% in 2008 to 2.4% in 2012. This growth is consistent with the notion that users are increasingly likely to share a link to a photograph or resource when using social media. Also there is an increased use of initialisations such as RT or Retweet to communicate when an idea is being shared.

An examination of the words used from the frequency table (Table 5) and word clouds (Figure 1) reveals some interesting trends. “Learning “ is part of each event but whilst 2008 had a clear emphasis on “standards” and “pedagogy”, in 2012 there is an increased recognition of other users and conversation around the ideas being shared.

Figure 1: World Clouds Generated From Final Day Tweets From Each Event



Wordle of #ACEC08 tweets (with acec08 removed)



Wordle of #ACEC2010 tweets (acec2010 and rt removed)



Wordle of #ACEC2012 tweets (acec2012 and rt removed)

Table 5
Comparison of Word Frequencies and Popular words from final day tweets⁹

Conference	ACEC 2008	%	ACEC 2010	%	ACEC 2012	%
Top 10 words	ACEC standards garystager ¹⁰ ICT If teachers learning HTTP based pedagogy	1.03 2.0 2.0 1.3 1.3 1.1 1.1 1.0 0.8 0.8	ACEC RT HTTP garystager bit.ly you what learning keynote school	9.2 2.1 1.6 1.3 1.1 0.9 0.8 0.6 0.6 0.6	ACEC RT HTTP you great animations ackygirl learning thanks your	9.5 5.0 2.4 1.0 0.9 0.6 0.6 0.6 0.6 0.5
Popular initialisations	ICT (1.3%) HTTP (1.0%)	1.3 1.0	RT HTTP (1.6%)	2.1 1.6	RT HTTP	5.0 2.4
10 most frequently mentioned Twitter users (mentions)	@jomcleay (1) @djuler (1) @Laurenogrady (1) @Steve_Collis (1) @StevenCaldwell (1) @lucybarrow (1) @jarruzza (1) <i>*only 7 users each mentioned once within final day tweets</i>	0.19 0.19 0.19 0.19 0.19 0.19 0.19	@ackygirl (90) @garystager (77) @Steve_Collis (59) @betchboy (42) @jennyluca (34) @mountainmoss (32) @mentormadness (29) @bronst (29) @kerryank (24) @heyjudeonline (19) @murcha (17)	0.92 0.79 0.60 0.43 0.35 0.33 0.30 0.30 0.25 0.20 0.17	@ackygirl (88) @acec2012 (69) @rgesthuizen (52) @paulfuller75 (36) @sarahstopher (35) @henriettaMi (35) @paulhuebl (32) @karistubbs (31) @anthesperanza (30) @mgraffin (29) @lnbm (28)	0.63 0.50 0.37 0.26 0.25 0.25 0.23 0.22 0.22 0.21 0.20

Shifting hard and soft technologies

Some of the behavioural changes observed between events may be a result of social media users that are more familiar with Twitter and have a better understanding of how it could be used. It would be interesting to consider if this change in user behaviour has happened gradually over time between events with increased social media use or if it was directly learned during the event by the high density conference Twitter stream and posts made by other skilled users.

Another change to consider is the different devices used by participants at each event and the impact on access to social conversation. An anecdotal observation at the 2008 conference is that the majority of participants used laptops, some suggesting that these needed wheels or a backpack to carry about the venue. Photographs of the conference audience showed that in 2010, many participants started to use smart phones, and at the 2012 conference many were holding iPad tablet devices. It would be interesting to consider how educators may have engaged differently with each type of technology.

OZ-Teachers Ethical Dilemma

The suggestion of an ethical problem with using social media is not entirely new. Some research has been conducted examining the increasingly blurred line between personal and professional relationships, hinting at a perilous ethics landscape for social networkers (Taylor, 2012).

During October 2008, there was considerable concern raised by teachers on the OZ-Teacher mailing

⁹ Data analysis generated by <http://textalyser.net>. Initialisations have been capitalised for clarity.

¹⁰ Combining different variations of the keynote name and capitalisations.

list¹¹ about the impact of mobile devices and social media. Concerns were raised about the appropriate ethical behaviour or netiquette that should be adopted by participants. After examining the posts, the following two different views emerged that highlight the spectrum of perceptions in 2008 about how social media should be used at a conference event.

- It is rude for participants to blog, tweet or tag websites during presentation. The glow of laptop screens was distracting. Rather than multi-tasking ineffectively, participants could better engage by turning off all their electronic and mobile devices. Conference organisers should consider a policy or code of ethics to guide device use.
- Using mobile technology could help participants work paperless, make better notes and reflect upon the proceedings. Social media could help contribute to a backchannel that engages participants beyond the event, improving collaboration, communication and learning. In addition, it can help to improve real world feedback and interpersonal relationships and the conference experience.

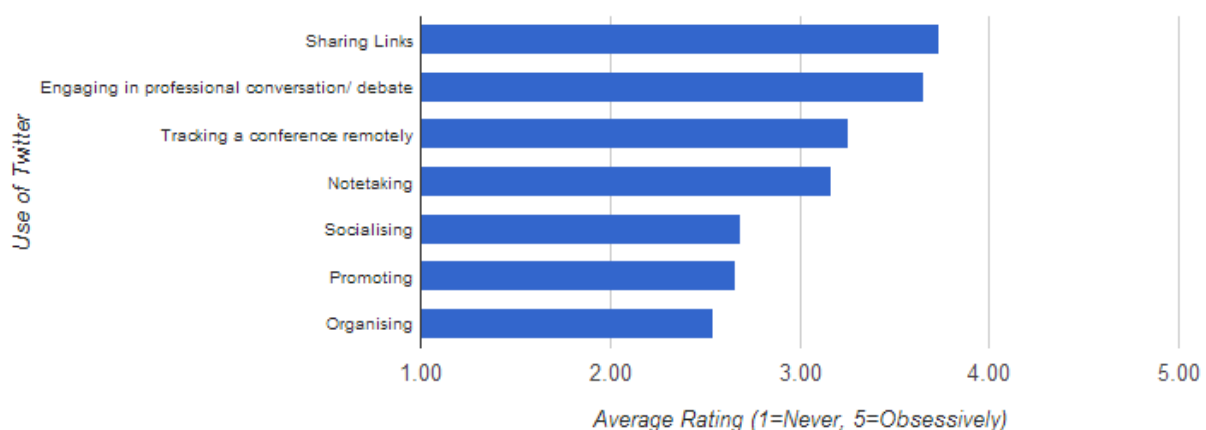
The evolution of uses and perspectives

To determine the relevance of the value and perspectives of a survey was conducted in 2014. 35 responses were received with 4 indicating they were present at ACEC 2008, 17 at ACEC 2010, 14 at ACEC 2012 and 13 did not attend any of these events. Responses were from people who actively use Twitter at conferences (average of 4.1 out of 5), and find its use valuable at these events (average 4.3 out of 5). Respondents noted that the use of Twitter was:

- frowned upon during ACEC 2008 but valued by those not physically present.
- intense, valued and enabled deeper connections at ACEC2010; providing intellectual and social discussion. A few respondents indicated that this was the start of their PLN.
- widely accepted, active, used for organisation and discussion at ACEC2012 and provided an enhanced experience for those unable to attend.

Those survey participants indicated that they use Twitter in the following ways from most frequent to least.

Figure 2: Extent of Types of Twitter Use



The survey also asked respondents to rate a series of statements that drew upon some of the concerns identified from the 2008 OZ-Teachers mailing list conversations. From these responses it can be deduced

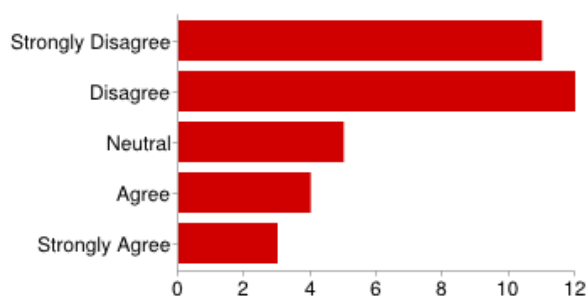
¹¹ Synthesised from 32 emails retrieved from the public OZ-Teachers mailing list in discussion threads titled "Conference Session Professional Respect" and "ACEC2008". <http://lists.rite.ed.qut.edu.au/pipermail/OZ-Teachers/2008-October/subject.html>

that current perspectives on the use of Twitter at conferences are that:

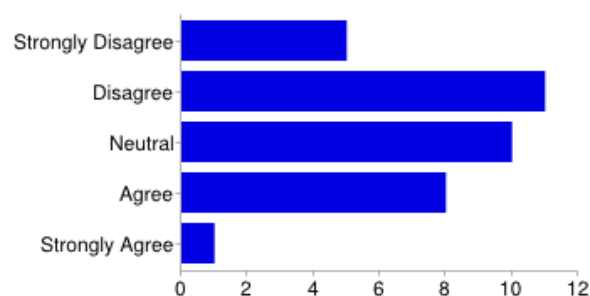
- Sharing content from a presenter during a presentation is a generally acceptable practice.
- It is not rude to tweet at while listening or participating in a conference.
- The backchannel enriches the experience.
- Mobile devices are a valued tool and can be left on.
- Twitter strengthens participants' networks and connections.
- Twitter provides resources that can be reviewed after the event.
- Opportunities to meet other backchannel contributors are and would be valued.
- Active engagement in the backchannel by presenters and keynotes would mostly be seen as valuable
- External participants in the backchannel can enhance the learning experiences
- The use of Twitter for housekeeping communications and by officially designated people

Figure 3: Responses to statements regarding use of Twitter at conferences

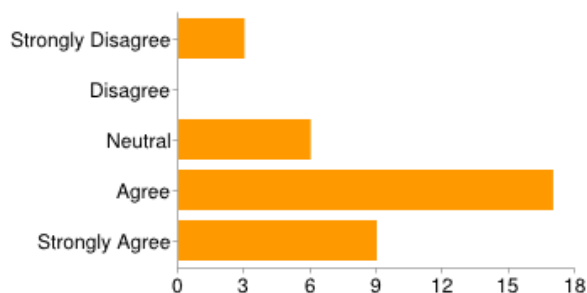
I find it distracting when tweeting and reading Twitter during a conference session or keynote.



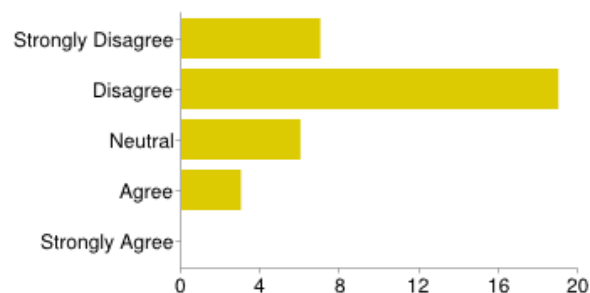
Some people tweet too many social and off task things to the conference hashtag.



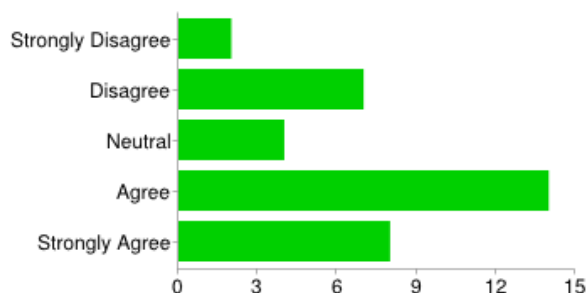
Conferences should display tweets in a visible place during keynote sessions.



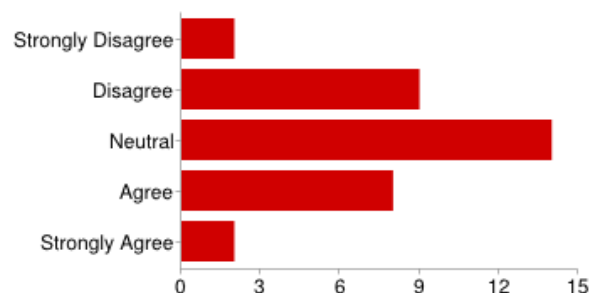
It is annoying when people who aren't at the conference tweet to the hash tag.



I would rather spend time talking to people in my Twitter PLN face to face than attend sessions that don't interest me.



The use of Twitter forms a divide between those who tweet and those who do not.



As shown in Figure 3, some statements met with a divided response, indicating that:

- Some participants find it distracting when they or others are using and reading tweets during a session or keynote.
- While generally a social use of Twitter is accepted it was felt that some people tweet too many social and off task things to the conference hashtag.
- There is some value in displaying tweets at the live event, although this should be considered with caution.
- There is some concern about the use of the hashtag from those not physically at the conference.
- Some participants value time with those in their network over attending specific sessions.

The statement with the most diversity of responses was “The use of Twitter forms a divide between those who tweet and those who do not”. A majority of responses were neutral and only a few indicated a strongly agree or disagree stance, so it could be argued that the statement itself was problematic or that opinions are yet to be determined in this area.

Limitations of the study

The use of Twitter as a data set and the ability to make generalisations from this study is problematic for several reasons as identified below:

- Only public posts that used the conference Twitter hashtag were analysed. Private conversations, replies and posts to other social media sites could not be included. We do not claim that the data examined was a complete representation of all the social media activity that took place.
- Whilst each event was held on a different year and location, this sequence of events was organised by the same national body and promoted to a similar group of educators.
- The researchers were event participants and significantly engaged. Whilst this provides a unique insight to any online engagement and behaviour, it must be acknowledged that this perspective could bias the reflections and data interpretation.
- Some users may not have been at the event or even in the same time zone. For the purposes of this research it will be supposed that every Twitter user who re-shared or posted a tweet was in some way engaged and contributing to the associated learning.

Conclusion

Although the use of Twitter as a data set presents limitations, it can be used to determine the place and prominence of messages exchanged. In addition, text analysis can be used to measure and help identify the volume and diversity of participants who tweeted during selected keynotes, nature of the ‘conversation’ and types of tweets shared. By adding personal reflections from the authors and other key tweachers, patterns and trends in the contributions over time can be further examined.

When people gather in one place to attend a conference keynote session, something important happens when they can influence each other. During the 2010 keynote, speaker Gary Stager presented some controversial and challenging ideas that were popularly retweeted (Gesthuizen, 2012). Online social media seems to augment the collaboration and sharing occurring during a keynote by amplifying the voice of distant participants across a room and beyond the event.

Social media and digital aspects of a conference can no longer be ignored and consideration must now be given towards how best to analyse, manage and integrate the technology into the event itself. Our results indicate that the use of a Twitter backchannel has evolved from a controversial activity between a few delegates to a conversational tone and expected part of a conference experience for many delegates. We observed a significant increase in the interaction between participants including the number of mentions and retweets. This is similar to Sopan et al. (2012),

who noted that an overall trend was to communicate with others including in-person and remote conference participants.

Our analysis provides a valuable insight into the online behaviour of educators at a major conference and that the trends observed can be broadly generalised to other similar events. It is only a snapshot of part of the picture. The data set used can be further interrogated beyond the scope of this paper. Future studies could use a more complete set of data and determine the social interaction before and after the conference as well. Greater insight would be provided though the use a more detailed analysis tool during the event and track how the nature of the interaction and conversation evolves over the lifespan of an event.

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ACEC2014 - TEACHERS CONNECTING WITH STUDENTS THROUGH GAMES

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Abstract

Most Primary students play digital games. For many children these digital games are an important part of their lives. How can we as teachers connect with our students about the games they play? How can we incorporate their gaming experiences into our teaching? How can we teach literacy in such a way that it includes critical gaming literacy?

In this paper I outline sections of a case study on what children aged 8-13 years know and want to talk about with adults in relation to digital gaming. I consider the importance of using discussions about gaming to connect with students and enhance their engagement with school learning.

An action research is then explored, explaining how I, as a classroom teacher, used lessons involving students in creating their own digital games. This section focuses on using lessons to build critical multiliteracy skills amongst the students as well as assisting them to develop cultural competencies and social skills. There is a specific focus on the skills of play and collective intelligence as they present in the classroom.

Today many of us play digital games. Almost all of our school students play digital games of some kind – on a computer, a gaming console, a tablet or a mobile phone. For many students these digital games are an important and time-consuming part of their lives. In doing the research (Gibbes 2012) for my doctoral thesis (and as a teacher and mother of three teenage boys) I wanted to find ways of connecting with students' gaming to enhance their learning. Throughout this paper I consider the overarching question: How can primary school teachers acknowledge and connect with students' personal gaming culture to build learning relationships and teach critical multiliteracy skills?

Digital gaming is an important part of the 'lifeworlds' (Kalantzis and Cope, 2004) of our students, having a large impact on many of their lives, yet gaming is rarely discussed or used in schools as a method of connecting with students or for teaching and learning. In addition, the teaching and use of critical gaming literacy skills seem to be non-existent in the educational lives of students. My purpose in doing my doctoral research was to be able to, as part of my dual leadership and teaching role, better support teachers in:

- building relationships with students around their gaming
- enhancing student learning through connecting with their gaming, and
- teaching students critical gaming literacy skills.

Children talking about digital gaming

I start by examining what primary school children were prepared to discuss in terms of digital gaming with a staff member in the school environment. In a Case Study undertaken in the school where I worked (Gibbes, 2012) I listened to twenty children from years 3-7 in small single gender focus groups as they answered my questions about the games they played and discussed the links between digital gaming and learning. Thirty two focus group interviews were held over the year of 2010.

All Year 3-7 students (110 students) in the school completed an initial questionnaire giving basic information about their ownership of computers and game consoles, their game playing preferences and their assessment of the time they spent gaming. These data were then used alongside interview and group discussion data to clarify similarities and differences of students in the case study to the whole

cohort of students, as well as providing me with further information about lines of questioning and issues for focus.

The analysis of the data demonstrated that all of the children had played digital games at some time and that over 90% of the children had gaming consoles in their homes. All of the 20 students in the focus groups demonstrated that they knew a lot about digital gaming and were eager to discuss and share this knowledge with adults, although two of the girls were slower to share their knowledge. The focus groups included children who were friends, children who did not know each other well and children who clearly did not like each other much. This resulted in some excellent discussions as the children questioned each other quite harshly at times, especially in considering the effect of violent games on their own behaviour. There was also power play in two of the five groups, with children taking on a range of roles including speaker, listener, questioner and summariser. The children all revealed a willingness to consider all questions asked and to reflect more deeply on their gaming experiences in response to these questions. The discussions clearly demonstrated how the topic of digital games provides opportunities to explore aspects of social relations, identity formation and power play in a safe setting.

Talking with the children in small groups provided the occasion for me to listen and respond to their interpretations, as well as opportunities for me to further shape their discussions and reflections by asking probing questions and encouraging them to consider their gaming through different lenses. Children reported many ways in which their gaming allowed them to play with identity representation, especially as they discussed avatars, gender and the ideological messages in games. These group discussions provided openings for children to reflect on, and talk about, issues such as physical fitness, learning, violence and family values.

Identity

A strong link between gaming and identity was clear throughout all of the interviews with the children. Gee (2003) outlined three identities in gaming – virtual, real and projective identities. The virtual identity is one's identity as a virtual character in the virtual world of the game. The real identity is the player's own identity as a person playing a computer game. The projective identity stresses the interface between the real world person and the virtual character as the player makes decisions about the kind of person they want the virtual character to be.

The children reported many ways in which their gaming allowed them opportunities to play with identity representation, particularly in their creation and use of avatars and their discussions relating to gender and the messages and values in games. Children often defined themselves and their position relative to others throughout their talk on games. Emily discussed her Mathletics avatar and how her decisions around the creation of this avatar were impacted upon by how she felt others would perceive her, displaying strong connections between her personal identity and the avatar.

Emily: I have like tried to make mine so it looks pretty because [my brother] has friends over for Mathletics and um he, they all go on my names and I don't like mine looking ugly when other people can see it. (from Transcript 12, Year 3/4 girls, 6/5/2010)

In the excerpt below Spartan117 outlines how he bases a soccer avatar on himself (small and from Adelaide), but gives the avatar excellent soccer skills. Spartan117 commented elsewhere that he has few sporting skills in real life and is working to develop these.

Spartan133: With Pro Evolution Soccer you can't make your own team but what I did I went into the Australian team settings because you can actually change what the players stats are and stuff and what they look like and what their names are and stuff... So I pretty much change Vadooka, the one who kicks my goals into a person called Spartan133. He's as small as you can get him and he's like, compared to all the other players he's tiny and ... I have him the lowest. He's the youngest age which

is about 15 or something and he's as small as you can get him which is about 2 foot something... So now he outruns everyone, now he never misses a goal as long as I press, do the right thing to kick the goal, um he never misses a pass. He always headers it, he has full stats, he can do everything. (from Transcript 8, Year 6/7 boys, 22/4/2010)

Students and teachers need to understand the ways in which identity formation is increasingly happening in virtual spaces (James et al. 2008). Virtual identity play can aid or undermine the identity formation process as it provides new tools and varied spaces for self-expression, self-reflection and feedback from others. It is important that teachers open discussions with students which enable exploration of how their digital participation “facilitates and detracts from the development of healthy, autonomous, and socially responsible identities” (James et al. 2008, p.19).

Values / Messages in games

Games and other media are not neutral or value free. They are shaped in certain ways and for certain purposes by the people who produce them, often being economically driven (Buckingham 2007a). “Consequently, the students’ sense of self, or personal identity, is open to influences from, and interactions with, many different groups that hold a range of beliefs, value systems and attitudes” (Anstey & Bull 2006, p.14). Games are a part of most children’s culture and their experience of this technology is often extremely different from that of their teachers, and sometimes of their parents. Koo and Seider (2009, p.1) suggest that digital games are different from other media forms as they have various ‘levers’ through which they influence worldview, values and behaviours of players, including scaffolding “players’ experiences not only via narrative and audio-visual content but by the rules, principles, and objectives governing what participants do”. In digital games, values are intrinsically embodied via the rules that control play. Games can act as ‘message transmitters’, as interactive systems controlled by rules and as ‘social practices’ in which players interact with each other (Croft 2011, p.9).

Mel: The Bratz games are giving you, like say if you want to go around and do make-up by yourself and learn how to put make-up on and learn how to do your hair. Also what they teach would probably be in one of the Bratz game, you try to not be sneaky and not being mean to anybody.

Emily: I reckon in this sort of like Bratz game you have to try and find a boyfriend.
(joint oooh)

Emily: And I don't actually really know if there are actually messages in the game 'cos I think they're just for fun. That's what like I think with all the stories - why does it have to be a message, they're just for fun.

R: Very true, though sometimes things that are fun still give you a message, like to me, the Bratz games are giving you a bit of a message about what they think a girl should be like.

Emily: So I should really look like that.

R: But do you agree with that message?

Emily: No way

(from Transcript 18, Year 3/4 girls, 20/5/2010)

Here Mel was able to identify how the Bratz games present the requirements of a female character – the need to maintain a femininity which displays beauty and ‘niceness’ or good behaviour, and Emily adds to this the requirement for girls to find a boyfriend. With support and questioning the girls were able to challenge the dominant view of femininity and Emily clearly stated that she would not want to be like that. The girls demonstrated their willingness and ability to engage in critical discussion with support and direction from the researcher.

As the groups of boys discussed the Grand Theft Auto games they demonstrated different attitudes and levels of involvement in the game. DT13’s commented about it being fun to partake of the game, but not for him in real life, which points to the comments Gee (2007) makes about games giving the

opportunity to experiment with identities and behaviours that you may never do in real life. However, some boys showed either an unwillingness to evaluate the game or an inability to consider the inappropriateness of these behaviours in real life. It was clear from the conversations with the children that stable beliefs and values were important to their ability to reflect ethically on games.

As James et al (2008, p.19) concluded, “Virtual identity play may provide youth with unique opportunities to develop healthy identities, but this outcome is by no means guaranteed”. Children need to participate in ethical reflection about the games they play and a supportive environment with constructive feedback from others is necessary to develop this. “Such abstract thinking requires certain cognitive and moral skills, including the ability to take different perspectives, think critically about possibilities, hypothesize about the future, and make connections between actions and consequences” (James et al. 2008, p.45).

Students did not expect me to understand their games, but were keen to engage in discussions about their home gaming experiences. They demonstrated eagerness to be perceived as experts, and an amazing willingness to consider complex questions about gaming and learning as well as considering ethical questions about gaming. This required me as a teacher to maintain a non-judgemental stance and to consider ways of asking questions that would expand students’ ability to reflect on their gaming in new ways.

Students creating digital games and learning multiliteracy skills

Following the discussions with children about their personal digital gaming experiences I moved on to consider “How can I as a teacher use lessons involving students in creating their own digital games in the classroom to teach critical multi-literacy skills?” I decided to plan and teach a series of lessons involving students in creating their own digital games to teach students critical multi-literacy skills. These lessons were undertaken with 4 Primary classes over 10 weeks, in 3 separate cycles (Gibbes 2012).

The Multiliteracies Map

The figure below shows the multiliteracies map (*Mapping multiliteracies: children of the new millennium* 2002-2004, p.146) which was designed to enable educators to plan, observe, analyse and assess children's development in each of the four quadrants.

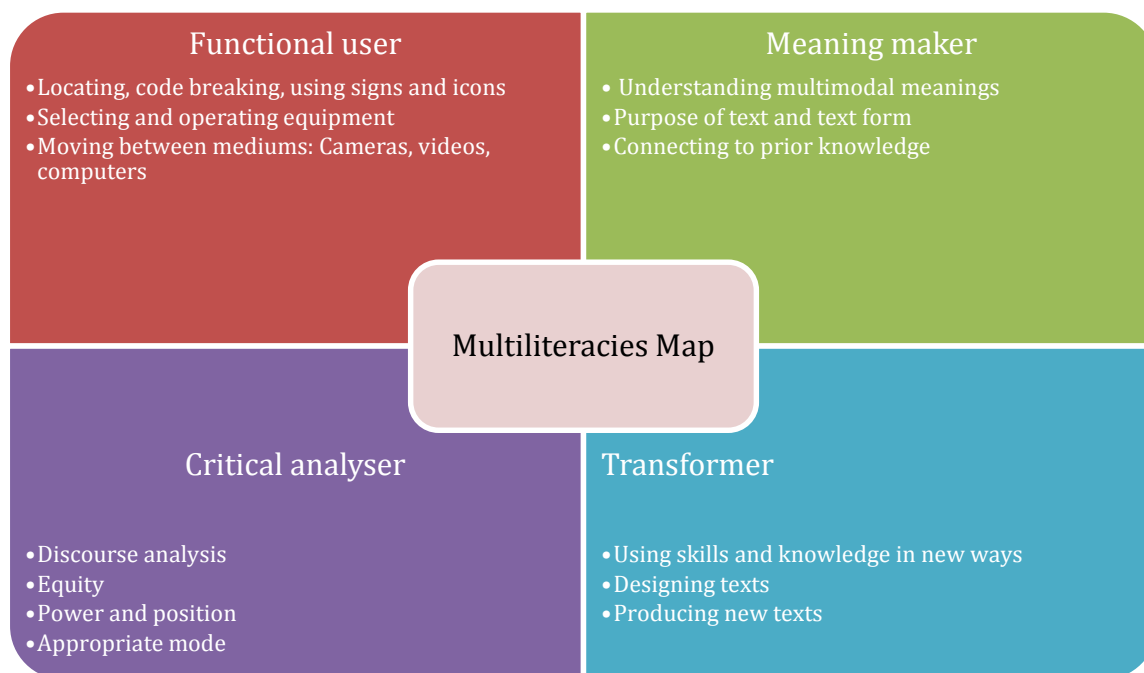


Figure 1: The multiliteracies map

Within the action research I planned to connect children's learning to their interests and lifeworlds (Kalantzis & Cope 2004), accessing their expertise and knowledge as related to digital gaming in order to build on their literacy skills within the areas of the Multiliteracies map. I used a blend of explicit instruction, exploration and problem solving as the students designed their own games. The students had to integrate the knowledge they already had from playing games into creating their own games.

The possibilities for game creation were initially limited by the need for students to focus on gaining functional skills both as computer programmers and as game creators before they could focus on more complex messages and visual literacy in games. This initial need to focus on functional technical skills was frustrating for students who wanted to be able to instantly produce work of the quality of the games industry. Part of my role was to provide ways their ideas for making meaning could work together with their functional skills. As students gained more skills and a more realistic view of what they could do, they were able to produce higher quality games.

Students developed many new skills as functional users, meaning makers, transformers and critical analysers in the process of creating their own games. Students were highly engaged and motivated by the game creation task and involved in constant consideration of their audience (the game player) as well as ongoing problem solving. About a third of the students in the first cycle of the research struggled to perceive themselves as game creators or programmers, blaming problems in their game on the computer itself or on the game. As students became more proficient game creators they began to develop a powerful understanding of "what programming is, how programmers make decisions, and how those decisions influence the ways the software and its users function" (Rushkoff 2010, p.134). Many of their games were able to be installed on the school server to be played by other students, providing students with an even better understanding of games as interactive, played by others and designed with purpose.

As they worked to incorporate explicit and implicit messages into the games they created, students began to examine other games more critically. Initially students showed little awareness of matters related to visual images and stereotypes. They needed explicit direction, support and focused questioning to

identify social and cultural impacts inherent in the games they played and created. As students improved their functional skills, and as I became more adept at having other students assist with the teaching role, I was able to focus more on this important role of the teacher as questioner; for example providing opportunities for students to examine, reflect upon and discuss visual stereotypes when working with the whole class or asking probing questions of individual students. I also established regular opportunities for students to provide feedback to each other within a structured environment, and over time this became an excellent opening for students to question the messages in, and visual impact of, each other's games. Some students were also able to identify representative details of the games created in class, more critically analysing some of the imagery used and some of the sounds selected. As one student stated in a class discussion, "Not all bullies look the same. Sometimes bullies can look nice."

All students began to learn and utilise metalanguage as they created their own games and analysed each other's games, providing opportunities for more critical discussions incorporating concepts such as genre, view, stereotypes and imagery. The development of language, combined with probing questions and time for reflection, provided students with the framework for analysing games in ways they had not considered previously. As we progressed through the cycles of the research, students definitely became able to use more critical gaming literacy skills both in their analysis of their own and other students' games, and in their discussions about digital games they played at home. Students continued to positively surprise me with their willingness to engage in critical gaming literacy tasks and discussions.

Violence in gaming was an ongoing theme raised by the children. Some students wanted to incorporate shooting into their games. It was important to me that students were not ostracised from the school task of game creation because they wanted to include guns, and I discussed with them our school values and the inappropriateness of violent or gory images in the school environment. Almost all students were able to negotiate acceptable ways of including guns (for example, using water pistols) in their games. These discussions with the individual students were extremely valuable in allowing me to better understand their out-of-school experiences and in opening opportunities for deeper discussion with students about values and issues related to gaming and violence while attempting not to make judgements that would exclude them from the task. These discussions provided students with deeper awareness of cultural and societal issues and increasing critical multiliteracy skills as they reflected on the games they played and created.

Cultural competencies and Social Skills

Jenkins et al. (2009, p.4) outlined how most new literacies entail social skills developed through collaboration and networking and that these skills "build on the foundation of traditional literacy, research skills, technical skills, and critical analysis skills taught in the classroom". They argued that this set of cultural competencies and social skills should be fostered in schools:

- Play — the capacity to experiment with one's surroundings as a form of problem-solving
- Performance — the ability to adopt alternative identities for the purpose of improvisation and discovery
- Simulation — the ability to interpret and construct dynamic models of real-world processes
- Appropriation — the ability to meaningfully sample and remix media content
- Multitasking — the ability to scan one's environment and shift focus as needed to salient details.
- Distributed Cognition — the ability to interact meaningfully with tools that expand mental capacities
- Collective Intelligence — the ability to pool knowledge and compare notes with others toward a common goal
- Judgement — the ability to evaluate the reliability and credibility of different information sources
- Transmedia Navigation — the ability to follow the flow of stories and information across multiple modalities
- Networking — the ability to search for, synthesize, and disseminate information
- Negotiation — the ability to travel across diverse communities, discerning and respecting multiple perspectives, and grasping and following alternative norms

Many students are already gathering these skills through their affiliations with participatory culture and their informal learning with new literacies. However, we need to engage students in critical dialogues that assist them to express more deeply their instinctive understandings of these experiences. As students created their own games they gained deeper understanding of how games work and opportunities to more formally develop and use the above skills. Here I focus on two of the skills most important for us as a group working on learning to create our own games and develop critical literacy skills – play and collective intelligence.

Play

Play is always personal and was evident throughout the action research. Through play the students learned many skills that they could apply to tasks later, including skills in using computer programs as well as literacy and numeracy skills. When children play games they are highly motivated to achieve the outcomes within the game, even if that involves doing repetitive, even boring, activities in the process. As a teacher I tapped this motivation about playing games as the children created their own games.

The unit was structured around the opportunity for students to play games created by other students as well as to create their own games and play them while searching for issues and problem-solving. Part of what makes play valuable as a mode of problem-solving and learning is that it lowers the emotional stakes of failing: players are encouraged to suspend some of the real world consequences of the represented actions, to take risks and learn through trial and error (Jenkins et al. 2009, p.23).

Collective intelligence

Throughout this Action Research it became obvious that the game creation tasks included opportunities for every student to know something that they could share with the group. No one student was able to know everything, and neither was I as the teacher. I had to constantly reflect on my role as the teacher, becoming more of a curriculum director and supporter for learning and less of the expert or upfront lecturer. I had to consciously focus on inviting students to explain solutions or ideas to the class and to each other. It became important for me to restrict my time at the front of the class and focus on moving amongst the students, working with small groups or providing access to written information or internet tutorials for learning extension. Inviting students to demonstrate their games regularly helped with this, especially as they then selected students to give them feedback. These sharing times gave the demonstrator ideas for improving their game and often resulted in students asking the demonstrator for specific assistance.

As a collective community we learned an incredible amount about game creation. As individuals or groups acquired new skills or discovered new options they shared these around the class and with me, sometimes individually and sometimes to the whole group. Ideas and questions raised learning opportunities for all of us to develop our skills well beyond where they were at the beginning of the research.

Conclusion

Changing our teaching to incorporate digital literacy in deep and meaningful ways involves “new kinds of communicative relationships between students, and between students and their teachers, and in this sense digital literacy can have a destabilising effect on traditional classroom routines” (Merchant 2009, p.38). This could be threatening for teachers who may be restricted by their level of technological skill, their willingness to take risks in learning new skills, or the change in teacher student relationships. While I began these lessons as a beginner in terms of my own programming skills, I have developed my skills and have been taught many new techniques by the students. I have been prepared to take risks in my own learning and been willing to tell students that I don’t know the answer, sitting with them to trial and learn alternative ways to solve the problem. As many of the students in the school have learned alongside of me, we now have a ‘pool of experts’ and this can cause other teachers some angst as they attempt to

help students with the task while realising that they know less than many students in the class. I know that for me the change process took time, and is still progressing.

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APPRAISING MOBILE MATHS APPS: THE TPACK MODEL

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Abstract

The purpose of this study was to develop an instrument for appraising educational apps in mathematics education. The instrument allows mathematics related apps to be analysed based on the three aspects of the TPACK (technological pedagogical content knowledge) model, namely, content, technology and pedagogy. Four sub-scales were created with the first one examining the app role according to the type of task promoted: explorative, productivity and/or instructive. The second sub-scale appraises the degree of cognitive involvement when a learner interacts with the app. The third and fourth sub-scale deals with general pedagogical and operational affordance. The instrument framework was piloted and subsequently trialled with ten school teachers and mathematics educators to ensure content validity. It was further endorsed with examples of educational apps currently available in the context of the secondary curriculum.

Introduction

This article describes the conceptual framework underpinning the design of an instrument aimed at assisting teachers in appraising mobile apps related to the teaching and learning of school mathematics. In the past 30 years, technology has changed. Apart from the change in technology, learners' profile has changed a lot. Today's learners are mobile. They demand access to the learning material and information anytime and anywhere. Use of mobile devices such as tablets and smart phones to access information is wide spread. This makes it critical for teachers at all levels to re-examine how learning materials are designed and delivered for the new generation of mobile learners (Ally, 2007).

Various instruments which mostly appear on the WWW have been developed to appraise the quality of educational apps but they do not provide evidence of being grounded in educational theory and do not discuss their conceptual constructs (Watlington, 2011). Besides their ad-hoc design, most of them present a uni-dimensional structure foundation and are not discipline specific (Kearney, Schuck, Burden & Aubusson, 2012). This paper describes the rationale for an instrument based on the TPACK (technological pedagogical content knowledge) model initially elaborated by Mishra and Koehler (2006).

It is only in the past decade or so that researchers in the area of mobile learning (henceforth referred to as m-learning) seriously considered the need for some theoretical framework for m-learning. As discussed in the literature review section, there are several frameworks around learning through mobile technologies. Different frameworks provide different contexts for m-learning. The literature around m-learning identifies the correlation between the role of mobile technology in learning, that is, how mobile devices can help learners and enhance and enrich their learning experience.

The literature review in this paper examines a number of theoretical considerations on m-learning. It reviews some quality design principles introducing the TPACK model as the theoretical framework to embed those attributes. The resulting maths app appraisal instrument (please see Appendix) reflects such criteria for assessing mobile applications in primary and secondary mathematics education within a pedagogical and operational context.

Literature review

Use of mobile learning applications

In general, mobile handheld devices differ from other tools such as laptops because the latter, although portable, are typically not small and light enough to carry around. The term mobile devices is commonly applied to smartphones and tablet PCs although other portable hardware can fit into that category devices such as CD-ROMs and DVDs, flash storage devices/drives, Global Positioning Systems (GPS), laptops or notebooks, mobile computers, MP3 players, Personal Data Assistants (PDAs), portable media players and portable video game devices.

Mobile applications, commonly know as apps, can provide more or less structure to facilitate or scaffold the collection and presentation of data by students or groups of students. An app is an application capable of running in mobile devices. These self-contained programs are endowed with various technical and pedagogical affordances. For example, they are multimedia based with audio, image and/or animation functionalities.

In addition, some apps automatically aggregate and visualize data about students' learning (e.g. their responses to questions) for teachers to examine (Vahey, Roschelle & Tatar, 2007). Their capacity of representing complex mathematical concepts, process and procedures has been highlighted for an increasing body of research in the past ten years (Handal, El-Khoury, Cavanagh & Campbell, 2013). At low cost or sometimes free of charge, these applications are linked to the internet allowing multiple learning and teaching experiences such as simulations, collaboration, document-sharing, online testing, audio/video-recording, m-blogging, surveying, presentations, note-taking, digital-story telling, social networking, email and geo blogging.

Mobile applications differ on how rich (complex) or lean (less complex) their contents are conveyed. Leaner applications only present a limited set of content, typically well-structured to facilitate certain kinds of behaviour and communication. Also, mobile applications, or more precisely, the activity built around mobile technologies, could differ on the degree of interactivity required between students and the tools (Parsons, Ryu & Cranshaw, 2007). Some activities require students to interact more intensively with the tools. Again, some activities require students to interact more with their peers rather than with the tools (Geddes, 2004).

M-learning frameworks

Mobile learning is an instructional mode that results from the interface between individuals and handheld technologies creating a specific educational environment. Various authors have suggested the advantages brought by mobile devices into school education which, in a way, make m-learning different from other instructional delivery modes (Traxler, 2009). Their ubiquity and mobility make m-learning more situated and unique. Other particular m-learning features include connectivity scope and structure, data collection by students, student data aggregation, content richness, interactivity and collaboration (Peters, 2005; Geddes, 2004; Parsons, Ryu & Cranshaw, 2007).

With connectivity scope, mobile devices and applications can be set to allow local communication within the classroom, or narrower still, within groups, through Bluetooth or Wi-Fi. Alternatively, they can be set to allow communication with others beyond the classroom and access information on the internet as collaboration is considered an important aspect of the m-learning. Similarly, students can be connected directly only to the teacher (i.e. to a central device that the teacher has access to), and indirectly to other students via the teacher. Alternatively, students can be interconnected directly to one another (Roschelle, Vahey, Tatar, Kaput & Hegedus, 2003).

A number of theoretical models have been developed to explain m-learning as an instructional approach. Their attributes are useful to characterise quality m-learning design principles. These design principles can be applied to the learning situation itself as well as in the construction of effective educational apps.

Most authors agree that an m-learning framework, should be able to describe pedagogy along with mobile technologies (Koehler & Mishra, 2008; Roschelle, Rafanan, Estrella, Nussbaum & Claro, 2010; Roschelle, Shechtman, Tatar, Hegedus, Hopkins, Empson, Knudsen & Gallagher, 2010).

A commonality across these frameworks is their multi-dimensionality allowing for complex realities within the m-learning construct (see Table 1).

Table 1: Main m-Learning frameworks dimensions

<i>Authors</i>	<i>Dimensions</i>
Danaher, Gururajan and Hafeez-Baig (2009)	Engagement, presence and flexibility
Koole (2009)	Device aspects, learner aspects and social aspects.
Kearney, Shuck, Burden and Aubusson (2012)	Personalisation, authenticity, and collaboration
Peng, Su, Chou and Tsai (2009)	Learners and tools, pedagogical methods (constructivism and lifelong learning theories), a vision
Pachler, Cook and Bachmair (2010)	Structures, agency and cultural practices
Koehler and Mishra (2008)	Knowledge, pedagogy and technology

A review of the above frameworks reveals that the pedagogy and theories of teaching and learning may need to change in the perspective as a result of the emergence of m-learning particularly on mobile literacy. Some of the themes coming from those frameworks and related literature include a new literacy where participation is considered as a part of cultural practice (Pachler, Cook & Bachmair, 2010). Also, teaching and learning is becoming more informal (Seipold & Pachler, 2011) with elements of situatedness, collaboration and problem-solving along with strong focus on knowledge building (Geddes, 2004) and meaning-making (Roschelle et al., 2010a). The authors see the notion of mobility not just as *moving* (Traxler, 2009). Mobility is seen in context with space, time, activity, relationships, curriculum and engagement (Kearney, Shuck, Burden & Aubusson, 2012; Pachler, Cook & Bachmair, 2010). Users are encouraged to generate their own content and context for example aided by the mobile devices that allow ubiquity, choice and knowledge appropriation (Pachler, Cook & Bachmair, 2010).

The TPACK model

The TPACK model developed by Koehler and Mishra (2008) is described below with its three dimensions: technology, pedagogy and content. While recognising the advantages of the aforementioned models in terms of their various dimensions, this study chose the TPACK framework as the main theoretical framework to underpin the design of an app appraisal instrument. In arriving to at such a decision the authors considered TPACK capacity as a theoretical tool to include the subject area and specific mathematical concepts and processes.

Several instruments have been developed using the TPACK framework in order to examine a wide range of variables in the context of mathematics education. These include assessment (Schmidt, Baran, Thompson, Mishra, Koehler & Shin, 2009), students' achievement (Lyublinskaya & Tournaki, 2011), teacher education (Lee & Hollebrands, 2008), teachers' eLearning skills, professional development (Niess, van Zee & Gillow-Wiles, 2011), teachers' attitudes towards technological and pedagogical skills (Handal, Campbell, Cavanagh & Petocz, 2012), curriculum development (Niess, Ronau, Shafer, Driskell, Harper, Johnston, Browning, Özgün-Koca & Kersaint, 2009), among others.

Considering TPACK's use in previous research and through the development of these instruments it was considered that TPACK be the best instrument to use in this situation. For example, the FRAME Model by Koole suggests that "mobile learning experiences are viewed as existing within a context of information" (Koole, 2009, p.26) thus, the learner is consuming and creating information. The limitation

of this model is that there is no pedagogical inclusion as its three parts include device, learner and social aspects, but there is no aspect for the teacher or teaching. Similarly, the framework of ubiquitous knowledge construction proposed by Peng et al. (2009) considers learners, tools, and learning theories such as constructivism but does not directly address pedagogy. However, the authors do advocate that, “Educators should take a proactive stance towards emerging technology and become integrally involved in the development, as well as the evaluation, of pedagogically sound educational tools.” (p.178). The instrument developed in the present study is designed to facilitate such a process.

Kearney et al. (2012) and Pachler, Cook and Bachmair (2010) both provide a pedagogical perspective on mobile learning to assess lesson activities and pedagogical approaches from a socio-cultural perspective. Kearney et al. (2012) identify three characteristics of m-learning pedagogy in their model: personalisation (learner agency and control), authenticity (situated learning experiences), and collaboration (connections to people and resources). Pachler, Cook and Bachmair’s (2010) model is based on agency (students’ ability to engage with technology), cultural practices (norms and practices of students’ everyday lives) and socio-cultural and technological structures. However, both studies are not primarily concerned with the evaluation of tools and devices so while they offer important insights into pedagogical practices the models they propose are not of direct relevance to the present study.

Danaher, Gururajan and Hafeez-Baig (2009) is a framework based on mobile learning and teaching environments at university level and it uses three items which are engagement, presence and flexibility. This is limited in that the context and technology are not taken into account. The authors of the model acknowledge that there are future research directions for their model and although their research suggests there are strategies that work in fostering student engagement and flexibility in using mobile learning in teaching they realise their model has some limitations.

TPACK constitutes a conceptual framework that is valuable because it integrates three dimensions in using ICTs in teaching and learning, namely, pedagogical knowledge, technological knowledge and disciplinary content. Pedagogical knowledge (PK) represents teachers’ understanding of evidence-based quality teaching as well as expertise aiming at enhancing students’ experiences and therefore learning. In turn, technological knowledge (TK) represents those operational capabilities that teachers need to deploy technology. Content knowledge (CK) stands for teachers’ acquaintance with the subject matter, more specifically, expertise in a particular branch of learning that qualifies them as professional in the field.

The interaction among PK, CK and TK renders three singular constructs: technological pedagogical knowledge (TPK), technological content knowledge (TCK) and pedagogical content knowledge (PCK). TPK is knowledge about the link between technologies and pedagogy, that is, the selection and application of technology in the context of a particular instructional approach. For example the ability to use technology to develop students’ research skills, or using it to provide students with alternative forms of assessment. TCK deals with understandings about using a specific technology in a mathematical context such as making calculations on a spreadsheet or using computer algebra software. Furthermore, PCK represents the integration of pedagogy and content such as the ability to teach mathematics effectively to schools students.

Figure 1 shows the various elements of the TPACK model.

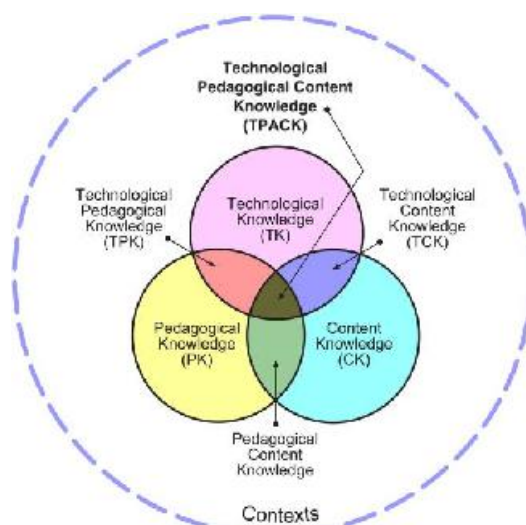


Figure 1: the TPACK model
Source: <http://tpack.org>

The intersection of these three fields yields the area known as technological pedagogical content knowledge (TPACK). It represents the full and seamless blending of knowledge about technology along with the appropriate deployment of suitable pedagogies related to a specific learning objective within the school mathematics curriculum. Such space provides a reflective place to explore how the three dimensions interact with each other to ensure that learning and teaching with technology and within knowledge content takes place at its highest level (Handal, Campbell, Cavanagh, Petocz & Kelly, 2013).

M-learning applications, commonly used as apps, can be comprehensively analysed through the TPACK model. Looking through the TPACK lenses, apps can become powerful tools in the hands of teachers and students. Teachers can use them for enacting effective curriculum experiences with great creativity and depth while students can actively engage in meaningful learning becoming producers rather than consumers of knowledge. Hence, the need to promote awareness of these tools within the school setting so that teachers and students can be cognizant of their benefits in teaching and learning. TPACK, due to its three dimensions, can become the vehicle through which apps can be appraised based on their own pedagogical affordances, technical capabilities and content delivery. This paper elaborates on these three themes.

On developing a TPACK model to appraise educational maths, this paper argues that pedagogical knowledge (PK) can be represented by the level of cognitive engagement facilitated as well as by the general instructional facilities offered by the app. In turn, the quality of technological knowledge (TK) embedded in an app as a piece of school software can be corresponded to their ability to evidence efficient interface design, navigation and control. Finally, the app ability to render the subject matter for specific mathematical purposes can be equated to the content knowledge (CK) component. The intersection itself from these three TPACK components leads to establishment of a *summa samarium* zone; where mathematical knowledge is creatively taught by the teacher and efficiently cognated by the student through the technology.

The Maths app appraisal instrument

The development of the maths appraisal instrument (see Appendix) was informed by the literature as outlined throughout the paper with emphasis on the TPACK model. The instrument is divided into four parts. The introduction requires teachers to identify the primary role of the app. There are four subscales. The first sub-scale dealing with the structure of each task through three item sets (e.g., explorative,

productivity and informative apps). The other three sub-scales relate to cognitive engagement, pedagogical and operational issues. Table 2 shows the link between sub-scales and components from the TPACK.

Table 2: Relationship between TPACK components and sub-scales

<i>Sub-scale</i>	<i>TPACK component</i>
Task structure	Technological Pedagogical Content Knowledge (TPACK)
Cognitive engagement	Pedagogical Content Knowledge (PCK)
General Pedagogical issues	Technological Pedagogical Knowledge (TPK)
Operational issues	Technological Content Knowledge (TCK)

Responses to semantic items give the users the opportunity to select four options: *Always*, *To some extent*, *Never* and *Not applicable*. Instructions emphasise that there are no right or wrong answers. Icons of representative apps by task structure are shown to provide an element of visual imagery to respondents.

The maths appraisal instrument was validated with ten academics and secondary mathematics teachers from the Sydney area are to ensure clarity and meaning of the semantic items as well to guarantee content validity.

The task structure sub-scale

This sub-scale section refers to three main types of apps task structures, namely, exploration, production and practice and information. The TPACK notion was represented by the task structure sub-scale of the instrument because the semantic items describe a construct combining technology, pedagogy and content. Task structure elements relate to the teacher's deep knowledge about how best to use m-learning apps in developing students' understanding of the subject matter of mathematics. Identifying the task structure of the app raises the teacher's awareness of how the app's instructional roles can support and enhance different aspects of student learning. The task structure subscale therefore identifies the complexity of the inter-relationships between m-learning apps as technological tools, the mathematics content they include, specific teaching practices aligned to exploration, production, or practice and information, and student learning. Task structure brings into play an amalgam of the teacher's mathematical and technological content knowledge along with the choice of appropriate pedagogical approaches which the teacher selects based on the particular instructional role of the app.

In appraising m-learning apps it is vital to understand the instructional role that the each plays in mathematics education. Handal, El-Khoury, Campbell and Cavanagh (2013), based on Goodwin's work (2012), developed a framework to categorise apps for the type of task promoted as the learner interacts with the interface. The framework permitted a no "one-size-fits-all" approach to look at how apps can be delivered in the curriculum. Apps were assumed to have a particular instructional design structure depending on any of three instructional roles addressed (explorative, productivity and instructive roles).

The task structure sub-scale explores these three roles (Goodwin, 2012). The three groups were initially identified as common role characteristics. Explorative apps are useful for exploring and demonstrating mathematical models or concepts through manipulating objects that mimic or simulate complex physical situations (Botzer & Yerushalmy, 2007). These apps are designed to mirror a real-life situation and students can enter their own data as well as visualise changes in the model (Baya'a & Daher, 2009). Explorative apps embed a degree of ambiguity and uncertainty embedded in the task to encourage problem solving. The exploration is guided within a predetermined learning discovery framework which promotes personal investigation. Depending on the openness of the task, problem solving is actively promoted as well as students' research skills and their ability to conjecture, hypothesise and predict. Exploratory apps are very student-centred as students can pose their own problems and investigate possible solutions leading to deep learning.

Productivity apps are more centred on the tool itself and embed an authoring aspect. These are apps useful for measuring and graphically representing objects or concepts in 2D/3D, collecting data, making calculations, or creating multimedia materials which make students producer of mathematical content (Franklin & Peng, 2008). Through these apps students can creatively come up with their own design and/or concept. These apps allow users to represent mathematical content by linking symbolic, numerical and graphical data. Usually, the app guides student in creating their own content/understandings. A great advantage of these apps is that they can represent or present mathematical content using a variety of digital tools (e.g., audio/video recording, measuring devices, etc). Frequently, app tools are intuitive and easy to use. Ideally, these tools would present an interpretive space for the learner to reflect on the activity done. At the highest level of instructional design, a productivity tool should encourage students assist to come up with new conceptual or procedural knowledge through hands-on experiences.

In turn, instructive apps are useful for practicing content through drill exercises, acquiring new skills through questions and answers (tutorials) or retrieving factual information which is a role traditionally supported by mathematical software (Handal, Handal & Herrington, 2006). Generally, these apps contain a variety of different activities/exercises and provide students with feedback with various degrees of meaning. It is expected that not only summative but formative feedback during the questions and answers process is provided to promote deep learning and help students in developing their maths problem solving skills. Ideally, instructive apps should engage students in critically analysing online content texts or images within real-life situations (Kearney & Maher, 2013). Similarly, a good instructive app would also require students to be able to demonstrate their mathematical understanding rather than engage in rote-learning text-like formats (Kurz, Middleton & Yanik, 2005). It should also let students acquire mathematical content in a variety of different ways with a non-linear navigation. Preferably, the content should be meaningful, fostering engagement and rich problem solving. Similarly, activities/exercises should cater for a range of student ability levels and should be graded and summary data provided (Handal & Herrington, 2003).

All of the above task structure concepts were embedded in the sub-scale items portraying the ideal combination of content, technology and pedagogy in specific mathematical educational contexts.

The cognitive engagement sub-scale

The Cognitive Engagement sub-scale section of the appraisal instrument was guided by the pedagogical content knowledge (PCK) because it leans more on general pedagogies of teaching rather than on subject specific matters. PCK is important as it teachers need to have both content knowledge and pedagogical knowledge when teaching. For the purpose of this sub-scale PCK is the teacher's ability to appraise a maths education app based on its pedagogical and content capacity and for their capacity to foster student's cognitive engagement. PCK is rendered in the sub-scale by the cognitive elements of the reviewed Bloom's taxonomy (Anderson & Krathwohl, 2001).

The measure of a student's cognitive engagement turns out to be a critical m-learning aspect as in many cases apps are of small educational value being the equivalent to a rote learning activity, with little problem-solving, or paralleling a bell-and-whistle multimedia spectacle barren from meaningful learning (Shuler, 2012). When learners are in m-learning situations, they would ideally interact with their mobile devices in a way that is pedagogically productive. M-learning should be student-centred and put the individual first because what is mobile is actually the learner not the device (Traxler, 2009). Educational technology, in general, should be used when no other teaching strategy can provide a better educational experience.

Hence it is crucial for the application/software to have high levels of cognitive interactivity to engage learners. Such levels of cognitive interactivity could be seen in the context of Bloom's taxonomy where in learners are engaged at various levels of achievements. Due to its bearing in rendering differential

assessment items as well as for its capacity to conceptualise curricular learning outcomes the Bloom's taxonomy has been extensively used in mathematics education (Webb, 2013)

Anderson and Krathwohl (2001) revised the Bloom's taxonomy (Figure 2) narrowing down to six domains, namely, remembering, understanding, applying, analyzing, evaluating and creating. The framework provides a context for measures of cognitive engagement which could be articulated smoothly to m-learning.

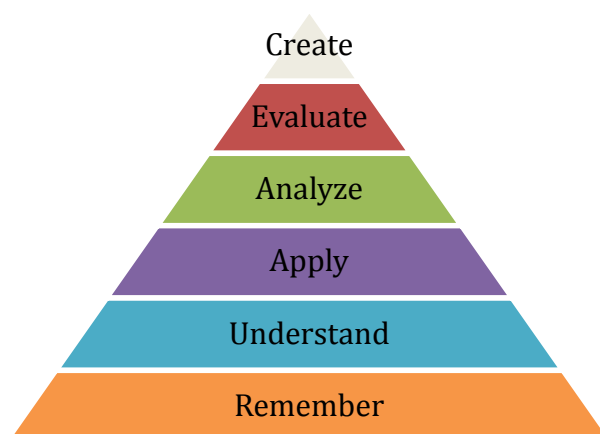


Figure 2: Revised Bloom's taxonomy

Such a scheme can be represented in terms of levels and definitions as follows reflecting the extent to which the app, in a math education context, encourages students to move from lower levels such as remembering facts to higher levels like creating knowledge. Table 3 represents this continuum of cognitive engagement related to the use of technology in mathematics education. Those definitions were incorporated in the cognitive engagement sub-scale.

Table 3: Levels of cognitive engagement

<i>Level</i>	<i>Definition</i>
Remembering	retrieve and review mathematical concepts/skills/procedures
Understanding	demonstrate understanding of mathematical concepts/skills/procedures
Applying	apply their knowledge of mathematical concepts/skills/procedures in practical contexts
Analysing	critically analyse mathematical content in text, graphs and/or animations
Evaluating	appraise and justify mathematical ideas or products
Creating	construct new and meaningful mathematical ideas or products

The general pedagogical issues sub-scale

The General Pedagogical sub-scale was represented by the technological pedagogical content knowledge (TPK) component of the TPACK model (see Appendix). The ten sub-scale semantic items represent teachers' understanding of general pedagogical competences that technology should promote. It centres on instructional capabilities that the app would enhance to enrich the student experience and promote learning. In a way, these capabilities require linking technology and pedagogy at a more general

level such as processes, practices and methods of teaching and learning. In an app context, TPK reminds the teacher to select those that facilitate the general outcomes of instruction.

For example, the sub-scale semantic items portray the idea that when students are encouraged to design their own problems they learn to think mathematically about the world around them. Such a competence moves them from being passive recipients of information to creators or co-sharers of a body of knowledge (Reys, Lindquist, Lambdin & Smith, 2008). There are documented instances when, for example, students are requested to create examination items or create an investigational project plan (Luxton-Reilly & Denny, 2010). This also leads to the issue of giving students control over their learning rather than placing such exercise in the hands of rigidly designed curricula and content usually portrayed by textbooks (Zoric, Cindric & Destovic, 2012).

The sub-scale items provide credit to cross-curricular knowledge. This is an important TPK element that adds to quality teaching because it gives the possibility to apply mathematical knowledge from a confined subject-matter niche into other branches of learning. There is certainly great pedagogical reward in extending students' mathematical knowledge across the school syllabus such as geography, history, science and the like (ACARA, 2012). Other aspects of good practice, acknowledged by the sub-scale, include the provision of differential activities for various levels of achievement through increasing levels of difficulty (Tucker, Singleton & Weaver, 2006). All the above attributes are applicable in m-learning when it is considered an instructional resource within the curriculum.

Some apps allow for collaboration such as in classroom learning response systems where students see what others share as well as their understanding and/or misunderstandings. This principle can also apply to group-based scenarios is similar to classroom response systems, in that the teacher presents short problems or multiple-choice questions using mobile devices. But instead of asking students to individually input their responses, the teacher gets students to work in groups to solve the problems. In addition, through collaborative data gathering, as acknowledged in this sub-scale, students can use mobile devices to collect, aggregate and present data. The analysis and presentation or visualization of the data is typically performed automatically by the device/application. This allows students to focus on discussing the meaning of the data/findings in the context of inquiry-based learning (Vahey, Roschelle & Tatar, 2007; Spikol & Eliasson, 2010). Finally, the general pedagogical issues sub-scale also allows examining the app capacity to show a reading level appropriate to the student's level as well as its ability for saving and keeping students' work in order to resume incomplete tasks or just simply to monitor performance.

The operational sub-scale

The Operational sub-scale of the appraisal instrument was informed by the TPACK Technological Content Knowledge (TCK) component (see Appendix). The TCK ensures teachers to have balance between students' capabilities around the use of technology (such as understanding navigation, what is expected in what fields and so on) and what s/he wants to achieve (for instance what kind of data he wants to gather). This leads to many more operational aspects that a teachers needs to be aware of while selecting the app. These aspects could include what is there in the app that encourages students to redo the task if it is not done correctly at first? Does the app allow any reinforcement? Does it allow for repeating the task? What is there in the app that allows students to self assess? More generally we could call it interface design combined with knowing the nature of the content and understanding of the learning goals. Even though we can separately correlate component of TPACK with various subscales, at broader level the components merge to paint a holistic picture.

The ten sub-scale semantic items deal with the app technical and operational technical affordances. Very little research has been conducted in this area with most of the perspectives coming from the literature on evaluating general educational software (Watlington, 2011).

There are also calls for letting students alter its settings to customise the app to their needs and be provided with helpful technical instructions to the user (Rosenthal-Tolisano, 2012). These additional features might include a Help function and a supporting web page providing additional useful information. Instructional designers also suggest checking for the app capacity to easily importing a range of media (audio, video, image, text, animations) and presenting an uncluttered display which is visually stimulating. New mobile functionalities now allow an interface with the broader online environment (e.g., Facebook, wiki, blog, Twitter) and allows file sharing, streaming of content and/or online communications (Schrock, 2012; Shuler, 2012).

Conclusions

The rapid inroads of mobile apps into the school maths curriculum during the past ten years made more compelling the need to evaluate systematically the deployment of those applications in teaching and learning. Mobile devices like smartphones and tablets began making a strong presence in school settings as personal tools for communicating and accessing information instantaneously. Later, due to its ubiquitousness and multimedia capabilities, these devices, once born for more general purposes, have become an essential element of school life.

Their integration with the curriculum is gaining momentum as their pedagogical affordances are being explored, discovered and utilized more systematically. Such is their popularity that within a short period of time these devices are aggressively competing for curricular space with long-standing tools such as laptops, desktops let alone the traditional computer lab.

The coming of mobile devices have brought, however, an astonishing number of apps into the market. It is claimed now that, as we write, over a million applications have been developed only on the Apple platform (148AppsBiz, 2012). In such a short period of time academics have also advanced our understanding as how these devices and their applications can be productively utilized to enhance the student experience. This has resulted in the formulation of various frameworks emphasizing diverse m-learning conceptual models whose empirical implications and validation remains a challenge for future researchers.

This study is the first known attempt to develop an instrument for appraising educational maths apps. The four sub-scales semantic items were drawn from the literature and validated with maths educators from schools and universities (see Appendix). A distinctive feature of the instrument was the appraisal of educational apps according to their instructional role in maths education. The instrument also characterised various levels of cognitive engagement, pedagogical issues as well as surface features, interface design, navigation and control.

The TPACK model was chosen as the conceptual framework because of its potential to integrate technological content knowledge (TCK), technological pedagogical knowledge (TPK) and pedagogical content knowledge (PCK). Due to its various dimensions the model lends itself well to understand the instructional design of an app from multiple technical pedagogical dimensions. As a result, the instrument embeds an evidence-based methodology acknowledging an app capacity to render differential degrees of task structure, cognitive engagement, pedagogical and operational affordances.

The next stage of this research will consist of a qualitative study to determine teachers' inter-rater reliability of the instrument using a larger sample. It would also look at other understandings that teachers bring to the process of selecting an appropriate app through observations and interview studies. As such, the prospective study will bring more closely the environment and context variables within the research equation.

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Acknowledgement

All images were sourced from the Apple Store at www.apple.com/itunes

Appendix

Appraising Maths Apps

Maths apps are created to serve specific roles in teaching and learning across the school curriculum. Depending on their role maths apps can be classified either as explorative, productive or instructive, or as a combination of one or more of these.

Explorative apps: for exploring and demonstrating mathematical models or concepts through manipulating objects that mimic or simulate complex physical situations, e.g.:

Sketchpad Explorer



Move the Turtle



Weighing



Productivity apps: for measuring and graphically representing objects or concepts in 2D/3D, collecting data, making calculations, or creating multimedia materials, e.g.:

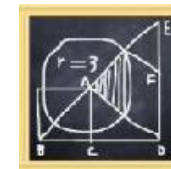
Protractor



Stopwatch



GeoBoard



Instructive apps: for practicing content through drill exercises, acquiring new skills through questions and answers (tutorials), or retrieving factual information, e.g.:

Math Dictionary



Mathemagics



Math Paradise



Instructions:

1. Investigate the app thinking about its role in teaching and learning mathematics – there are no right or wrong answers.
2. Choose any of the three roles described above– *You can choose a combination where roles overlap.*
3. Go to the relevant section(s) next page 6 and 7 where specific issues are presented for your appraisal
4. Complete items on following page.

Step 1	Choose the app role(s)
Step 2	Explorative app → Go to next page: Section 3
	Productivity app → Go to next page: Section 4
	Instructive app → Go to next page: Section 5
Step 3	Complete items on following pages 4 and 5

Task Structure

Circle any of the three roles outlined below – You can choose a combination where roles overlap.

SECTION 1: EXPLORATIVE APPS *(please check one of the options for each row)*

	Always	To some extent	Never	Not applicable
App closely mirrors a model or real-life situation	☐	☐	☐	☐
Students can enter their own data and observe changes in the model	☐	☐	☐	☐
Exploration is guided within a predetermined learning discovery framework	☐	☐	☐	☐
Tasks are goal oriented driving student interest and curiosity	☐	☐	☐	☐
There are elements of ambiguity and uncertainty fostering personal investigation	☐	☐	☐	☐

If you are not doing any other section please continue to next page

SECTION 2: PRODUCTIVITY Apps *(please check one of the options for each row)*

	Always	To some extent	Never	Not applicable
App lets students to creatively come up with their own design and/or concept	☐	☐	☐	☐
App allows representing maths content by linking symbolic, numerical and graphical data	☐	☐	☐	☐
Students are guided in creating their own content/understandings	☐	☐	☐	☐
Students can represent or present maths content using a variety of different tools (e.g., audio/video recording, measuring devices, etc)	☐	☐	☐	☐
App tools are intuitive and easy to use	☐	☐	☐	☐

If you are not doing any other section please continue to next page

SECTION 3: INSTRUCTIVE Apps *(please check one of the options for each row)*

	Always	To some extent	Never	Not applicable
App contains a variety of different activities/exercises	☐	☐	☐	☐
Appropriate feedback is provided to students	☐	☐	☐	☐
Activities/exercises cater for a range of student ability levels	☐	☐	☐	☐
Content is meaningful, fostering engagement and rich problem solving	☐	☐	☐	☐
App contains activities/exercises that are graded and summary data is provided	☐	☐	☐	☐

If you are not doing any other section please continue to next page

Cognitive Involvement

The app encourages students to ...	(please check one of the options for each row)				Always	To some extent	Never	Not applicable
retrieve and review maths concepts/skills/procedures (Remembering)					☐	☐	☐	☐
demonstrate understanding of maths concepts/skills/procedures (Understanding)					☐	☐	☐	☐
apply their knowledge of maths concepts/skills/procedures in practical contexts (Applying)					☐	☐	☐	☐
critically analyse maths content in text, graphs and/or animations (Analysing)					☐	☐	☐	☐
appraise and justify maths ideas or products (Evaluating)					☐	☐	☐	☐
construct new and meaningful maths ideas or products (Creating)					☐	☐	☐	☐

General Pedagogical Issues

The app ...	(please check one of the options for each row)				Always	To some extent	Never	Not applicable
permits students to pose their own problems					☐	☐	☐	☐
allows for differentiation through sequentially designed degrees of difficulty					☐	☐	☐	☐
gives students control over their learning					☐	☐	☐	☐
delivers content in an appealing and motivating way according to the age group					☐	☐	☐	☐
provides meaningful teaching and learning guidelines					☐	☐	☐	☐
integrates maths with content from other Key Learning Areas					☐	☐	☐	☐
allows students to collect and record their own data					☐	☐	☐	☐
shows a reading level appropriate to the student's level					☐	☐	☐	☐
saves and keeps students' work					☐	☐	☐	☐
provides opportunities for collaboration					☐	☐	☐	☐

Continue to next page ...

Operational Issues**The app ...***(please check one of the options for each row)***Always To some extent Never Not applicable**

has an intuitive and user friendly navigation

☐ ☐ ☐ ☐

contains helpful technical instructions to the user and/or a Help function

☐ ☐ ☐ ☐

lets students alter its settings to customise the app to their needs

☐ ☐ ☐ ☐

allows file sharing, streaming of content and/or online communications

☐ ☐ ☐ ☐

is flexible permitting students to move in different directions

☐ ☐ ☐ ☐

has a supporting Web page providing additional useful information

☐ ☐ ☐ ☐

easily works with a range of media (audio, video, image, text, animations)

☐ ☐ ☐ ☐

can interface with social media tools (e.g., Facebook, wikis, blogs, Twitter, YouTube)

☐ ☐ ☐ ☐

presents an uncluttered display which is visually stimulating

☐ ☐ ☐ ☐

permits a student leave at any time and begin where he or she left

☐ ☐ ☐ ☐

Write here any other comments you might have about the quality of your maths app.**-END OF THE APPRAISAL-**

RPL EPORTFOLIOS: RECOGNISING QUALITY EC TEACHING

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Abstract

This conference presentation will examine the progress of an innovative project, commenced in July 2014, aimed at supporting diploma qualified, experienced early childhood educators to work towards the completion of a four-year Bachelor degree that has been designed specifically for the sector. Based upon a literature review of how social media informs and shapes personal identity through social referencing and the existing, early childhood pedagogical tool of the narrative observation, this project uses existing teaching and learning materials to create a Recognition of Professional Learning (RPL) ePortfolio that potentially could cut a four-year course down by two thirds. Inspired by the Massive Online Open Course model, this project aims to support enrolled students, to use existing teaching and learning materials in a manner that facilitates the creation of a structured RPL ePortfolio to annotate professional artefacts, which directly match the learning outcomes of some of the academic units of study. This presentation will examine how the Australian Catholic University, in collaboration with industry and government stakeholders is currently using ingenuity, commitment, and technology to shape the future of children in the Australian Capital Territory.

An issue of being a four-year trained early childhood teacher

Evidence of a divide between what an early childhood teacher *knows* about what they are ‘doing’, and what they *are* when they are ‘being’ a teacher, was revealed through a stakeholder consultation phase of an Australian Capital Territory (ACT) Education and Care Workforce study that ACIL Allen Consulting was commissioned to undertake on behalf of the Children’s Policy and Regulation Unit (CPRU) in the ACT Education and Training Directorate. A round-table discussion held between members of the ACT Government Directorates, members of the ACT Early Childhood Industry sector and ACT Training Providers indicated a similar problem of a sense of a professional ‘disconnect’. It was articulated that this was a common experience for those early childhood educators, who whilst having decades of valuable experience, struggle to articulate that professional competence when seeking to convert it into Recognition of Prior Learning (RPL) for a university bachelor qualification. The complexity of working toward RPL means that it often gets placed into the ‘too hard basket’ and there is avoidance of the task of navigating the unfamiliar halls of university policy and government regulation. It is easier to keep doing professional development programs that appear to nibble around the edges, yet never actually satisfy the appetite for worthwhile professional recognition. Thus, there is no ‘re-connect’ mechanism, one that meets the tertiary and Australian Qualification Framework requirements and converts a highly resilient professional competence into the highly prized credit towards a tertiary program that would ultimately make the leap into a new era of meaningful, professional recognition.

It is becoming clearer, that this professional disconnect, is perpetuated by a raft of issues and certainly not just by those pressured individuals who cannot see a way out from ‘under’ it all. There certainly appears to be a social, regulatory and governmental underlying perception that those who currently teach in the early childhood sector are not ‘teachers’. This missing element of professional recognition appeared as a thread that surfaced a numerous points throughout the stakeholder consultation undertaken through ACIL Allen Consulting.

For many diploma-qualified early childhood educators, the visible pathway, to that professional recognition, is through the completion of a primary teaching qualification and is often perceived as a “pathway *out of* childcare” (Watson, 2006, in Gibson, 2013, p. 128). With very little formal recognition of what their early childhood pedagogy and experience bring to the role of ‘teacher’, the completion of a four-year, university teaching degree takes a considerable commitment. For a caring, early childhood worker, there are many barriers to their participation in a university degree, such as a lack of confidence, a limited financial capacity, and due to a rotating, shift-work roster, a scarcity of available time. The

provision of a clearer, formal pathway will purposefully navigate these issues of professional identity referencing, recognition, and acknowledgement and may result in a higher level of teacher retention. A pathway, whereby those who undertake it, stay within the sector and actively contribute to an enriching and strengthening of the professional perception within the sector for others.

Conflicted professional referencing

It appears that qualified individuals engage in professional referencing in a similar manner for which they engage in social referencing (Lopes & Pereira, 2012), through various Web 2.0 tools, such as Facebook, Twitter, Google+, and LinkedIn. Each of these tools, like a social community, contributes to strengthening and shaping an individual's personal image. Where a social and professional connection with members of a similar professional community can be used to strengthen and invigorate professional understandings and a professional image (Lanigan, 2011). A recent newsletter issued through the *National Quality Standard* Professional Learning Program narrated an experience that deliberately sought to avoid the 'tick and flick' approach to recognising existing skills (Dwyer, 2013, p. 3). The difference was the degree of support afforded through the TAFE institution, which steadily built up an immensely valuable 'community of practice' in a very social manner; shaping and moulding professional identity through conversations and dialogue in both digital and other spheres. This is evidence of how a community of practice, over a period of time and grounded within a sociocultural-historical theoretical framework, can use a shared personal narrative of inquiry and learning to positively influence, shape and strengthen the early childhood educator's own professional identity (Meier & Stremmel, 2010). This is a process that has been documented as being the same experience for pre-service primary teachers (Flores & Day, 2006; Sutherland, Howard & Markauskaite, 2010; Meir & Stremmel, 2010). It can be interpreted that the early childhood educator's image of themselves as 'teacher' is both being shaped by their own experiences and their knowledge of the experiences of others within their immediate ecology (Coles in Larson & Marsh, 2005). The early childhood educator's personal critically reflective practice provides a constant "cyclical process" of generating, deconstructing, reflecting and re-generating a professional image of themselves as teacher, steadily refining an image of themselves as a teacher (Sutherland, Howard & Markauskaite, 2010, p. 462). The power of the early childhood educator's critically reflective practice is brought into sharp focus as highlighted by Meir and Stremmel (2010), where an individual and collaborative narrative is able to provide teachers with a valid methodology to utilise "key moments and critical incidents into visual and written stories of identity, knowledge, reflection, and change" (p. 256) and build a positive professional referencing mechanism. Yet, where the early childhood teacher's professional identity is embedded within primary teacher training and registration, there is a constant stream of conflicting messages that are reinforced through the student's immediate academic and social ecology.

Through a deliberate use of the ability of social-media to shape an individual's self-concept a deliberate reflective use of a professional, digital portfolio (ePortfolio) to support the development of a registered primary teacher's professional identity. University students, use Students within all of the ACU Bachelor of Education courses work towards building an ePortfolio prior to graduation, one that will transfer with them on into future employment, and one that supports their maintenance of full teacher registration. Within ACT primary teacher registration, there is a requirement for each registered teacher to produce and maintain a professional portfolio that is a "direct representation of their work". Each registered teacher is tasked with using artefacts as evidence and to include annotations, or narratives, of how those artefacts address the Australian Professional Standards for Teachers (TQI, 2013).

For the pre-service teacher, the creation and management of the ePortfolio within the university education course provides significant opportunities to build and develop synergies between the student's learning experience and their profession identity. This relationship between learning and the openness of a common ePortfolio framework requires the inclusion of the more open-ended, social elements that motivate and support the pre-service teacher to improve their work, through a greater degree of 'ownership' (Garrett, 2011). Garrett's research, emphasised the importance of the student's perception of "control", "ownership", "ease of use" and "social learning" in order to facilitate a demonstration of their completion specific academic requirements. Garratt also reported that "Student's enjoyed learning from peer work, and did it even when not required". This sociocultural approach to learning is also visible within the university student's digital social networking as it occurs on a daily basis (Williams,

Karousou, & Mackness, 2011). In all cases, these open-ended, critically reflective practices are managed within the context of a community of practice. In each, there is the development of an authentic professional narrative (Meir & Stremmel, 2010), these deliberate elements of peer collaboration supports the pre-service teacher to identify with a “lived pedagogy” (Niemi, Heikkinen & Kannas, 2010, p. 138). For the early childhood educator, participating in this same digital portfolio process with peer pre-service primary teachers, a conflicted professional referencing process is perpetuated.

Conflicted professional recognition

This is perpetuated by the fact that the early childhood sector is mostly staffed through a range of either unqualified or Vocational Education and Training (VET) qualified individuals, with many not holding the necessary qualification of a four-year trained early childhood teacher. Since 2007, the Rudd Labor Government’s Early Childhood Agenda commenced a drive towards a complete and national overhaul of the early childhood sector. A significant milestone appeared as a 1st of January 2014 deadline for the employment of university, four-year trained early childhood teachers to head up the delivery of a quality of the early childhood education program for all preschool-aged children. At the time of preparing this writing in early February 2014, there were no early childhood teacher registration mechanisms. An individual, seeking the early childhood teacher registration, did so through having trained outside of their professional sector in order to gain primary teacher registration. The Australian Children’s Education and Care Quality Authority (ACECQA) published the following in September 2013, stating that, for those who did not have an accredited, university provided, four-year early childhood teacher degree, the equivalence was:

*“a person who holds **ALL** of the following will be recognised as equivalent to an early childhood teacher:*

- *a primary teaching qualification that includes at least a focus on children aged 5 to 8 years old (e.g. a qualification with a focus on children aged 3 to 8 or 5 to 12) **AND***
- *teacher registration in Australia (or accreditation in New South Wales) **AND***
- *an approved education and care diploma or higher qualification (e.g. approved graduate diploma) published on ACECQA’s qualification lists” (ACECQA, 2013, p. 1)*

As the professional recognition of an early childhood teacher is granted through *teacher registration in Australia*, the pathway for an early childhood worker to gain *teacher registration* requires the individual to study a four-year university Bachelor of Education course that contains enough content to satisfy a primary teacher qualification; a four-year academic pathway largely outside of their preferred professional sector.

As the coordinator for a Bachelor of Education (Early Childhood and Primary) in a national university, the capacity to meet the focus on children aged 5 to 8 is simple, when professional experience requirements for the program accreditation mandates a spread of professional experience placements across all the years of primary schooling. However, the capacity for a primary teacher education program to deliver the focus required to meet the early childhood qualification necessitates a dual qualification in the span of a four-year degree. Much of the time is spent delivering the main focus for the individual’s professional recognition – primary teacher registration. Thus, it is certainly not surprising that Gibson (2013) speaks of the discursive practices that have sculpted the professional referencing of an early childhood educator as they work to overcome the challenges of achieving *teacher registration*.

Conflicted professional acknowledgement

Whilst the conflicting discourses of teacher qualification and the academic provocation of the school-aged child remain dominant, there will continue to be issues surrounding professional recognition of existing skills and achievement through any RPL mechanism that is not suited towards supporting the transfer of existing knowledge into new frameworks. For the university sector, the issues arising from RPL are numerous; they lie within sectors of academic philosophy (Pitman & Vidovich, 2013) and consistency of meaning (Pokorny, 2013). For the Australian Catholic University (ACU), the policy that supports the granting of RPL simply indicates that the individual’s prior “non-formal and informal

learning” has been “recognised for purposes of entry to a course or obtaining credit towards an undergraduate or postgraduate qualification” (ACU, 2014, p. 1). The ACU policy caters for formal, non-formal and informal learning through making quite broad and generalised statements, particularly as they are applicable to all courses that the University offers. The policy outlines that any assessment for RPL must be outcomes-based, equitable, culturally inclusive, transparent, and accountable, that the process of assessment must be comparable in standard and integrity to those used to assess the relevant unit/course/qualification, and be subject to quality assurance practices as is any other assessment practice within the University. In reality, it is the author’s experience, that very few RPL determinations are made using the individual’s non-formal and informal learning. Without a clear sense of how to approach the process of preparing and presenting relevant documentation, or what professional language is to be used, it is very difficult for an individual to be able to aptly apply their non-formal and informal learning towards achieving credit (Harris & Wihak, 2011 cited in Hamer, 2013). It takes a considerably self-motivated individual, with a strong sense of their professional identity, to take hold of what they already know and apply it to stated learning outcomes within a university academic environment.

As the immediate ecology of the early childhood sector is infused with persistent professional turmoil (Ley, 2014), early childhood, diploma-qualified individuals do not commence their academic study, towards primary teacher registration, from a sound and confident professional platform. Anecdotally, the prospect of having to complete a four-year university degree to gain primary teacher registration is itself a considerable deterrent. When an early childhood educator does participate within a primary teaching degree, there is a struggle to match their inerrant “mindset” with the content knowledge that is required, which in itself is not an indicator of a lack of professionalism (Horsely & Bauer, 2010, p. 434). They assume a deficit view of their own profession, of themselves within that profession, and believe they need to leave it behind in order to be a teacher in their own right and to receive acknowledgement for formally achieving a recognised degree of competence (Hamer, 2013). It is within the power of the institution to reject this deficit view of the candidate and to enact the rights of the individual through a mutually empowering dialogue when constructing RPL assessment processes.

Conflicted professional opportunity.

For the early childhood teacher, embarking upon the long journey towards gaining a bachelor teaching qualification, the landscape of higher education in Australia is one that is not as welcoming of their considerable experience. The university sector is experiencing its own considerable economic turmoil. There are not many opportunities for the early childhood teacher to commence and continue their university study in a way that can manage their shift-work employment and acknowledge and recognise their teaching experience. There have been many suggestions for opening up tertiary education, ranging from the free and radical tertiary education ecology promoted and envisaged by the developers of Massive Online Open Courses (MOOC) (Billsberry, 2013), to the creation of smaller regional campuses focused upon developing a teaching-focus with greater synergies within the local context, and a heightened sense of industry competitiveness as envisaged as a series of outcomes from the Bradley Review (Benedict, 2010). Whilst these options potentially offer a greater degree of flexibility for the early childhood shift-worker, none of these options are financially attractive to the university sector. For the universities exploring these delivery options, all are burdened with increasing duality of market competitiveness to meet exacting research targets, whilst increasing student participation and managing the increased infrastructural complexity. However, with the change to a demand-driven system in tertiary education, the attractive potential lies within the manner in which these options can use a university’s current infrastructure to reach a wider, largely untapped student base, with minimal outlay. Technology is still viewed as the key, even if the exact shape and nature of that key is still to be determined.

Despite the immense interest and some investment into MOOCs, research on MOOCs is only just appearing in journals, indicating that whilst gaining a reputation for not achieving their ‘dream’, there appears to be the potential to “overturn centuries of tradition in education” (Billsberry, 2013). However, there is a great deal of reluctance in universities to offer credit (recognition of prior learning) for a MOOC course (Billsberry, 2013), as there is very little to ensure that the person claiming to have completed the work actually did the work. Making the responsibility of the academic and quality assessment of the non-formal and in-formal RPL claim a critical factor that a university is not likely to, or readily willing, accept. So for the early childhood teacher, there is virtually no opportunity to

undertake a bachelor degree that will grant teacher registration in a manner that accommodates the complexity of their daily work-life.

The proposed strategy

This paper proposed a strategy to support an increase in the number of early childhood educators entering and completing a university teaching degree and then returning to the early childhood sector. The proposed strategy is contextually relevant for all stakeholders, the early childhood pre-service teacher, the current early childhood sector, and the university providing the teacher education program. It is proposed that a professional collaboration be established between these stakeholders, one that would deliberately set about building a digitally based forum for the establishment of a professional early childhood teaching community of practice. Within this professional community of practice, diploma-qualified, early childhood professionals, enrolled in a contextually relevant four-year teaching degree, can set out on a journey to establish recognition for their existing knowledge through the implementation of a purposeful, reflective and realistic professional narrative (Larson & Marsh, 2005; Meier & Stremmel, 2010; Sutherland, Howard & Markauskaite, 2010). For the diploma-qualified early childhood educator, being a member of such a digitally based forum has the potential to remove many of the provocations that contribute toward the development of a chaotic professional identity (Gibson, 2013). The nature of the digitally based forum draws it outside of the usual university context and situates it within the early childhood teacher's own professional context.

As an enrolled university student, the barrier to accessing university support and technology can be removed. The university internal technology can also be used to build an open and collaborative digital learning community, a bit like a MOOC does for a university outside its more traditional boundaries. Where access to teaching and learning materials, through the support of a tutor, can be used to support the development of an authentic, professional narrative (Meier & Stremmel, 2010), where the elements of the collaboration tutor, lecturer, student becomes a "lived pedagogy" (Niemi, Heikkinen & Kannas, 2010, p. 138).

The opportunity to use the structure and process of a MOOC would remove the barrier for an enrolled undergraduate participant to produce a professional RPL ePortfolio that is course-aligned (Niemi, Heikkinen & Kannas, 2010). Potentially, a professional RPL ePortfolio created through this community of practice would satisfy the existing university academic and RPL requirements, whilst offering a way in which to smooth the way into a university degree for an experienced individual whose professional identity is fragile, and to facilitate the transition into a professional development portfolio for future teacher registration. The potential of deliberately applying a process of open and professional dialogue between those seeking RPL and those within the university could, potentially, afford the opportunity to overcome some very significant barriers to the overall participation of this marginalised group within a university education degree (Benedict, 2010). There is a very real opportunity for those participating in such a forum would naturally cause a ripple effect through changing professional conversations within the workplace (Sutherland, Howard & Markauskaite, 2010).

Significant for this venture, is the current regulatory environment for the early childhood sector that will from 1 January 2014, require the employment of a qualified, four-year trained early childhood teacher within each setting (ACECQA, 2013). There is a caveat of 'working towards', which would be satisfied, as the individual be enrolled in a four-year Bachelor of Education course that has been accredited by ACECQA as offering the necessary Early Childhood Teacher qualification. For the diploma-qualified early childhood educator, a year of study is removed from the contextually relevant course comes through articulation of formal learning RPL. The development of a Professional RPL ePortfolio built using the evidence of non-formal and informal learning, would potentially further reduce the workload of such a course, and could easily be used after the degree is completed, to continue to chart the professional development of an early childhood teacher.

The set up of this concept is not without cost; it would require initial establishment, management and coordination. The costs of initial project, to seed the concept, could be alleviated through a scholarship offered to course participants to pay the labour and infrastructure to set up the program and ensure that it achieves its objective. However, the future potential of this concept could be that, once set up, it can become self-sustaining through a sectorial teacher registration process. Continued funding would, as in

any teacher registration, would reside within the fees and levies associated with the registration mechanism. However, the objective would be to generate a sustained provocation to professional conversation within the early childhood sector, through those who participate inviting others to join into the evolving narrative within a community of practice.

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ETHICS OF TEACHING WITH SOCIAL MEDIA

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Abstract

This paper goes beyond the commonly held concerns of Internet safety, such as cyberbullying. Instead, it explores the ethical dilemmas we face as teachers when using social media, in particular social networks, in the classroom. We believe old ideas of respect and culture of care for children and young people need to be reconstructed around new media. This paper draws on the authors' experience in teaching with, and researching students' use of, social media in the classroom. In this paper we explore the ethical issues of consent, traceability, and public/private boundaries. We tackle the complex issue of the rights around virtual identities of the students followed by a discussion on the ethics of engaging students in public performance of curriculum and their lives. Finally we discuss the ethical dilemma involved in recognising and responding to illicit activity. While we reflect on our own response to these dilemmas and propose a dialogic process as the way forward, we also return to the argument that these ethical choices are dilemmas in which most, if not all, options are unpalatable or impracticable.

Introduction

Social media offer spaces for innovative teaching in classrooms. However they also pose a number of ethical dilemmas for teachers. While this paper pays particular attention to the concerns raised by social networking features of social media (such as epitomised by social networking services like Facebook), it also includes other web based media that mediate interactions between people, such as blogs (e.g., Blogspot), microblogs (e.g., Twitter), wikis (e.g., wiktionary.org), forums (e.g., minecraftforum.net), video sharing (e.g., YouTube), and image sharing (e.g., Flickr). Social media can also include virtual worlds (e.g., SecondLife) and massive multiplayer online role playing games (MMORPG) such as World of Warcraft as well as other Internet based games. In addition, many apps (applications) for mobile phone and personal devices (e.g., iPad) also fit the definition of social media, for instance, Localmind (an IOS app that connects people in geographic areas).

An important feature of social media is the way the texts are collaboratively constructed. A Facebook “wall” or Twitter profile page is not only made up of images, text and other media from the individual but also from those friends or followers who comment. Unlike early forms of digital word processing that supported a high degree of individual authorship, social media facilitates the joint production of texts. Due to the nature of the texts in social media, many of the texts are constructed by people with a particular sense of purpose and audience. Just as social media was not designed for classroom use to support curriculum and assessment, the content of most social networking sites was not designed to be used in the classroom. This does not preclude their use in classroom contexts, as demonstrated by the growing number of studies (Snyder, Henderson, & Beale, 2012; Wong & Hew, 2010), but it does raise ethical issues for teachers when (a) they use texts designed for different purposes and audiences other than their classroom, and (b) they encourage the creation of texts that extend beyond the control of the

authors. Indeed, the ethical issues are largely founded on the understanding that both students and teachers have lifeworlds outside of school that are characterized by complex identities, social practices, and discourse that influence how they engage or disengage with each other and with social media texts such as Facebook.

Furthermore, social media, particularly social networking sites, have been the subject of considerable negative media focus in terms of cyberbullying and predatory behaviour that has stimulated a moral panic beyond issues of documented risk contexts (Green & Hannon, 2007; Merchant, 2011). This stigma has inevitably resulted in a tension when planning to use social media in a classroom. Nevertheless, there is a growing body of evidence that demonstrates, despite the risks, social media have a valued role in communication and the management of interpersonal relations, identity building, creative activities, and for learning (ACMA, 2009; Byron, 2008; FCC, 2009). As a consequence teachers are left in a difficult position of trying to innovate in their classroom using social media while at the same time being conscious of the risks. However, we argue that while risks such as cyberbullying have been well documented, and are addressed through numerous cybersafety initiatives, there are a range of other professional dilemmas in using social media in the classroom which have not been explored in detail.

While well-established guiding principles of ethical conduct in research such as justice, beneficence and respect (NHMRC, 2007) are relevant and valuable, we argue that there needs to be a more nuanced understanding of how they apply in new and complex technology-mediated social spaces. The choices and consequences are easier to identify in well-trodden fields. When social media is involved, available guidelines for our moral deliberation can be unclear, such as: who are participants, whose data is it, what is private, and what are the consequences for now and in the future (Henderson, Johnson, & Auld, 2013).

In the context of teaching with social media we need to draw on a broader, and less defined, set of ethical guidelines. We argue that from an ethical perspective classrooms are synonymous with the culture of care the teacher brings to the classroom. A useful guide is given by Nias (1999) who identifies six aspects of the culture of care in a primary classroom: affectivity, responsibility for learners, responsibility for relationships in the school, self-sacrifice, over-conscientiousness and identity. Lévinas (1979) also provides a useful frame for ethical practice in the classroom: he argued that all people depend on more than just themselves for life, sustenance, and education and we are continuously in an ethical relationship with the “other”. While this construct of “other” reinforces our notion of duty of care in the teaching profession, it is also relevant when trying to understand our ethical response to those others who have participated in the construction of the text, such as a Facebook page. For example, the texts the students access or bring to class might be a montage of authors that include different people in different places who have not provided permission for their texts to be unpacked in a classroom environment. In addition, social networking sites blur the boundaries between professional/school and personal lives, thus there has been considerable caution on the part of teachers and institutions.

We argue that there are four ethical dilemmas that need to be considered by teachers who are using social media content or services with their students, or who are planning on researching/documenting the use of social media in the classroom. In this context, we define ethics as a moral choice, which means that teachers have to ultimately decide their own response to the dilemmas, according to their socio-cultural and professional contexts. These are represented in Table 1 and have been organized according to well established ethical practice (consent, traceability/confidentiality, boundaries, and dealing with illicit activity).

Table 1

Ethical concerns for teachers using social media in the classroom or in research

Ethical issue	Ethical questions	
	Teaching with social media (adapted from Auld & Henderson, 2014)	Teacher as researcher (adapted from Henderson et al., 2013)
Consent	Do we have the right to colonise or marginalise students' out of school social networking practices in the classroom? Should we access students' out of classroom virtual identities from their social media in a classroom context?	When and how should we seek informed consent in an environment that promotes socially mediated and co-constructed texts, a sense of privacy in the crowd, anonymity through avatars, and in which personal data are increasingly leaving the control of the individual?
Confidentiality (Traceability)	Should we be engaging students' social networking in public performances of the curriculum?	The loss of confidentiality - how can we de-identify participation in an increasingly networked, pervasive and ultimately searchable dataverse?
Boundaries	Am I prepared for the inhabitation of my social media by students as a reciprocal response to my teaching?	Am I prepared for the inhabitation of my social media by students as a reciprocal response to my research activity?
Recognizing and responding to illicit activity	How will I negotiate any illicit activity associated with the student's use of social media?	What is illicit activity that requires intervention when in a socially mediated environment?

By raising these issues we do not want to dissuade teachers from using social media. Rather we are hoping to construct a space in which teachers are empowered to engage with the dialogue and implications surrounding the ethical dilemmas they encounter in their changing professional practice.

Consent – the right to colonise?

Consent concerns the respectful way to gain permission from people to engage with them in current or new practices and in gaining access to their data. There are a number of issues concerning consent that teachers face when using social media with their students. One issue with consent is what constitutes public data. While this appears straightforward when teaching young people, there is a debate about what constitutes private and public data. Rosenberg (2010) considers what is publically available on the Internet and what is perceived as public by the participants could be quite different. For example, if a young person publishes a video on YouTube for friends, they would not expect the same video to be shown in the classroom. Teachers need to ask what kinds of social media resources should they be using in the classroom when their producers potentially did not want, expect or perceive them as something for public consumption? To further complicate the issue of consent, Boyd and Marwick (2011) suggest that young people do not have a full understanding of the long term implications of posting to social

media. Obviously teachers need to consider the original purpose and audience of the intended text when asking consent to use these texts in class.

Another issue with consent involves the possible decontextualisation of the text in a classroom environment. Bakardijeva and Feenberg (2000) argue for a concept of ‘non-alienation’, where the content of online communication is not taken out of context of the original occurrence without explicit permission. When teachers use social media alienated from the context where it is produced, the students in the class are not provided with the postings or comments that have gone before and after these texts were made. The narratives that teachers make about the use of social media in the class could be rather different to the comments that have surrounded the production of the texts in the original form produced in the social networking sites. Teachers should unpack whether it is ethical to participate in, or expect access to their students’ identities that they use in their social media as part of their learning process in the classroom. The use of social media in the classroom means that teachers need to extend Nias’s (1999) construct of care, with reference to being responsible for relationships in the school. Teachers using social media are responsible for relationships with students and ‘friends’ outside of school mediated in the digital environment. When students do give consent for their images, texts and identities to be used in the classroom, teachers should be aware that this consent might need to be renegotiated at regular intervals. There is a real issue in determining participants’ understandings of how their private information and interactions can be transformed into public data.

By including social media in the classroom context, we are implicitly requiring students to draw on their funds of knowledge around social media in order to succeed in the curriculum. While Moll, Amanti, Neff, and González (1992) have suggested that utilizing the home practices of students in the classroom can lead to successful pedagogy, we need to also consider if we are colonizing a classroom with ill-matched and poorly understood use of social media that may lead to unintended consequences and which amount to an invasion of the out-of-school technological practices and identities of students. A review of the literature reveals that despite students’ familiarity with social media, they are not experienced in, or necessarily enthusiastic about, using social media for collaborative curriculum based activity (Snyder et al., 2012). Certainly, students’ propensity to use co-authored texts from social media in their personal lives is not a sufficient foundation in itself to use the technology, no matter the guise of “authenticity”.

Traceability – the ethics of public performance

When we ask our students to tweet, blog, post, share, or co-construct their texts with the rest of the class, we are asking them to perform in public or semi-public arenas. In this situation we are faced with the ethical question of whether this practice is caring for the identity of our students. How can we promise students that their digital footprint (online conversations, interactions, personal details) will be confined to the classroom context? A significant feature of social media is that they create an archive of profile that persists over time. This is made all the more problematic as more powerful search capabilities make it possible to search out and collect the profile data of an individual across a variety of social media platforms, thereby making public a very different and potentially unwanted profile of a student that they have little or no control over. In addition, the way in which social media, particularly social networking sites, record, trace, connect, and publish with a degree of autonomy from that of the individual whose information is being used has led the International Council on Human Rights Policy to note, “Today, the ‘private man’ is a public entity... that he controls only partly” (2011, p. 65).

It appears that nowadays search engines are so powerful that almost every digital phrase is traceable. The International Council on Human Rights Policy (2011) consider we are all part of a ‘dataverse’ referring to the ubiquitous nature of the data surrounding our everyday lives and the access people have to this data. Teachers who quote people anonymously from social networking sites in a class may find students plugging extracts of the quote into search engines to see if they can find the author of the text. Even more worrying is that by encouraging students to use social media for learning purposes, in which we expect and celebrate student’s taking intellectually creative risks, we are potentially reifying the students’ identity for years to come.

Boundaries – teacher becoming public

A dilemma arises when the regulatory codes of conduct meet emerging technologies that redefine heretofore well-established boundaries between private and public, personal and professional/student, and even leisure and school/work. Teachers need to consider what the implications are for co-inhabiting spaces that are designed to connect people and share information. The two most obvious ethical concerns of social media co-habitation are (a) teachers sharing their private (out-of-school) identities and practices in their profiles with their students that might not be congruent with the expectations placed on them as professionals, and (b) students actively seeking contact with teachers on the networks and, in doing so, building a profile of the teachers that may be incongruent with expectations, or even place the teacher in a compromising position. These ethical concerns are valid both in and out of social media. However, the unique characteristics of social media such as anonymity of the browser, persistence of data including histories of social interactions, and simplicity of searching across networks have increased the potential risk for teachers

Whether teachers are using social media for personal or professional (i.e., to enable teaching and learning) reasons there is a risk of public scrutiny of their profiles, including students observing aspects of what may be considered private lives. Furthermore, the definition of communication becomes problematic in this regard since social networking applications are usually historical, providing archives of activity that, in effect, are being communicated to students by the simple measure of allowing student access to their profile.

Social networking applications expose teachers' out-of-school identities and their networks to a greater degree of scrutiny by their students, colleagues, and school communities. An obvious answer to this problem is for teachers to choose to only engage with social networking applications that offer a higher degree of privacy and control. However, this is not always feasible, nor is it necessarily desirable, as it reduces the authentic context to a staged pretext. Another strategy is for teachers to create a social networking profile specifically for their professional work. While this resolves some immediate concerns, it still requires considerable thought and considerable maintenance (eg. removing "friended" students at the end of each year, cleaning out histories of interactions, including photos, etc.).

Recognizing and responding to illicit activity

If a teacher came across a piece of student's work which used an image of a well-known movie star or popular cartoon character, should the teacher consider this as illicit behaviour? Even though the risk of being sued is minimal, many teachers would dismiss these concerns and treat the process as a positive expression of identity (Henderson, De Zwart, Lindsay, & Phillips, 2010). The issue here is the publishing of material online, the extent of the readership and the student understanding of copyright that is promoted in the classroom environment. Before the teacher can respond to illicit activity, the teacher needs to recognize it. In the above example, how is the teacher supposed to know all the copyrighted images the students could be using in their classroom learning?

When dealing with social media it is not always easy to identify the key players (perpetrators, victims, regulatory or reporting bodies) or even the illicit nature of the activity itself (Auld & Henderson, 2014). For example, social media that allows the joint creation and editing of texts (such as in a wiki) can make it hard to identify the perpetrator. Moreover, there is a question of degree of illicit participation, for instance, if someone only edits the grammar are they participating in the illicit activity? The joint design, production, and distribution of social media texts makes identifying authorship problematic, let alone intervening.

Teachers will also come across students' work that are a montage of other texts. Does a teacher ask the students if any of the sounds from songs or video from movies have been illegally downloaded? If the students admit to the teacher they have illegally downloaded material, what should the teacher do? There are implications of reporting this to the school management as the act of reporting would undermine the

respectful relationship between teacher and student. If the teacher does not report such activity, what is the student learning from the teacher about making moral choices about following the law? Students will learn understandings about the law and morality from the actions teachers do and do not take associated with social media in the classroom.

Concluding Comments

Drawing on our own experience, as teachers and as researchers of our own teaching practice, we have outlined four complex ethical issues associated with the use of social media in a classroom context. We have offered dilemmas surrounding ownership, use, and archiving of texts and images by teachers as they introduce social media in schools. Guidelines for teaching practice nor codes of conduct are wholly adequate in addressing these issues. This is partly due to the continually changing landscape of social media, and partly due to the fact that some of the issues, such as the ethics of colonizing student social spaces, are simply not directly addressed. We suggest that teachers (and students) should go beyond reference to guidelines, but consider their ethical relationship with the “other” (Lévinas, 1979) including those beyond the classroom such as ‘friend’ networks.

Although we argue that students’ choice about sharing texts should be respected, we also subscribe to the notion that we can engage in dialogue with students about those choices. The very nature of technology, especially that of social media, continuously decontextualises and recontextualises personal information, leaving it “out of context” and available to misinterpretation (Mayer-Schönberger, 2009, p. 13). However, when students are encouraged to examine and critique their use of social media, such as Facebook, when interacting with the teacher or with fellow students, they are being asked to behave, converse, share, and self-regulate in ways that are different to their already established practices (Auld & Henderson, 2014). Merchant (2011) suggested that effective use of social media in a classroom context will involve learning from, about, and with social media so teachers have a better understanding of the practices associated with these texts. We argue that underpinning these practices are a set of ontological approaches that are motivated by respecting the other. Where teachers foster a dialogue amongst students and between teacher and student, they will have a strong foundation in their planning for social media in their classrooms.

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TECHNOLOGY ENHANCED FEEDBACK ON ASSESSMENT

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Abstract

The two most common forms of providing assessment feedback to students have been written comments on the assignment or face to face discussions. However research reveals that written comments are often limited in depth and marred by ambiguity while face to face discussions are often impractical and dependent on student memory. In contrast over recent years we have witnessed an increase in technology enhanced modes of feedback delivery. At its simplest this involves annotating documents with written comments. However, there are a variety of other options. This paper will outline the limited but growing empirical research on the design and impact of video, audio, screencast and other annotation feedback mechanisms. Drawing on this literature and the presenters' own research we propose a series of design principles for the creation of effective technology enhanced feedback.

Introduction

Research has illustrated that feedback is both a broad term that incorporates a range of contexts (for example, see: Hattie & Timperley, 2007; McConnell, 2006) as well as being a valuable component of the learning process (Orsmond & Merry, 2011), with some authors indicating that feedback could be the most influential single factor affecting student achievement (Brown & Knight, 1994; Hattie & Timperley, 2007). Despite a number of papers reporting on feedback, it is somewhat surprising to find that there is no clear agreement of how feedback, including summative assessment feedback, should be designed or delivered.

Although video and other media being available for more than two decades in schools and universities, there has been very little research investigating the design and delivery of technology enhanced assessment feedback. Within this context, we provide a synthesis of effective principles when creating assessment feedback artefacts (e.g., text, video), offer a comprehensive review of research on technology enhanced individualised feedback and then report on how we have been designing such artefacts in our own research.

Assessment feedback

Feedback provided to students about their performance on assessment tasks is different from other forms of feedback provided during the learning process (for example, see: Biggs, 2003; Boud, 2000; Costello & Crane, 2010; Crook et al., 2012; McConnell, 2006) as effective assessment feedback provides more than a number or letter grade to students (Joint Information Systems Committee [JISC], 2010). Despite the literature confirming the importance of assessment feedback as part of the learning process, the same body of literature also points out that many students do not value the feedback comments but simply skip to the grade (for example, see: Bailey & Garner, 2010; Crisp, 2007; Higgins, Hartley, & Skelton, 2001; Orsmond & Merry, 2011).

With such student dissatisfaction, many researchers have turned their attention to feedback design characteristics in an attempt to improve the quality of feedback being provided by teachers. Notable examples are Evan (2013) and Nicol and Macfarlane-Dick (2006) who separately outline general principles of effective feedback. However, the recommendations of these and other researchers do not always fit easily with each other, nor are they all relevant to the concern of this paper: educators creating feedback artefacts for summative assessment. Consequently, a guiding set of principles relating to the design of teacher created feedback artefacts on summative assessment has been synthesised from key texts in the literature (see Table 1).

Table 1
Principles for the Design of Teacher Created Assessment Feedback Artefacts

Principle	Description	Reference
be timely	Give feedback while details are still fresh, and in time to assist the student in future task performance.	Bailey and Garner (2010); Costello and Crane (2010); Evans (2013); Glover and Brown (2006); Rodway-Dyer, Knight, and Dunne (2010)
be clear (unambiguous)	It is important to be unambiguous in communication. For example, do not assume students have the same understanding of academic language or discourse. Similarly phrases such as “good work” are unclear due to lack of specificity.	Brockbank and McGill (1998); Chanock (2000); Duncan (2007); Evans (2013); Glover and Brown (2006); Higgins et al. (2001); Lillis and Turner (2001); Weaver (2006)
be educative (and not just evaluative)	Indicating something as incorrect is not as helpful as suggesting how it could be corrected or improved. It is also valuable to focus on strengthening, developing and extending what has been done well.	Costello and Crane (2010); Evans (2013); Lizzio and Wilson (2008)
be proportionate to criteria/goals	More time should be spent providing feedback on the more significant goals of the assessment task.	Boud (2000); Davies (2003); Hattie and Timperley (2007); Nicol and Macfarlane-Dick (2006); Stefani (1994)
locate student performance	in relation to: - the goals of the task (feed-up) - clarifying what they did well and not so well (feedback) - and as a result what they can most productively work on in the future (feed forward) More emphasis should be placed on feed forward.	Bailey and Garner (2010); Boud (2000); Crook et al. (2012); Duncan (2007); Evans (2013); Hattie (2009); Hattie and Timperley (2007)
emphasise task performance	Feedback to students should be focused on the task rather than self or attributes of the learner. In particular the feedback should provide guidance on the process and metacognition (self-regulation) level.	Boud and Molloy (2013); Evans (2013); Hattie and Timperley (2007); Higgins et al. (2001); Nicol and Macfarlane-Dick (2006)
be phrased as an ongoing dialogue rather than an endpoint	Instead of an end-point in the teaching and learning processes, feedback should be seen as an invitation and a starting point for reciprocal communication that allows students to continue developing skills and ideas through conversations with their teachers.	Bailey and Garner (2010); Blair and McGinty (2013); Crisp (2007); Evans (2013); Higgins et al. (2001); Nicol (2010); Nicol and Macfarlane-Dick (2006); Orsmond and Merry (2011)
be sensitive to the individual	Feedback should reflect the individual student's: - context and history - emotional investment and needs - power - identity - access to discourse It should encourage positive self-esteem and motivation.	Bailey and Garner (2010); Costello and Crane (2010); Crisp (2007); Higgins et al. (2001); Jonsson (2013); Lea and Stierer (2000); Lizzio and Wilson (2008); Orsmond and Merry (2011); Reid, Francis, and Robson (2005); Whittington, Glover, and Harley (2004)

While these principles provide helpful guidance, trying to apply them all at the same time through text based feedback, while not impossible, would be complicated and time consuming, particularly in large classes. As a result of the tension between the desire to provide effective feedback and our own limitations in time, the authors intuited the potential of digital based multimedia (e.g., video) as an alternative to text based feedback.

Video-based assessment feedback

In contrast with the considerable body of literature dealing with feedback, little attention has been paid to the ways or medium in which assessment feedback is delivered to students. Very little literature is available that deals with the use of video-based feedback in relation to assessment tasks. Hattie and Timperley's (2007) meta-analysis noted that "video or audio" feedback had an average positive effect size of 0.64 yet they failed to explain what they mean by video feedback or identify the source of the meta analysis. Personal correspondence with Hattie (16th Nov 2012) clarified that the results in their meta-analysis were drawn from studies of Computer Assisted Learning. As such, the results are not directly relevant to this investigation since we are dealing with videos recorded by educators in response to student assessment, as opposed to typical CAL applications of video cues in response to student actions.

A literature review on the use of technology in feedback by Hepplestone, Holden, Irwin, Parkin, and Thorpe (2011) made no reference to video-based feedback. However, in a similar review of technologies for learner-centred feedback, Costello and Crane (2010) identified video having some benefits, but their conclusion is based on two sources, only one of which was based on empirical evidence (Parton, Crain-Dorough, & Hancock, 2010), while the other (Denton, Madden, Roberts, & Rowe, 2008) is itself making a passing reference to a much older article from 1997 (Hase & Saenger, 1997).

After a significant search of the literature only a small number of journal articles were found that reported empirical research about video-based assessment feedback. Over a decade ago, Hase and Saenger's (1997) study of recording assessment feedback on analogue videotape and posting the video to students found that the "videomail" was "an extremely valuable and personalised method of obtaining feedback by learners" as the lecturers were able to use "a wide variety of communication techniques such as self-disclosure and reflection, for example, not available to them using written feedback only" (p.362). However, they concluded that video feedback is a means of enhancing, not replacing, written feedback. Inglis (1998) discussed the technical feasibility of providing digital video via email for assessment feedback, concluding that while it was possible at that time, it would be more feasible as bandwidth and computer processing increased. Despite Inglis' prediction being correct, there is a gap of almost 10 years before researchers looked again at digital video as a means of assessment feedback.

When comparing podcasting (audio) and video used for weekly generic (i.e., whole class) feedback on students' performance in the previous week's assessment, Cann (2007) notes that the video files were downloaded over five times more than the podcasts, indicating the students' strong preference for the medium. However, no explanation for this preference was offered other than the suggestion that while video is widely accepted by younger learners, podcasting is considered to be too restrictive. A slightly more detailed case study is offered by Abrahamson (2010) in which 10 generic short videos were created to supplement written feedback on assignment drafts. The videos were numbered and referred to as and when appropriate in the written feedback, thus offering a degree of personalisation that was particularly valued by the students. Abrahamson (2010) also noted that the video-based feedback provided staff with "greater freedom in expressing feedback as a learning process and not simply as a product of learning" (p.4). Cann's and Abrahamson's conclusions reflect those of studies conducted a decade earlier: students valued the video; the video was useful as a supplementary aid to text based feedback; and video offered educators new opportunity for richer communication.

Crook et al. (2012; 2010) report on a much larger project spanning several universities (8 staff and 105 students completing the post-video questionnaire) in which an online platform was created to host generic videos in response to student formative assessment. As with the previous studies, all of the

teachers and a majority of students responded positively to the use of video-based feedback with 80% in favour of it being used the following year. The students reportedly took more notice of the videos, with the main advantage being that the content was easier and clearer to understand, and that it was “more extensive, informative, the key points were better emphasised and that it aided their visualisation of the task through demonstrations and/or diagrams” (Crook et al., 2012, p. 391). However, a minority of students noted the disadvantage of technical difficulties (12%) and particularly that the feedback was too generic (17%), and de-personalises the feedback experience (12%). From the staff perspective, the majority felt that using video positively changed their approach to feedback. However Crook et al. (2012; 2010) do not provide detail as to how the content of the videos were designed other than the staff were encouraged to adopt a feed forward perspective. They conclude that the approach can enhance staff and student feedback experiences and that, while video was used as a generic response in their project, it could be used for individual feedback dependent on small class size.

Research from the last decade has only produced one paper related to individualised video-based assessment feedback. Parton et al. (2010) conducted a study in which an instructor provided 12 graduate level students with written feedback on their first assignment, a combination of written feedback and a video explaining the remarks made on the hardcopy of the second assignment, and only video-based feedback on the third. The videos were approximately five minutes in length, and created through the use of a Flipcamera (video camera with USB connection). However no further detail was provided about the design of the video-based feedback. The instructor reported the students found the video feedback easier to understand. The most striking outcome of the project was the clear indication that the video-based feedback resulted in the students feeling they had a closer connection with their instructor. As a consequence Parton et al. (2010) conclude that the “primary benefit of the videos appears to be in developing the bond between instructors and students” (p.5). However they note that the small number of participants is a major limitation to the study.

Audio recording and screencasting assessment feedback

Since there has been little research in video-based assessment feedback, the authors extended their literature review to other digital modes of feedback delivery, namely audio recordings and screencasting.

Hepplestone et al. (2011) noted that audio based feedback is a “recent innovation” (p.121), with Jonsson (2013) reporting on a small but “growing number of studies investigating digital audio feedback” (p.65). The research is characterised as small case study or quasi-experimental designs with unique contexts and small numbers of participants. However, there is enough evidence of benefits to learners to recommend further research and suggest that video-based feedback may not only share in these benefits but also be able to strengthen them. The reported benefits of audio based are listed as part of Table 2.

Table 2
Benefits of Audio and Screencasting Feedback

Benefits	Audio feedback	Sceencasting feedback
Greater detail in feedback	Hepplestone et al. (2011); Jonsson (2013); Lunt and Curran (2009); Merry and Orsmond (2008); Rodway-Dyer et al. (2010); Rotheram (2009)	Hyde (2013); Marriott and Teoh (2012); Mathieson (2012); Thompson and Lee (2012)
Faster or just as efficient to create feedback (in comparison with text feedback)	Jonsson (2013); Lunt and Curran (2009); Rotheram (2009)	Edwards, Dujardin, and Williams (2012)
Clearer meaning (audio visual cues such as tone perceived as conveying meaning easier)	Bourgault, Mundy, and Joshua (2013); Ice, Curtis, Phillips, and Wells (2007); Merry and Orsmond (2008); Rodway-Dyer et al. (2010)	Edwards et al. (2012); Marriott and Teoh (2012); Thompson and Lee (2012)
Feedback is perceived as more individualised	Bourgault et al. (2013); Rotheram (2009)	Edwards et al. (2012); Hyde (2013); Marriott and Teoh (2012); Mathieson (2012)
Students feel a stronger connection with their teachers, or stronger social presence of teachers	Ice et al. (2007); Johnson and Keil (2002)	Thompson and Lee (2012)

Screencasting is also increasingly appearing in the literature as a mode of feedback delivery. Screencasts typically include a video recording of the computer screen while the marker uses the cursor to point to examples, makes edits, highlights or annotates sections of the individual student's work while simultaneously audio recording the marker's voice as they talked about the student's work. In the literature search, there were only a relatively small number of publications based on empirical research. In these examples, there were no video recordings of the marker's face although that is an option in some screencasting software.

As in the case of audio recordings, the literature on screencasting is dominated by small case study and quasi-experimental designs. While keeping these limitations in mind, it is interesting to note that the findings are not only similarly positive but repeat the same themes as shown in Table 2.

The benefits of audio visual feedback could be explained, at least in part, by the affordances of the media: namely, the speed of talking in comparison with writing and the richer communication cues, such as tone. In turn, it is plausible that such a detailed and richly communicative response would increase clarity of message, as well as a sense of individualisation and social presence leading to stronger connections or rapport. However, while the literature reviewed to date agrees that students are largely in favour of audio visual feedback, the same literature also calls for further research. The following section explains the method by which we have successfully implemented video based feedback and how the same principles can be generally applied to all multimedia feedback artefacts.

Implementation of technology enhanced feedback

This research has evolved out of a scholarship of teaching practice. In contrast to a planned research project, our use of video-based feedback resulted from a feeling that this approach had the potential to increase student understanding and satisfaction in graduate and postgraduate classes in an Education faculty. This approach has now also been used in secondary schools with equally positive results. Research findings are briefly mentioned in the conclusion of this paper and will be presented in detail in future publications. The goal of this paper is to describe how video-based assessment feedback (and by extension other digital modalities such as audio, screencasting, and portfolio) have been effectively constructed in our own teaching and research.

The design of video-based feedback

In producing the videos we have used different hardware and software including a webcam coupled with video recording software, and even an iPhone (propped up to reduce camera movement). These methods mean that the videos are immediately available and in a format ready for uploading without any editing or post-production work. The simplicity of the process meant that we could easily record the videos wherever we marked the assignment, at work or home.

As shown in Figure 1, the camera was focussed on the heads and shoulders of the teachers with enough space in the frame to allow some movement and capturing of hand gestures. Consequently, there is no need for high quality video resolution so long as the student can see the facial expressions and clearly hear the teacher. Keeping video files sizes small enough to upload quickly and even email is an important consideration. We have found that five minutes is sufficient to provide detailed feedback while also maintaining manageable file sizes for uploading and downloading.



Figure 1. Frames from a feedback video

The videos were generally recorded immediately after the assignment was read which allowed teachers to provide specific comments with a sense of immediacy as no ‘scripts’ were written with comments based on notes made while reading the assignments. We rarely re-recorded and never edited videos as this would make the process too time consuming; however, this meant that the videos often contained pauses, ums, and even moments where we had to rephrase our comments because we realised we had not been clear enough or were momentarily distracted. The recorded videos along with the grades were then uploaded to an LMS (Moodle). We chose not to use public hosting services such as YouTube due to the (at the time) concerns over privacy.

In comparison to text-based feedback from the same teachers it was found that the video-based feedback gave more time to establishing and building on relationships with students and emphasised students future performance. The structure of the video-based feedback is elaborated in Table 3.

Table 3
Structure for technology enhanced feedback artefacts

Structural element	Description
Salutation	Conversational/ informal salutation: “Hi Lee.”
Relational work	Recognition and valuing of the student including personal circumstance and history. This both draws on and reinforces the pedagogical relationship between teacher and student. This might include a sympathetic comment (e.g., “I know you have been quite ill lately and I am truly impressed that...”), appreciation of effort of previous drafts (e.g., “I can see you have made a lot of changes to your introduction”), reaction to quality or other aspect of submission (e.g., “Thank you for submitting... I can see how much effort...”).
Evaluative summary	General statement of evaluation not necessarily the grade or mark. Very few of the videos specifically stated the grade which was indicated to the student before they opened the video. A general evaluative statement here provided a chance to highlight the overall strength and weakness of the assignment before dealing with the more specific issues. For instance, “The essay is very strong in its theoretical approach... need work in...” and “I thoroughly enjoyed... but there are some issues we need to talk about, namely...”
Textual issues	Briefly describing the nature, patterns and extent of textual issues in this assignment, occasionally with one or two specific examples. This segment of the feedback is short but generally included the same volume of comments about textual issues as the final evaluative notes in the text-based feedback (but not the specificity of the in-text edits).
Commenting on the substance of the assignment with an emphasis on feed forward.	Engaging with the conclusions, arguments, logic, justification, and literature included in the assignment. Commenting on strengths, weaknesses, flaws, gaps, creativity and insights. Importantly, comments were phrased to emphasise how students can improve their grades in future work and how they can extend their thinking about the substance of the assignment. This might include examples of alternative arguments, additional literature and different ways to think or approach the topic. Usually 2 to 3 issues were discussed in detail, regardless of result.
Valediction and invitation	This is largely relational work. Usually involving use of student name, coupled with congratulations or commiseration over result or other interpersonal validation, such as, best wishes for future studies / holiday. Importantly, this structural component included an invitation to contact the lecturer to “continue the discussion” of this feedback and future work.

While these guidelines were originally developed and evaluated in relation to video-based feedback, the same guidelines have been applied to other technology enhanced feedback, primarily digital audio and screencasting. The media, combined with the structure of the feedback (Table 3) has resulted in positive responses from students and teachers in higher education and secondary contexts. In brief, students reported five main strengths (perceived as more personalised than text; increased clarity; more supportive and caring; prompting reflection; constructive and useful) and two potential weaknesses (initial anxiety about receiving feedback and a degree of difficulty in matching feedback to specific parts of the assignment). These findings relating to impact will be presented in future publications.

Conclusion

There is a growing interest in technology enhanced feedback on assessment. However there is a need for guidance about how to design and implement such feedback. This paper has presented a synthesis of the literature relating to the design of teacher created feedback artefacts (e.g., text, video). The resulting principles are: be timely; be clear (unambiguous); be educative and not just evaluative; be proportionate to criteria/goals; locate student performance; emphasise task performance; be phrased as an ongoing dialogue rather than an endpoint; and be sensitive to the individual.

This article has also offered guidelines about the creation and structure of technology enhanced assessment feedback, including framing, length, and unscripted nature of the content. The structure is much the same as what may be found in text based feedback but places a greater emphasis on relational

work, invitational work, and feed forward (see Table 3), all of which are aided by the richness of the media.

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HIGH POSSIBILITY CLASSROOMS: IL IN ACTION

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Abstract

Providing school students with an experience of learning that is both important and relevant to their social futures is a significant education issue. Better education cannot be more of the same: the focus of Innovative Learning (IL) is about the personal, the cognitive, the aesthetic and the moral, and the interplay among these elements. In this paper I focus on IL from the perspective of these four elements and some others in the actions of a group of exemplary teachers in New South Wales (NSW) government schools in Australia. The paper draws on snapshots of findings from a purposive sample of teachers and how they conceptualized their knowledge of technology integration in education contexts. The research was a series of case studies of teachers in classrooms (approximate ages of the students: 6-16 years) conducted in four phases across two years. Practice in the classrooms of Gabby, Gina, Nina and Kitty encompass many IL elements and as such act as potent scaffolds for the creation of what are termed 'High Possibility Classrooms' in schools. Such findings add to what is known about technology integration in IL and are of theoretical and practical significance to leaders, teachers, academics and policy makers in education jurisdictions.

Studies of technology integration in teaching and learning underpinned by theoretical constructs in the Australian context are scant; however, teaching with technology in classrooms in Australian schools is ubiquitous. New research (Hunter, 2013) presented in this paper is both significant and timely, given the current education context and the large financial commitments by governments both in Australia, and around the world, to increase technology capability in schools. Studying a group of exemplary teachers, who are extraordinary users of technology and detailing how they conceptualize their knowledge of technology integration in innovative ways using the TPACK or Technological Pedagogical and Content Knowledge framework (Mishra & Koehler, 2006), provides considerable insight into the phenomenon. The teachers play the 'game of school' in the morning and then get on with 'real learning' after that. Such examples of practice show how some classrooms can focus on Innovative Learning (IL) where students 'get into flow' and produce rich digital narratives to demonstrate their literacy capabilities. Such spaces can traverse the political and 'data hungry' expectations of some education policies.

The TPACK framework was used as the study's theoretical starting point and what emerged from the research builds on what we now understand about particular teachers' knowledge of technology integration. Teachers in the study demonstrated the seven TPACK components in their daily practice. However, on closer examination there were other aspects of their knowledge of technology integration at play. This paper focuses on a new model for technology integration known as HPC or *High Possibility Classrooms* as a robust example of IL in action; the TPACK components of the teachers' practices can be referred to in full in the dissertation (Hunter, 2013).

The HPC model has five core conceptions of technology integration that form practices that can be considered IL: theory, creativity, public learning, life preparation and contextual accommodations with 22 underpinning themes of pedagogical practices and student learning processes. This paper features Gabby, Gina, Nina and Kitty, the four teachers in the study, whose Stage 1- 5 classrooms (approximate ages of the students: 6-16 years) feature the conceptions and themes of the HPC model. The classrooms are highly inventive and engaging and as such, arguably fit with more contemporary visions of what IL in schools can look like in action when technology integration is effective.

Methodology

The research framework for the study was qualitative in nature and used case methodology to uncover the teachers' technology integration conceptions. It used a purposive sample of four exemplary teachers drawn from Australian government schools in a major metropolitan education jurisdiction. The exemplary teachers had to satisfy six criteria that arose from findings in an earlier pilot study (Hunter, 2007) on teacher professional learning integrating technology.

The central research question of how particular teachers conceptualized their knowledge of technology integration was addressed through interviews, observations, document analysis, focus groups with students and a day of cross case analysis with all teachers in the research.

Data for the study was collected in four phases over a two-year period. The data sets were analysed for commonalities and differences using NVivo 9 software. The staggered nature of the data collection period was a clear advantage, as there was opportunity to analyse each case intensely prior to starting the next, drawing out individual themes and comparing them to subsequent uses and to the TPACK framework. Cross case analysis was conducted to determine commonalities/differences in their practices.

Collections of cases like the ones in this research locate themselves in an interpretive frame within a socially constructed world view (Kamberlis & Dimitriadis, 2011). Using more than one case in a study of teachers' knowledge of technology integration "offers the researcher an even deeper understanding of process and outcomes of cases, the chance to test (not just develop) hypotheses and a good picture of locally grounded causality" (Miles & Huberman, 1994, p.26). This strengthens one of the key arguments for case study methodology in that it enables 'closing in' on real situations, allowing the research to test views directly in relation to phenomena as they unfold in practice (Flyvbjerg, 2011). Each context was distinctive, and there was adaptation or accommodation by the teacher to the unique school setting. The following section describes features from each of the case studies.

Results

In the snapshots below, taken from the full cases in the dissertation, five main conceptions and some of the themes of the teachers' knowledge of technology integration are highlighted. Brief detail of the teacher's professional background and the school contexts are given together with common conceptions and themes in their technology integration practices. These are presented in summary form at the end of each case. The first case of Gabby, the Stage 1 teacher, follows.

Case 1: Gabby's early year's classroom

Gabby taught a composite class of 28 students in a relatively middle-class school in a major city. Her foray into teaching began more than 20 years ago, and commenced with Teaching English as a Second Language (TESOL). The classroom was set up with an interactive whiteboard (it was a tool for the students to use), digital cameras and scanners, projectors, microphones, laptops and an iPhone. Gabby considered herself an early year's specialist and in her classroom student learning was made public through performance.

The classroom was a place where active engagement, better quality outcomes and audience were important in technology integration. These practices added to Gabby's beliefs about creativity and involved the continuous co-creation of products, defined by peer support and modelled and guided practice. Of significance were the importance of differentiation and negotiation, and her actions supported students' experimentation and a sense of 'unfinishedness'. For example, students had multiple pieces of writing in production at any one time. Promoting experimentation and 'getting into flow' is tied to her view that producing 'beautiful generic things' for assessment tasks is not the aim of learning:

If everyone produces the same item then it's easier to gauge which product is better, but this is not what innovative learning is. Learning should flow and teachers should go with the flow. Seeing what is important to each student is better revealed without everyone producing the same thing at the same time. If teachers control how students use technology and what they produce, they are acting as gatekeepers and that's why I pulled away from encouraging

teachers to use technology creatively ... many didn't know how to do it [the teachers] have to live with a sense of unfinishedness when technology is integrated.

Her students prepared rich narratives that were highly original and replete with complex, sophisticated language. Students played in the classroom and so did Gabby. They made movies, podcasts and digital games. It was the kind of 'thick play' that Mackey (2009) refers to, and in this classroom play was linked to life preparation, where a sense of fun enabled story-telling, dressing up and developing students' mathematical thinking.

Furthermore, extended learning time supported students to deepen their thoughts by consciously giving them more time to develop imagination, expand and complete class work. Table 1 provides a summary of the conceptions and themes of her knowledge of technology integration coded within the data.

Table 1: Conceptions and themes of Gabby's knowledge of technology integration

Gabby				
Learning made public through performance	Creativity	Differentiation and negotiation	Play and fun	Extended learning time
Better quality outcomes	Continuous co-creation of products	Experimentation	Dressing up	Imagination
Audience	Peer support	Going with the flow	Story telling	Length of session time
Active engagement	Modeled and guided practice	Unfinishedness	Mathematical thinking	

Case 2: Gina in the primary years

Gina taught 28 students in a Stage 2 primary year's classroom. She was also appointed to a position of technology consultant for the region and this meant she was available to work with hundreds of teachers to enhance their technology integration practices by 'working at their elbow'. She liked to teach Science, this included the unit *Model Car Challenge – Alternative Energy*, where students constructed self-propelled model cars that were either balloon or rubber band powered.

Her classroom was quite traditional in its layout and there was no interactive whiteboard, instead Gina used her own computer, her iPhone and a projector screen. Students had access to computer lab. Gina was one of two teachers in the study who spoke about the importance of students learning how to write computer programming code: "It teaches you how to think" she said. For Gina, this idea was crucial in 21st Century learning contexts and spoke to notions of logic and problem solving skills. Knowledge of technology integration centred on a belief that purposeful teaching was crucial. Every lesson had clear and well defined goals, comprehensive planning and connections to larger concepts and this could be achieved through extending language and conversation with students.

In terms of theory driving practice, constructivist teaching was key and Gina used a pedagogical framework for *Quality Teaching* (NSWDET, 2003) to support her aim; the framework used is built on being clear about what the teacher wants the students to learn, why the learning mattered, how the students demonstrated their deep understanding and how well she expected them to do their work. She deliberately built a sustained and deliberate questioning environment; often saying "Questions are more important than answers".

The conception of creativity stemmed from her idea that teachers needed to use narratives to explain complex ideas, and such ideas could be better articulated using various technology programs like

Stopmotion, iMovie and other apps like Popplet and Linouet. Technology gave students opportunities to perform. The real world application of technology was about preparing students for life, giving them a ‘voice’ and a sense of ownership and responsibility. In her knowledge of terms of professional identity Gina explained that the multiple roles teachers naturally take on when teaching in a school provided opportunity for professional growth. The role of technology consultant gave Gina license to work alongside education colleagues beyond her own classroom. Actions of modelling practice and shifting teachers’ ideas about classroom control are critical in her conception of how school systems should support professional development for technology integration. Gina gave the teachers she worked with options of how to approach technology integration, she argued:

Teachers are very worried and have strong concerns. Perhaps there is a problem in their teaching practice to start with? I might start by asking them about how they believe they control students. Technology is blamed as the issue ... maybe it requires teachers to be too liberal? They have to shift their sense of control.

Closely aligned to this theme is the role of teachers and learning communities in schools. Gina describes: “A community of learners includes the teacher”. She gave reasons why conversations about technology had to go beyond mere process:

Teachers must be willing to learn and know how texts work in technology mediums, and know what makes an effective text. Technologies have literacies themselves, which will increasingly need to be addressed.

The importance of a willingness to learn by both the individual teacher, and more broadly the education system, are repeated themes in Gina’s conceptions of technology integration. Professional identity affirmed through support for teacher roles and learning communities are the preferred means to enhance teacher knowledge of technology integration. Table 2 provides a summary of the conceptions and themes of her knowledge of technology integration coded within the data.

Table 2: Conceptions and themes of Gina’s knowledge of technology integration

Gina				
Purposeful teaching	Theory-driven practice	Creativity	Real world application	Professional identity
Purpose	Constructivist teaching	Narratives in action	Preparation for life	Teacher roles
Planning	Teaching for quality	Creating learning products	Student voice	Learning communities
Connections through language and conversation	Building a questioning environment	Performance	Ownership	

Case 3: Nina’s middle year’s classroom

It was a 1:1 classroom, and the laptop program added to the variety of technology programs students at the school accessed. The first computer mediated classroom was established by Nina at the school in 2000 when she set up the server. The school is a designated “Apple School of Excellence” because of its recognized technology focus. Her 28 students have been schooled together since their early years. Nina talked frequently about the importance of community in the school. She believed this phenomenon was supported by continuous class groupings of students’ right across the whole school.

The first conception that explains Nina's knowledge of technology integration in this class of 'gifted and talented students' is built from praxis with a focus on active construction of student learning using a model she developed from her own doctoral work QUEST (Question, Uncover, Explain, and Share Together). This model was a type of inquiry learning scaffold. When students used QUEST they would research a topic that they were interested in finding out more about, explain it in their own words and then share their understandings with peers in the classroom. At the same time while students' worked on QUEST projects she relentlessly probed and questioned them about what they were learning.

There was a focus on meta-cognitive learning through technology in the second conception and this was embraced in Nina's technology philosophy. She was a devotee of the ideas of Papert, and philosophers Ihde (1990) and Bronowski (1974). To Nina it was the pace of learning that mattered in the classroom and it was effective technology integration that more rapid learning possible. Nina said: "Students have to study robust subject matter, and be able to access content quickly otherwise learning is a waste of time".

Technology integration promoted creativity through the values of joy, celebration and preparation for life in the third conception. Following on from that conception in the fourth, the moral purpose of effective technology integration was central to Nina's classroom practices. Establishing a community of learners to fulfil the moral purpose of school led through technology integration involved shared ownership and self regulation for students.

In the fifth conception, Nina believed a redefinition of the 'game of school' was necessary, at both the personal and system level. Conflicting demands of current education approaches didn't have the students learning interests centre stage. Table 3 provides a summary of the conceptions and themes of Nina's knowledge of technology integration coded within the data.

Table 3: Conceptions and themes of Nina's knowledge of technology integration

Nina				
Praxis	Metacognitive learning through technology	Creativity	Community of learners	Redefining the game
QUEST	Technology philosophy	Values of joy and celebration	Shared ownership	Personal context
Theory-based with a focus on active construction	Pace of learning	Preparation for life	Self-regulation in learning	Conflicting system demands
Relentless probing and questioning	Robust subject matter			

Case 4: Kitty's high school classrooms

Kitty taught in a large, ethnically diverse, high school in a large city precinct. She was a qualified filmmaker before embarking on her teaching career. At this site, Kitty taught Visual Arts, and was the school's leading technology advocate. In addition to teaching her own subject, Kitty supported other teachers' technology integration in History and English curriculum. She conducted competitive digital media programs for students in the senior years. In this context, it was surprising to find Kitty's classroom practices shared commonalities with Gabby's early year's methods but there were also key differences in their pedagogical styles.

Flexibility in her knowledge of technology integration was strengthened by planning and organization, a focus on self-regulation and differentiation. Kitty used a simple ‘3 x 3 rule’ with the Netbook devices where students either worked online, offline, or on paper. This meant if they had left their computer at home they had no excuse to not get on with learning.

Secondly, experiential learning relied on authentic experiences and developing students’ subject matter knowledge through video and art. In her popular digital media projects students made short films for state-wide competitions. For Kitty, creativity was about its aesthetic significance and enabling student learning to be made public using technology. In one example, she used bonsai to create images and outlines in shade and light for students who struggled with creating the visual form. Public learning increased the quality of their work especially when they knew it had a ‘peer or public’ audience.

Kitty’s knowledge of technology integration stemmed from a belief that she was preparing students for life beyond school. She wanted her students to take risks with their learning and technology was the perfect medium to do it. To her, developing students’ sense of personal agency dominated. It was John Dewey (1934) who famously said: “Education is not preparation for life; education is life itself” (p.12). Kitty paralleled this well-known quote when she said:

I am preparing students for life beyond school ... for life. Visual Arts may be the only subject where some students experience success in their learning, and can walk out of school with a sense of how the world is.

The conception of preparation for life was pursued daily, both inside and outside, the classroom. It was the way education happened. This message was given by Kitty to her students through classroom conversations and the manner in which she encouraged students to take risks with their learning. They had the ability to complete tasks and reach personal goals.

Kitty acted to develop a whole school culture of technology integration at the school and this meant all teachers had to take professional responsibility for engaging and using technology in their daily teaching and learning practices in classrooms. She kept up with the pace of technology change by co-teaching with colleagues as a means of encouraging them to keep learning too. Table 4 provides a summary of the conceptions and themes of her knowledge of technology integration coded within the data.

Table 4: Conceptions and themes of Kitty’s knowledge of technology integration

Kitty				
Flexibility	Experiential learning	Creativity	Preparation for a life of learning	Whole school culture
Planning and organisation	Authentic experience	Aesthetic significance	Risk-taking	Professional responsibility
Self-regulation	Developing subject matter knowledge	Learning made public	Self-efficacy	Enacting a role
Differentiation				

Data analysis

The case studies describe particular conceptions of four ‘exemplary’ teachers’ knowledge of technology integration in classrooms of Australian school students in Stages 1-5. Each case featured data analysed into pedagogical themes, comprising diverse teaching strategies and student learning processes. The conceptions and pedagogical themes from Tables 1-4 were validated and further refined during a rigorous process of cross-case analysis where all teachers came together to validate the emergent model.

This step produced clear similarities and points of divergence in their knowledge of technology integration, and these are presented in final form in 22 themes under the conceptions in Table 5 below. The five main conceptions in the HPC model are shown in Figure 1 on page 8.

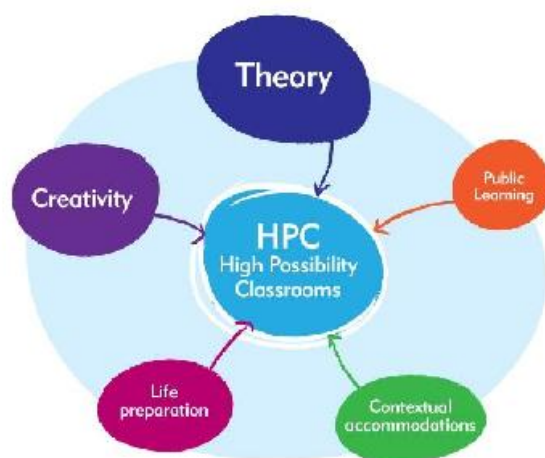
Table 5: Conceptions and themes from the four cases detailing pedagogical strategies and innovative student learning processes

Theory-driven technology practice	Creativity for learning through technology	Public learning through technology	Life preparation using technology	Contextual accommodations using technology
Technology drives construction of learning	Technology boosts creativity	Technology scaffolds performance	Technology operationalises the real world	Technology remains personal and professional
Technology enhances purposeful teaching	Technology creates opportunities for production	Technology enhances outcomes	Technology gives voice	Technology changes time
Technology focuses planning	Technology unleashes playful moments		Technology means ownership and possibility	Technology nurtures community
Technology enriches subject matter	Technology supports values		Technology reveals effectiveness	Technology defines the game
Technology promotes reflective learning	Technology differentiates learning			
Technology shifts conversation and thinking				
Technology engages students in authentic ways				

Moreover, analysis of data in the study showed that the pedagogical approaches in all classrooms varied, as did the technology tools and pathways teachers and students used to create and explore technology integration. What was interesting was that although the teachers believed their outcomes were similar, and their pedagogies were different: “I think we might have adopted different pedagogies but we end up in the same place” said Kitty.

For example, common to all of the teachers in the study is their understanding of learning driven by theory. The teachers take risks with the technology they use; all are confident users, and exhibit trust in students as thinkers. They know and value students as learners, and believe the ‘voice’ of their students is important. Technology is the learning enabler and all four teachers also see themselves as ‘expert learners’. Creativity was about providing opportunities for students to produce or make things, and in so doing the potential for ‘play’ in learning occurs. Such action allows particular learning values to be upheld along with easier differentiation or personalisation of the act of learning. If learning is made public in the classroom it serves to better scaffold how students can learn. How and what they write about, or perform in a task, often results in work of higher quality as opposed to work that is just recorded in a book or on paper. Private work has no audience, or perhaps only the teacher or parents, as its audience. Using technology prepares students for life beyond school; it is what people do in the ‘real world’ in workplaces, in higher education settings and at home. Technology drives ownership and responsibility and what it means to be an effective learner in today’s world. Each school context was able to accommodate what these teachers did at the personal and professional level in their technology integration practices. The teachers created longer blocks of learning time across the school day to allow students to ‘get into flow’. The classroom was about a ‘community of learners on a learning mission’ and it was technology that drove learning. Technology integration is a fundamental ‘game changer’ for all teachers and school leaders in all education jurisdictions must embrace its potential to change how learning is conducted in all classrooms.

Figure 1: *High Possibility Classrooms* or the HPC model



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Discussion and conclusion

New research that forms the HPC model I argue is an example of IL in action and forms what I denote is Action Knowledge (AK). Others have referred to this notion as knowledge-of-practice, knowledge-for-practice and knowledge-in-practice (Neiss & Gillow-Wiles, 2014). Such knowledge surfaced through deliberate study is significant for three reasons. Firstly, because it is drawn from a collection of case studies of ‘exemplary’ teachers’ knowledge of technology integration, where each serves as a motivational exemplar of IL in action and demonstrates what can be achieved using technology in today’s classrooms. Secondly, the research is a clear response to persistent calls in education literature for more case studies of teachers’ practice in technology integration in both Australian (Finger et al, 2007; Jordan & Dinh, 2012) and international contexts (Schrum, 2011). Previous studies of technology integration have, for the main part, revolved around studies of graduate or experienced teachers’ contexts using particular technology devices, like laptops and desk-top computers. And thirdly, the study fills a noted gap in the research literatures, in what is known about knowledge of technology integration in practice from teachers’ perspectives. It is highly personal. Therefore, together this distinctive examination of data from a group of ‘exemplary’ teachers’ knowledge of technology integration in Australian classrooms gives critical, *fresh* insights to what is now known.

The research shows that high level theory driven technology practice, inclusive of the cognitive aspects of learning can counteract pressures some teachers may feel to ‘simply teach to tests’ and disrupt the adoption of more narrow views of learning. Across some education literature there is frequent provocation to resist performative cultures of standardized tests (Chen, 2010; Gardner, 2012, Richardson, 2012), which thinly veil learning in schools in narrow terms, and evidence is provided that such ‘testing regimes’ will not fulfil what students need to lead successful adult lives into the future (Darling-Hammond, 2010; Zhao, 2012). All teachers in the study took the view that technology integration was about opening up learning possibilities, and their practices call on school systems to really imagine education by including the aesthetic and encouraging students to take learning risks. Futures in education in such classrooms are much more about visions of students as empowered learners and the teacher’s seamless integration of technology is the critical driver that enacts students’ autonomy. This kind of vision for classrooms has implications for current education policy agendas in schools.

Education policy that recognizes the importance of teachers continually renewing their exposure to education theories also emerges from the study findings. The teachers had continued their professional

learning beyond initial teaching qualifications and had integrated what was learned from ongoing professional development into practice. They could readily identify theoretical and pedagogical frameworks. One example where this concern was most apparent was creativity. This idea is on the current education policy agenda in many countries and in Australia it has manifested most recently in a new policy on *Creative Australia* (Australian Government, 2013). The attention is on workforces skilled with people who know 'how to be flexible, think and create'. Therefore, teachers in schools have a crucial role in preparing young people for future jobs in creative and innovative industries (Robinson, 2013). When teachers have a central role in defining education in their own context it means they can deepen the focus on learning. When there is less pressure to 'teach to tests' and accountability measures in schools places greater value on the professionalism and judgment of teachers, then opportunities for quality teaching expand. Opening up the current limitations of school education policy is important, and will assist more effective personalization, and customization of learning, that is more relevant and more significant for students. Continuing to play the current 'education game' is arguably not the answer.

Case studies that demonstrate particular teachers' technology integration in action offer strong arguments for considering the HPC model as an example of IL more broadly. The TPACK framework laid the valuable groundwork for the research. From that sound foundation it was possible to identify the new model for technology integration known as *High Possibility Classrooms* comprised of theory, creativity, public learning, life preparation and contextual accommodations. This *fresh* vision provides an original and exciting scaffold for teachers to create the kinds of classrooms that all students need to inhabit in the future.

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FLOWCHARTS: A TOOL FOR COMPUTATIONAL THINKING

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Abstract

New curricula in UK, US and Australia aim to introduce computational thinking into every school. Computational Thinking (CT) teaches how to solve problems by borrowing techniques used in computer science to design programs: problem decomposition, pattern recognition, pattern generalization to define abstractions or models and algorithm design.

An algorithm is a sequence of steps, decisions and repetitions to complete a task. A common approach to introduce CT and algorithms is by exposing primary students to visual programs such as Scratch or Kodu. These tools are engaging and they successfully teach students to develop simple algorithms. However, not all primary school teachers are familiar with them, and they may have constraints both in the access to school computers and the lack of time to upskill. Thus, we propose to support/complement visual programming with flowcharts, as they use plain English, require only pen and paper and can be applied to multiple subjects of the primary school curriculum.

Flowcharts are a good introduction to CT, as you could start with simple step-by-step procedures, and gradually introduce decisions, branches and repetition. In this paper we will review ways to incorporate CT with flowcharts into the primary school curriculum that is aligned with the ACARA Digital Technologies curriculum's content descriptions for algorithms at years F-6.

Introduction

Most primary school students regularly use computers, and produce their own digital documents such as multimedia presentations or reports. Thus, ICT is embedded in the curriculum but recently there has been a significant drive to extend and/or replace ICT with a basic understanding of computer science concepts. According to Guzdial (Shein, 2014),

"If someone is going to become a knowledge worker, or take on any job, that requires an undergraduate degree, they should know how to read a piece of code that is useful to them and be able to make changes to it." (p 16)

Following this recent trend, a curriculum that aims to teach some introductory Computer Science (CS) at F-10 level has been drafted in Australia (ACARA, 2013). Even though this is a noble goal, that has the potential to provide better opportunities to students in a knowledge economy, it poses pedagogical challenges. It is not enough to repackaging existing CS curricula and teach them at early stages.

One of the major issues is how much programming should be included as basic computer science? Programming is a core skill in computer science and involves abstract reasoning. Children typically develop the ability for abstract reasoning around the age of 12. Furthermore, writing descriptions in an unfamiliar programming language will be difficult for a student who does not yet have a good understanding of the processes that these descriptions are aimed to capture (Lu, 2009).

Two approaches to deal with this challenge are

- Using visual programming languages, which enable learners to avoid dealing with syntax, that often distracts them from process of learning. Besides, by producing visual outputs (animations or pictures) it both motivates the students and provides instant feedback.
- Introducing algorithmic thinking and problem-solving skills that are the backbone of the program creation using examples from everyday life such as writing a recipe or giving directions.

In regards to the second approach, Jeannette Wing (2006) coined the term *computational thinking (CT)* which she later defined as follows (Wing, 2010):

“The thought processes involved in formulating problems and their solutions so that the solutions are represented in a form that can be effectively carried out by an information-processing agent” (page 1)

In other words, computational thinking is what comes before writing the program, and is a core skill that should be taught to every student (Shein, 2014). CT focuses on learning problem-solving skills in computer science, similar to learning problem-solving skills in mathematics. From now on, we will refer to CT to cover in depth the second approach, including algorithmic thinking.

Visual programming has gained popularity in upper primary and middle schools in the last 5 years, and as a consequence there are many teaching materials available for it. Scratch (<http://www.scratch.mit.edu>), which has been around since 2003 is the most popular visual program, but in the last few years other variations of visual programming this such as Tynker (<http://www.tynker.com>) and Kodu (<http://www.kodugamelab.com>) have also been used at primary level and in many extra-curriculum activities such as CS clubs and holiday camps. A YouTube search for “Scratch games” returns 704,000 videos, many posted by primary students and/or teachers while a similar search on “computational thinking” returns 5,450 videos, most of them posted by academics/industry to promote the need to teach CT, and only a handful involving primary teachers or students. However the second approach is started to gain momentum due to curriculum changes in US (CSTA, 2012), UK (Computing at School, 2012) and Australia (ACARA, 2013), that aim to teach computer science concepts to every student.

Introducing the basic concepts of CT (sequential algorithms, conditions and decomposition) will improve the student’s critical thinking skills and encourage in-depth learning. We believe having prior experience in CT will enable primary level students to easier understand the fundamentals of visual programming. Furthermore, not all primary school teachers are familiar with visual programming languages, and they may have constraints both in the access to school computers and the lack of time to upskill. Thus, we propose to support/complement visual programming with flowcharts, as a tool to introduce CT at primary level.

The rest of the paper is organized as follows: firstly we will review the scope of CT and its place in the Digital Technologies curriculum. Then we will introduce flowcharts, their notation and explain why they are a good fit to support CT at years F-4. We will also show a range of examples of embedding flowcharts and CT in primary lesson plans, followed by some conclusions.

Computational Thinking in the Australian Curriculum

In this section we will present the key concepts and practices of computational thinking, discuss how CT fits inside Bloom’s revised taxonomy of learning (Anderson & Krathwohl, 2001) and see how CT fits in the new Australian curriculum.

There are many definitions of Computational thinking (Lu, 2009; Google, 2012; Wing, 2006), all capturing key concepts such as abstraction, algorithmic thinking and efficiency, but with difference emphasis or terminology depending on their target audience. The definition quoted next is published by the International Society for Technology in Education (ISTE) and the Computer Science Teachers Association (CSTA) (<http://csta.acm.org/Curriculum/sub/CurrFiles/CompThinkingFlyer.pdf>) and is aimed at school teachers and educators.

“Computational thinking (CT) is a problem-solving process that includes (but is not limited to) the following characteristics:

- 1. Formulating problems in a way that enables us to use a computer and other tools to help solve them.*
- 2. Logically organizing and analyzing data*
- 3. Representing data through abstractions such as models and simulations*
- 4. Automating solutions through algorithmic thinking (a series of ordered steps)*
- 5. Identifying, analyzing, and implementing possible solutions with the goal of achieving the most efficient and effective combination of steps and resources*
- 6. Generalizing and transferring this problem solving process to a wide variety of problems”*

Abstraction is a key principle in CT, which is crucial to deal with complexity of problems that require computational thinking skills. Algorithmic design also provides opportunities to learn abstraction, decomposition, iterative and conditional thinking. Other definitions (Google, 2012) use the terms pattern recognition and generalization, which are implicitly included in points 4 to 6 in the list above. Pattern recognition looks for similarities in the problem cases that can be used to design efficient algorithms; pattern generalization and abstraction allows us to represent an idea or a process in general terms (e.g., variables) so that we can use it to solve other problems that are similar in nature.

Computational thinking requires students to develop higher order thinking skills in Bloom’s pyramid: applying, analyzing, evaluating, and creating. For example, the CT activity described in Figure 3 later in this paper asks students first to *apply* a simple grammar rule to a list of words, *analyse* the result and *create* an improved version of the rule to accommodate the exceptions they found. They are also expected to *evaluate* the modified rule with a larger set of words. This approach will deepen their understanding of English grammar compared with the standard approach of the teacher providing the complete rule with exceptions to start with, and ask the students only to understand and apply the rule.

The Australian Digital Technologies curriculum has two inter-related strands: (i) Digital technologies knowledge and understanding and (ii) Digital Technologies processes and production skills. The second strand includes both “Managing and analyzing data” and “Specification, algorithm and implementation” as key components, which covers most of the CT characteristics listed above.

In regards to organize and analyse data, students in F-2 are expected to recognise and play with patterns in data (content description ACTDIK002) and to collect a range of personal, family and class data and use digital systems to organise and present the data (as explained ACTDIP003). Furthermore, students in years 3 and 4 should recognise a variety of different data types and explore different representation of the same data (ACTDIK008) and collect, access and present different types of data using spreadsheets, databases or other software to create information and solve problems (ACTDIP009). By the time students reach years 5 and 6, they should acquire, store and validate different types of data and interpret and visualise data in context to create information (ACTDIP016).

In order to learn algorithmic design, students in F-2 are expected to follow, describe, represent and play with a sequence of steps and decisions needed to solve simple problems (ACTDIP004). On the other hand, students in years 3 and 4, should be provided with opportunities to learn how to define simple problems, and describe and follow the algorithms needed to solve them (ACTDIP011); they should implement simple digital solutions as visual programs with algorithms involving branching and user input (ACTDIP011). When students are in years 5 and 6, they should be able to follow, modify and describe simple algorithms involving a sequence of steps, decisions, and repetitions that are represented *diagrammatically* and in plain English and implement the solutions using visual programming (ACTDIP019, ACTDIP020).

Flowcharts

A flowchart is a visual representation of the sequence of steps and decisions needed to perform a process. Most processes can be described using the 4 basic flowchart shapes shown in Figure 1(a). A process will have a start point and one or more exit points, which are represented with an oval shape. Each step in the sequence is noted within a rectangular shape and indicates an action, command or task to be completed. Steps are linked to each other by directional arrows. Decisions are represented with a diamond shape and test a condition or Yes/No question to decide which step to complete next.

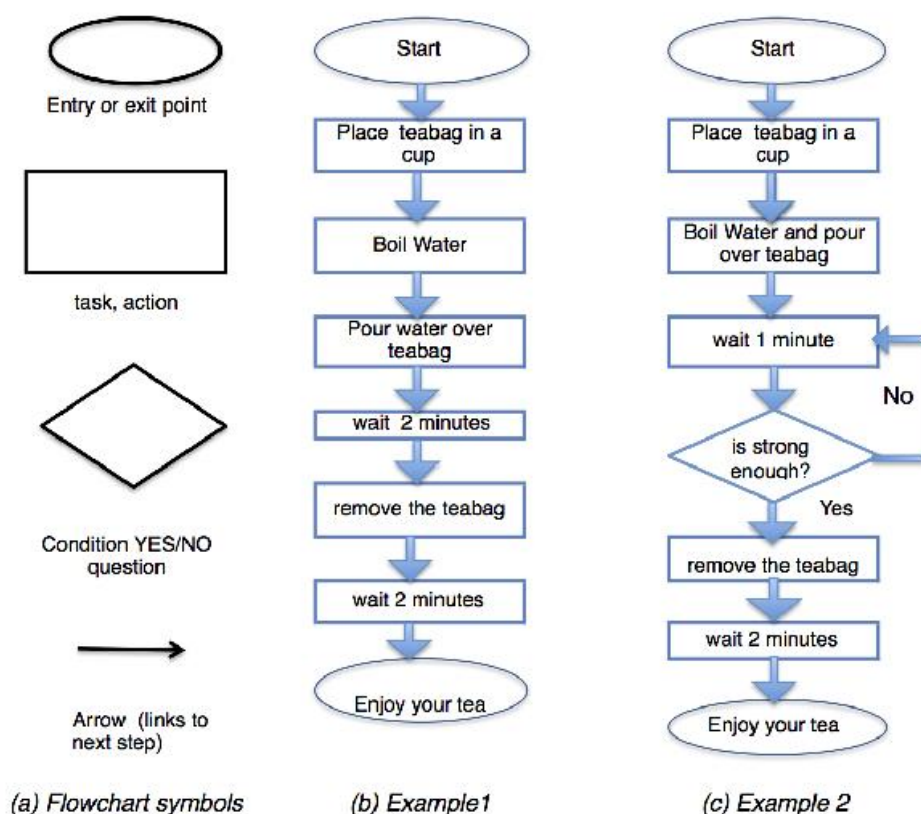


Figure 1. Flowchart symbols and example of use to describe a “make a cup of tea” algorithm.

Simple procedures, such as a cooking recipe, are a list of sequential steps. Figure 1(b) shows how we can use this flowchart notation to describe how to make a cup of tea. Our first example shows the six steps required: place the teabag in a cup, boil the water, pour it over the cup and wait 2 minute to infuse, then remove the teabag and wait for the tea to cool down. This process is clear and concise but will produce a cup of tea of fixed strength, regardless of how strong you like your tea. Figure 1(c) includes a condition, represented with a diamond shape, so you can adjust the waiting time to your own preference. Note the arrow from the condition returning to the previous step provides the semantics for repetition.

Flowcharts support computational thinking by breaking a complex process into a series of steps and decisions. Each flowchart step can be refined by asking yourself "Is this step necessary? Can it be improved?". For a teacher handout to the introduction of flowcharts, refer to the online flowchart worksheet (Robotics Academy, Carnegie Mellon University, 2005)

Reasons to use flowcharts

Flowcharts are a good tool to gradually introduce computational thinking at primary level. Charts and posters are widely used at Year F-2, to explain simple class rules and processes. Many of them could be easily converted to flowcharts so that students become familiar with the flowchart notation and can

read simple descriptions such as those shown in Figure 1. Students at Year 3-4 should be able to write their own flowcharts to describe daily actions and alternatives and become fluent in breaking big tasks into smaller tasks.

Flowcharts are also a simpler tool for primary teachers to learn and master compared with most programming languages. Some CT activities at primary level include simple *python* or *javascript* program. By using a flowchart in place of the program, we remove the need for primary teachers to learn a programming language in order to teach computational thinking. Familiarity with flowcharts will also help both students and primary teachers to be ready for the introduction of visual programming languages at upper primary level; they could easily grasp the concept of creating and executing programs by being familiar with writing and carrying out the actions of the equivalent flowcharts.

Flowcharts support visual learners who prefer to access and understand new information using images, maps and other graphical representations. Flowcharts can also be used in kinesthetic activities in which students perform the actions shown in the flow chart.

Embedding flowcharts in the primary school curriculum

In this section we will see how we can make small changes to primary school activities by editing the lesson plans to include the use of simple flowcharts. Most of the examples are based on activities that have been published online by primary teachers.

Flowcharts in Maths

Our first example is inspired by a poster on subtraction provided in an online mini-lesson (Teachers pay Teachers, 2013). We have created a new subtraction flowchart that follows the standard notation introduced in figure 1. We added a decision step to check if the top digit is smaller than the bottom one. If the answer is *YES* the next two steps complete the regrouping; otherwise these steps are skipped as shown in Figure 2.

We should note that by adding a few more steps to the flowchart, it could be used to explain subtraction for larger numbers, as this is a repetitive process in which we move one digit to the left and repeat the same steps including the new step we added (to test whether the top digit is larger than the bottom one). Thus a possible extension activity is to ask the students to extend the current flowchart for 3-digit number subtraction. Alternatively, we could review their understanding of addition by asking the class to write a flowchart that describes the process of adding 2 numbers.

We can see there are many other examples used by teachers with step-by-step instructions that would need only minor notation changes to become standard flowcharts. With regular exposure to this consistent notation, primary students will effortlessly become fluent in reading and writing their own flowcharts.

The online repository “Exploring Computational Thinking” (Google, 2012) has a mathematics activity called “Percentage change” which provides 5 word problems; it shows how to calculate the percentage for three of them. After students complete all the 5 problems, the activity asks students to design an algorithm that another student could follow to compute percentage increases and decreases. Some sample questions are provided to identify the key steps of the algorithm. The students could be asked to write the algorithm using a flowchart. The second part of the lesson provides a python solution, which they are asked to compare with their algorithm. This step could be used as a way to link flowcharts with their first exposure to Python. Alternatively, we can replace the Python code with its equivalent flowchart. In both cases, by comparing algorithms students can learn that there are multiple ways to approach a problem, and may realize that they have skipped over some steps.



Figure 2. Flowchart description of subtraction procedure

Flowcharts in English

We will start with a simple example provided by (Lu and Fletcher, 2009), in which Year 3 students are asked to sort a list of sentences in chronological order. The paper explains how this exercise, shown below, gives teachers a chance to discuss the concepts of state and search space and suggest three homework questions to reinforce the lesson on exploring a range of solutions.

Given the four sentences

1: I don't want pizza again for a long time.

2: I ate ten pieces of pizza.

3: Later that night, I got sick.

4: I felt very full.

Which of the following sentence orderings is correct?

a) 1, 3, 4, 2

b) 4, 3, 2, 1

c) 2, 3, 1, 4

d) 3, 1, 4, 2

e) 2, 4, 3, 1

Homework questions

1. What is the correct ordering between 2 and 3?
 2. Which of the states in the search space have 2 and 3 in the wrong order? Can these answers be correct?
 3. What are some other possible states not listed?
-

We could adapt this exercise so that the four sentences are printed in rectangular cards and students are asked to pin them into a board to create a flowchart. Similarly, we could print the steps of a cooking recipe into cards and ask the class to sort the steps, while discussing the reason to choose that particular order.

When developing writing at upper primary levels, we could ask students to write their own stories, with one sentence per card, shuffle them and give them to another students to sort out. If the order chosen by the second student does not match the original story, it may reflect the need for linkers from one sentence to the next.

Pattern recognition and grammar rules

Flowcharts are good at explaining grammar rules and their exceptions. We will illustrate this with the activity “Present Participle” from the online lesson repository *Exploring Computational Thinking* (Google, 2012) that we have edited to replace the Python program provided with the equivalent flowchart. This example teaches the formation of the present participle by looking at many sample verbs and identifying the underlying pattern. Figure 3 shows the python code provided by the online activity and its equivalent flowchart.

Python code

```
myverb = raw_input('please enter a verb: ')

def ing(verb):
    pres_part = verb+'ing'
    print '\n present participle:', pres_part

ing(myverb)
```

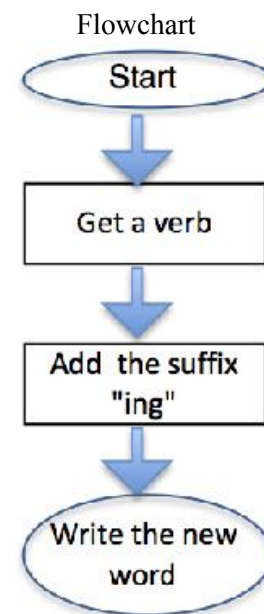


Figure 3. Present particle formation rule

Students are asked to follow the flowchart actions shown in Figure 3 with four sample verbs: *play*, *make*, *create* and *sing*. After looking at the words produced, the class is asked to discuss which words are now misspelled and how to correct the spelling. Could they modify the flowchart so that it works for the 4 sample verbs?

Student should identify that there is a special case that has a different rule, the verbs ending with 'e'. Then, they should be able to add a condition to the flowchart after the first step with an action to remove the last letter if the letter is 'e'. Therefore, this activity is teaching the grammar rule for the present participle and at the same time introducing the concept of patterns and pattern recognition. After the program/flowchart is updated, the testing of the rule is repeated with a new sample words: *run, learn, jump, stop and see*. This step leads again to a discussion of the last special case for the formation of the present participle.

Similarly, the activity "Indefinite Articles" from the same lesson repository (Google, 2012) asks students to investigate patterns in the usage of 'a' and 'an'. After studying several examples, they should be able to write an algorithm or flowchart to explain when to use each of these indefinite particles.

Classroom rules flowchart

Flowcharts provide a good representation of routines in which a list of steps is carried out in a regular order. Many primary classrooms have a "start of the day" or "end of the day" routines in which students are expected to unpack/pack their bags, hand in any notices, etc. Some teachers may have a notice board that lists this set of actions, which can be easily converted (if is not already) into a simple flowchart. Similarly, other school routines could be described in this manner. For example, an emergency plan or a bullying response plan can be described using a flowchart.

When appropriate, students could be asked to develop their own response plan for a given scenario. By comparing and merging actions from the different flowcharts, the class could agree on the best strategy and the final flowchart posted to remind students on the response they have developed. Quality Learning Australia (2008) case study for a Grade 5/6 Mathematics Program at a primary school in Victoria shows the result of this approach: a hand-written flowchart that describes the learning process a student should follow when doing their Maths homework. Similarly, it includes a second flowchart describing action students could take when they complete their work.

Phil Bagge provides an excellent set of CS resources for primary schools at Junior Computer Science (<http://code-it.co.uk>), including a range of flowcharts to describe the rules of popular playground games such as "IT" or "hide and seek". It also provides some bugged flowcharts to run an activity in which students need to find out what is wrong with the flowchart and correct it.

Summary

The new subject Digital Technologies will require primary teachers to introduce computational thinking (CT) in an already crowded curriculum and with limited school hours. In this paper we have review the scope of CT and proposed the use of flowchart as a first step to introduce algorithm design and decomposition at the F-4 year levels.

Flowcharts are simple to learn and support visual and kinesthetic learners. Fluency in reading and modifying simple flowcharts will set the foundations for more complex algorithmic thinking in the middle and upper school years. The paper has provided examples of a range of CT activities at primary level that can be embedded with minimal effort into other curriculum subjects.

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REDEFINING EDUCATION FOR THE DIGITAL AGE: A SNAPSHOT OF THE STATE OF PLAY IN THREE QUEENSLAND SCHOOLS

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Abstract

As curricula change, so must the tools used by learners and teachers and the plethora of mobile digital devices will likely play a major role in redefining education. The Digital Education Revolution (DER), with funding of more than \$2 billion, was intended to provide Australian students with a world-class education system underpinned by the effective use of Information and Communication Technologies (ICT). In Queensland, DER funding provided 141 000 laptops to students in Years 9-12. However, now that DER funding has ended, the Queensland government and schools are considering BYOD options, in order to maintain a 1:1 ratio of computers to students. This paper reports the progress made by three Queensland schools with the use of mobile digital devices, whether supplied by the schools or the students themselves, and outlines significant positive outcomes and challenges experienced by these schools as a guide to other schools when embarking on mobile digital initiatives. Further, the study is framed within the methodological context of the Vital Case Studies undertaken in England (http://edfutures.net/Research_Strategy) and draws comparisons between the results of those studies and other schools across Australia involved in the Australian Snapshot Studies.

Context

As school curricula change, so must the tools used by learners and teachers. There is an increasing diversity of digital devices used in education systems worldwide and enhanced classroom access to personal mobile digital devices by students and teachers is an emerging trend. These devices enable students to choose how, when and where they access learning opportunities and afford teachers opportunities to redefine their pedagogy. The Digital Education Revolution (DER) was funded with more than \$2 billion from the Australian Government, to provide Australian students with a world-class education system underpinned by the effective use of Information and Communication Technologies (ICT). In Queensland, DER funding provided, among other resources, 141,000 laptops to students in Years 9-12. Now that DER funding has ended and 1:1 computing is becoming an expectation within school communities, the Queensland government is considering Bring Your Own (BYO) options (Bita & Chilcott, 2013) in order to sustain and expand a 1:1 ratio of computers to students. Lee (2012) distinguishes Bring Your Own Device (BYOD) from Bring Your Own Technology (BYOT), though both require pupils to bring their own digital devices to school. The Queensland Department of Education, Training and Employment (2013) coined the term BYOx to include models in which students are allowed to bring only devices with a specific specification (x).

This project investigated the progress made by three Queensland schools with the use of mobile digital devices, whether supplied by the schools or the students themselves. The results reported in this paper, informed by content analysis of the three school data sets, indicate that the introduction of a 1:1 approach had encouraging outcomes including enhanced learning opportunities and motivation for learning. This paper reports the experiences of the three schools and notes implications as a guide to other schools when embarking on 1:1 computing initiatives.

Mobile Learning [m-Learning] and BYOD/T

m-Learning is one of the fastest growth areas in the study of ICT in education (Pegrum, Oakley & Faulkner, 2013). It embraces learning that is mobile, facilitated by a digital tool that can be carried anywhere the learner goes. The popularity of mobile handheld devices has increased dramatically in the past couple of years. The *Horizon Report* in 2011 suggested that by 2015 80% of people accessing the Internet would be doing so from a mobile device and Internet-capable mobile devices would outnumber computers (Johnson, Smith, Willis, Levine & Haywood, 2011, p. 12). The 2013 *Horizon Report* (Johnson, Adams, Cummins, Estrada, Freeman, and Ludgate, 2013) identified that “Tablets, smartphones and mobile apps have become too capable, too ubiquitous, and too useful to ignore” (p. 17). Norris and Soloway (2011) predicted that by 2015 every K-12 student in the USA will be using their own mobile device. Given the apparent rate of uptake for smartphones in Australia and the long history of 1:1 computing in Australian schools (Albion, 1999) it seems reasonable to expect that Australian schools will experience similar trends.

Technologies have the potential to support a range of pedagogical approaches and educators around the world are exploring the affordances of each new technology to enhance and transform curriculum, learning and teaching. Numerous research studies have investigated the impact of mobile technologies on education (Hwang & Tsai, 2011). Australian studies include the 2011 *iPads for Learning* project in Victorian schools (DEECD, n.d.), which concluded that “quality of teaching, combined with purposeful and effective use of ICT contributes to improved learning”.

It must be remembered that mobile digital devices were not specifically designed for education and must be repurposed for learning and teaching contexts (Traxler, 2010). For example, the small size of some screens, while making the device more mobile, also poses problems for emerging readers. While individual devices have specific affordances and constraints in education contexts, a BYO approach poses challenges of a different kind in terms of “the standards and specifications of the devices permitted to be used in class and, in particular, to log into an institution's network, with all of the attendant implications for institutional policies as well as IT support” (Pegrum, Oakley & Faulkner, 2013, p. 70). BYO will require careful attention to network speed and capacity, as well as network security (Traxler, 2010). Pedagogically, it has been suggested that teaching in distributed, 1:1 personalised environments, such as those created by BYO, will pose a new set of challenges for teachers, requiring them to acquire a new pedagogical skill set. Mobile literacy will require explicit development and therefore explicit teaching (Parry, 2011). Pegrum (2010) has suggested that BYO will intensify issues that exist to some extent in all networked learning contexts, but it may be more problematic for teachers within a mobile 1:1 BYO environment to guide, capture and document learning (Pegrum, Oakley & Faulkner, 2013).

Studies have indicated that the success of 1:1 projects is reliant on the school context; for example the school community socio-economic status; the readiness to embed vision and policy aligned with 1:1 computing; the teachers’ attitudes and beliefs about 1:1 computing; the capacity to implement the innovation; and the support for technology adoption including technical support and professional development of staff (Fleisher, 2012). If sections of the school community are not open to the use of 1:1 devices to enhance learning and teaching, and the policies and practice are not in place, limited success will be achieved.

BYO programmes are based on the premise that mobile devices are in widespread use among young people (CoSN, 2012). Schools, it is argued, can benefit from using these devices in classes because the

students are already familiar with them, removing the need for technical familiarisation (Azzurri, 2011). Ofsted (2011) see further benefits as BYO can engage students and parents in learning at school and at home.

Method

The three Queensland school cases reported in this paper represent a subset of thirteen Australian schools studied using a similar methodology between September and December 2013. The three Queensland schools were purposefully selected as they had been identified previously as schools that were pioneering the use of mobile digital devices for teaching and learning and were convenient to the university campuses of the researchers. Table 1 summarises the demographic characteristics of each of the three Queensland schools.

Table 1 Summary of the three Queensland schools

	School F	School G	School T
Type	Independent co-educational	Independent	Catholic Boys
Location:	Fraser Coast	Gold Coast	Toowoomba
Phase	F-12	F-12	5-12
Students enrolled	470	1200	750
No of teachers	32	80	70
Digital technology strategy	5 shared class sets of iPads & laptops (years F-6); 1:1 iPads (Years 7-9); BYO laptop (Years 10-11)	1:1 iPads (Years 5-12)	1:1 iPads (Years 8-10); laptops years (11-12)
Year group & subjects observed	Year 9 SOSE & Year 6 English	Year 7	Year 8 History

The research design in each of the three Queensland schools followed the approach devised for the Becta Tablet PC Evaluation (Twining et al., 2005) and also used in Vital's 22 case studies (see http://edfutures.net/Technology_Strategy_Case_Studies). The data were collected using questionnaires, audio recorded focus groups and interviews, classroom observations and viewing a small group of students' work portfolios. The main difference between the Queensland school studies and the Becta/Vital studies was that all the data collection was undertaken in one school day in each of the Queensland schools, as opposed to several days spread over at least three weeks. The participant sample in each school was pre-arranged using the basic design formula outlined in Table 2, and two members of the research team visited each school in October 2013. One member of each research pair was the same for all three schools, and this researcher also led the Becta and Vital studies noted above. The completed questionnaires were collected on the days of the school visits. The data were analysed manually using an emergent theme analysis building upon the themes that had previously been identified in the Vital Studies (see http://edfutures.net/Digital_technology_trends).

Table 2 Participants and instruments used in each of the three Queensland schools

	School F	School G	School T
Questionnaire		Deputy Principal ICT coordinator Yr 7 Teacher	Principal ICT coordinator 4 teachers Parent
Interview	Principal ICT coordinator Yr 6 Teacher Yr 9 Teacher Parent	Deputy Principal ICT coordinator Yr 7 Teacher Parent	Principal ICT coordinator Teacher HOD SOSE Teacher HOD English ICT technician Parent
Focus group & Portfolio (Student work) Observation	1 Yr 11 & 2 Yr 9 students Yr 6 ICT Yr 9 SOSE	3 Yr 7 to 10 students Yr 7 Japanese	4 Yr 8 to Yr 10 students Yr 8 Humanities

Results and Discussion

The School Contexts

The three case study schools, located on the Fraser Coast (F), Toowoomba (T) and the Gold Coast (G) in Queensland were described fully in three EdFutures publications available online as indicated in the Table 3.

Table 3: The context, vision, technology strategy, impact and emerging trends of the three Queensland schools

School	Location of report
F	http://edfutures.net/images/1/11/SS4_report_final.pdf
T	http://edfutures.net/images/4/40/Snapshot_Study_5.pdf
G	http://edfutures.net/images/6/60/Snapshot_Study_6_Report.pdf

Commonalities and differences among the 3 Queensland schools

Brief analyses of each school are presented below followed by a discussion of common issues emerging from them.

School F

Teacher, parent and student participants in **school F** all commented about: the affordance of mobile technology to allow students to work in groups; problems with the various forms of technology tried so far; older students being more likely to own a laptop leading to the BYOx approach they had adopted for Years 10 and 11 who could bring their own laptop; using tools such as browsers and built-in cameras rather than apps; students having ‘fun’ with iPods; being able to communicate with the class online; ideal classroom scenarios; and the need for teachers to retain control of the classroom situation.

Participants approved of the school’s BYO device policy and user agreements. The educational vision expressed by the Principal, however, did not converge with that of the teachers, parent or students. The Principal’s broad-brush vision related to students “feeling better about themselves today than yesterday. Knowing they had learnt something today they didn’t know yesterday”. The teachers, parent and students’ visions all related to specifics of curriculum requirements and using technology to enhance learning and teaching.

Participants also commented that teachers have to be willing to integrate technology, and possess effective classroom management skills to handle student use of 1:1 devices. Teachers require professional development (PD) on how to use technology to transform pedagogy and facilitate learning with technology. The option of moving toward a BYOD/T model was discussed by the Principal, ICT Coordinator, students, parent and both teachers as a more sustainable option for the school. The Year 9 teacher spoke a lot about doing curriculum tasks with prescribed software where there was no scope for students to choose the software/app for themselves. She was concerned that students could not use a specific piece of software she thought they should know how to use and the variety of experiences and technology tools often resulted in her having difficulty in maintaining control in the classroom. She believed it was important for teachers to maintain an expert persona with technology in the classroom. This links with the need for ongoing PD. The same teacher also described the ideal classroom scenario with technology as “when everything works perfectly, every child would be engaged and doing what they needed to with their own technology tools. Teachers would have the classroom management skills to handle students’ free use of technology for learning without blaming the technology for causing the problem”. The concept of ‘problems’ with the students using technology in the classroom related specifically to the technology malfunctioning and/or disruptive students, and was raised by the Principal, both teachers and the students themselves. The school has tried to deal with these ‘problems’ through *management arrangements* (e.g., user agreements, ICT policies, confiscating devices and removing user privileges, and organisation of devices for class use on powered trolleys) but the prevalence with which ‘problems’ were mentioned indicates that they are still of concern and a focus of attention at School F.

School G

In **school G** the basic structure of lessons had not yet changed though there was much greater variety in the activities that students undertook as a result of having the iPads; for example, the ability to easily share files had increased peer-peer collaboration in some classes. Some teachers were concerned about students being distracted as a result of having access to the iPads, though others felt that the level of off-task activity was similar before the 1:1 iPad strategy was implemented. A key difference was that off-task behaviour was less disruptive of the whole class than it had been before the iPads were introduced. The use of email had increased the speed of communication with parents, though this was not entirely seen as a positive.

Overall, the move towards 1:1 in school G was seen as inevitable, with two key factors learned by the administration from the process so far: ensuring WiFi capacity to meet growing use, and the need to engage all stakeholders, including parents who need support in knowing how to manage their children’s use of the devices at home. Teachers, initially daunted, found many “easy, creative and amazing things out there” that could be implemented quickly, though they acknowledged that it may take years for fundamental pedagogical change. Whilst younger students preferred to use iPads rather than laptops, there was more resistance to iPads in the senior years. This reflected the greater complexity of the work that the older students needed to do and raised questions about whether iPads were the best device across the whole school. In practice the older students had already started bringing in laptops as well as their iPads with the school moving to a Many:1 model in Years 10 to 12, in which students used the iPad as a companion device, but could also bring in other devices such as laptops.

School T

In **school T** the parents, ICT coordinator and teachers all referred to the ongoing PD made available for both the staff and parents as one of the successful strategies of the project. The workshops and information provided to parents continued beyond the introduction of the devices, and parents have valued being kept in the loop throughout the implementation. There has been an increased use of the technology by teachers who might be labeled ‘laggards’. However, much of the use has been to replicate what they had previously done with pen and paper or a standard whiteboard rather than being innovative. Interestingly, parents, students and teachers all identified the issue of off task behavior as a concern. As with school G though, the off task behaviours largely had little impact on other students. The students appeared to have no difficulty with the new technology; however, parents thought that they often did not have the technical skills to use or monitor student use of the device, especially at the

beginning. Parents did perceive that their children were more motivated to complete their school work when using their iPads. As with the other schools, the students perceived that they were working collaboratively more often, they were also producing assessment responses that included more digital information (e.g., photos, data) or presentations (e.g., digital video) due to access to the devices. There was ongoing exploration, by students and teachers, for additional apps that might be provided on the iPads to enhance learning and teaching. A future goal of the school was to explore a more blended approach for their teaching and learning.

Implications

Notwithstanding some of the issues raised in each of the schools, there were positive outcomes from these three cases related to the use of 1:1 devices which enhanced learning opportunities and increased motivation for learning. For schools exploring 1:1 projects the data from the three Queensland schools identified four areas which need to be considered: sustainability, device selection, off task behaviours, and training for all.

Schools should consider their context when investigating sustainability. They need to decide who pays and how much they are prepared to pay, for both the initial outlay and ongoing maintenance of the devices and infrastructure. The funding considerations should include the ongoing development of the network infrastructure such as wireless network, software/apps, technical support and so forth. The use of BYOD/T/x places a significant proportion of these costs on to the parents and in some schools this may lead to equity issues. Schools moving to BYOD might consider whether there is capacity for them to modify how they use their current IT budget for the provision of laboratories, class sets of devices or school owned 1:1 devices and wireless networks. Who provides the device will impact on the students' feelings of ownership.

When selecting devices schools should bear in mind initial and ongoing costs, support and maintenance required, screen size, battery life, how quickly they start up, ability to complete specific tasks related to software available, ability to lock down or monitor the use of the devices, and access to networks. Different devices offer different opportunities; for example, laptops can be locked down (less feeling of ownership, less distraction) whereas iPads cannot be locked down (more ownership, more scope for distraction). Another consideration that emerged from the data was whether the school required each student to have the same device or were their teachers comfortable with students having access to a range of different devices even within the same category of devices (e.g., laptops vs iPads, or merely different brands of laptops)?

Strategies for dealing with off task behaviours, both at home and at school, need to be investigated and implemented. Parents and teachers need to be aware of strategies to overcome this issue. It would also be useful to discuss with students what they can do when they realise they or their peers are off task.

Initial and ongoing training should be provided for students, parents and teachers. Prior to providing students with access it is beneficial to provide teachers access so they can develop competence and confidence with the devices. Teachers also require continuing professional development as they try new apps, devices and teaching approaches. These three studies indicate that students required minimal support; however, parents benefitted from access to a range of training and information sessions.

Conclusions

The three Queensland Snapshot studies confirmed several of the emerging technology trends noted by the Vital studies in England: provision, network, funding, management, professional development, pupil and teacher roles (see Twining, 2014). They highlighted the need for schools to have a shared educational vision and for all stakeholders (Principal, teachers, parents, students, IT managers) to have input into creating the vision, understand the shared vision and most importantly, know how digital technologies might be used to enable the school to achieve their vision. Pedagogically focussed

professional development for teachers is a critical element that will afford teachers and schools the ability to unpack and examine the ways technology can be used to achieve the school's vision. Beyond these fundamental pillars, issues related to the robustness and suitability of devices and networks need careful planning to ensure sustainability of any 1:1 program. The data from these three schools also confirmed that no single device will do everything that schools, teachers and students from F-12 require, and schools should be prepared to vary the device requirements based on year level and curriculum requirements.

The rapid rate of development of new technologies, and the parallel speed of uptake of them by the community at large, has caused educators and researchers in the field to caution that there is a danger that the technology will be emphasised at the expense of pedagogy and content (Pegrum, Oakley & Faulkner, 2013). A powerful argument has been framed to suggest that, especially in education, pedagogy and content should be privileged over technology (Dudeney, Hockly, & Pegrum, 2013). What is important in the field of m-Learning is not the technology per se, but *how* it is used to support learning and teaching.

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ACEC2014-ADAPTING AN INSTRUMENT TO MEASURE TEACHER TPACK

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Abstract

Developing a valid and reliable instrument to measure teacher TPACK continues to be one of the main areas of TPACK research. Researchers argue that developing such an instrument could aid teacher professional learning, and support the design and evaluation of teacher education programs. Some researchers such as Graham (2011) suggest that efforts are compounded by theoretical issues around defining ‘what’ constructs to measure, and clarifying ‘how’ these constructs relate to one another.

This paper examines this quest to develop a TPACK instrument. It focuses on the development and use of the Survey of Preservice Teachers’ Knowledge of Teaching and Technology (Schmidt et al., 2009b), originally designed to measure the TPACK of Pk-6 pre-service teachers majoring in elementary or early childhood education. This instrument has been highly influential and has been adapted and used by researchers in the United States, Taiwan, Singapore and Australia.

This paper examines how these researchers have used this instrument and the adaptations they have made to increase reliability and validity, including adaptations to the self-assessment scale, constructs, and items.

The TPACK framework

Developed over a number of years and various iterations, the TPACK framework by Mishra and Koehler (2006), is a highly influential conceptualisation of teacher knowledge in relation to ICT (Abbitt, 2011; Graham, 2011; Harris, Mishra & Koehler, 2009; Thompson & Schmidt, 2010). The central premise of the framework, that effective integration of ICT requires more than technology knowledge, and that moreover, requires multiple knowledge sets, which are both framed by and influenced by context, has resonated with the educational technology community and a considerable body of research has been the end result. Researchers have been particularly interested in developing a reliable instrument to measure teacher TPACK knowledge in the belief that such a development could influence teacher education and teacher professional learning (Albion, Jamieson-Proctor & Finger, 2010; Koh & Chai, 2011).

The TPACK framework builds on Shulman’s (1986) view that Content Knowledge (what to teach) and Pedagogical Knowledge (how to teach) are interconnected, and together form Pedagogical Content Knowledge or PCK. Mishra and Koehler (2006) argue that while technology knowledge is included within this view, it needs to be reconceptualised as a separate knowledge domain, given that teaching with digital technologies requires more complex knowledge than teaching with the traditional technologies available in Shulman’s time. Thus, their framework has as its base three knowledge domains, Content Knowledge (CK), Pedagogical Knowledge (PK) and Technology Knowledge (TK), which they contend interact and interconnect, thus forming three additional knowledge domains, Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), and Technological Pedagogical Knowledge (TPK) and one triad, Technological Pedagogical Content Knowledge (TPACK).

Theoretical weaknesses in TPACK

While researchers have been quick to embrace the framework, as evidenced by the publication of a large number of conference papers, journal articles, and an increasing number of dissertations, a number of theoretical concerns have continued to be raised in the literature (Abbitt, 2011; Graham, 2011; Brantley-Dias & Ertmer, 2013). Graham (2011) suggests that “while hundreds of studies claim TPACK as theoretical framing, very little theoretical development of the model has occurred.” Brantley-Dias and

Ertmer (2013: 104) in a similar vein argue that “despite this large body of work” issues around clearly defining the framework have yet to be resolved. Drawing on the notion of the ‘Goldilocks Principle’ (the utility of a concept or idea in terms of its size) they suggest the framework is perhaps too theoretically complex; that it is both too big, as it involves seven distinct knowledge domains, and too small, as these domains are difficult to distinguish. Others suggest that the framework ignores the particularities of context (Pamuk, 2012).

Graham (2011) suggests that effective theories have 3 key elements: (1) it clearly identifies ‘what’ factors or elements explain what is being examined (2), it describes ‘how’ these factors relate to one another and (3) it explains ‘why’ this theory is needed. He uses these key factors to frame his critique of the TPACK framework.

Beginning with the ‘what’, Graham acknowledges that on the surface, as 7 constructs have been identified; this key element has been achieved. Yet, as he then suggests, a lack of construct clarity throws this achievement into question and a number of challenges stand in the way of developing this clarity. These include: using an existing framework with established constructs (as issues around defining constructs are then inherited), finding a balance between the need to be comprehensive (identify all constructs) and the need to be simple (identify the main constructs), and lastly, the challenge in developing precise definitions, so there is common agreement around what the constructs represent. Numerous other writers support his position around the lack of clarity in defining the constructs (see for example, Angeli and Valanides, 2009; Voogt et al., 2012). Cox’s (2008) doctoral research argues that there have been some 89 different definitions of the central construct as well as other constructs including technology knowledge.

Turning to the ‘how’, Graham argues that there are two issues to consider; the first issue is to decide on the relationship between the constructs. Graham, as other researchers including Angeli and Valanides (2009) comment that researchers are divided over whether this relationship is an integrative or transformative one, that is whether the three main constructs integrate together to form TPACK, or whether, TPACK is a new and transformed body of knowledge, and not just an amalgam of its parts. The second issue, he argues, while connected with the issue around needing precise definitions, is discriminating between constructs. Angeli and Valanides (2009) also suggest that there is considerable ‘fuzziness’ in the boundaries between domains such as TCK and TPK.

Lastly, Graham refers to the ‘why’, that is, the rationale for the theory and the assumptions that underpin it. Graham acknowledges that the rationale to have a common language to talk about the integration of ICT is an important one, a view supported by numerous researchers including Brantley-Dias and Ertmer (2013). Graham however identifies two issues related to the value of the framework, namely, construct value issues (whether the complexity in the framework adds theoretical value) and the lack of attention to prescriptive value (whether the framework has value in predicting outcomes).

Measuring TPACK

Researchers have been keen to develop an instrument to measure TPACK knowledge (Abbitt, 2011, Voogt et al., 2012). In his review of instruments developed within the context of pre-service teacher education, Abbitt (2011) suggest two parallel approaches have been used: performance-based measures, such as in the study by Graham, Burgoyne and Borup (2010), in which artefacts were analysed for evidence of TPACK knowledge, and self-report based measures, such as the survey instrument developed by Schmidt et al., (2009b), used by pre-service teachers to self-assess their knowledge of particular TPACK domains.

To date though developing an instrument has been difficult due in part to the theoretical concerns described by Graham above (Abbitt, 2011; Brantley-Dias & Ertmer, 2013). For example, Archambault and Crippen (2009) and Archambault and Barnett (2010) tried to measure the TPACK knowledge of some 596 K-12 online teachers. They reported issues with construct validity, as exploratory factor

analysis revealed only 3 factors: items for CK, PK and PCK loaded as one factor, items for TPK, TCK and TPACK loaded as one, and items for TK loaded as another. In another example, this time in Taiwan, Lee and Tsai (2010) designed a 30 item TPACK-Web Survey, focusing on educational uses of the web. Their web-based instrument used 6 constructs, namely web-general, web-pedagogical knowledge, web-content knowledge, web-pedagogical-content-knowledge, web-communicative, and attitudes to web-based instruction. Yet factor analysis revealed only 5 factors, with web-pedagogical knowledge and web-pedagogical-content knowledge loading as one factor.

The Survey of Preservice Teachers' Knowledge of Teaching and Technology

Given the considerable interest in developing an instrument to measure teacher TPACK knowledge, this paper seeks to better understand researcher efforts to do so. As a means of illustrating these efforts, this paper focuses on how researchers have used the Survey of Preservice Teachers' Knowledge of Teaching and Technology (Schmidt et al., 2009b), widely adapted for use by numerous researchers in the United States, Taiwan, Singapore and Australia. According to Abbitt (201: 290) this instrument is “among the more mature tools”.

Developed by Mishra and Koehler and others, the intention was to produce a “fast, reliable, teacher-rated survey that measures teachers' understanding of each component of the TPACK framework” (Schmidt et al., 2009b: 128). It was designed for PK-6 pre-service teachers majoring in early childhood or elementary education and included 4 sub-categories in Content Knowledge (literacy, mathematics, science and social science) to reflect the content areas they would be teaching. For each of the survey items, participants were asked to indicate their level of agreement using a five-point Likert scale. To develop the instrument, they reviewed existing studies to inform the style and approach to be taken and then asked three TPACK experts to evaluate the content validity of some 44 items. Following review of these ratings, they made revisions, with the final version having some 75 items around the 7 TPACK domains, as well as demographic items. They then administered the instrument online to 124 pre-service teachers enrolled in an introductory technology course. Researchers then set about establishing the validity and reliability of the instrument, using Cronbach's alpha reliability technique to assess each domain subscale for internal consistency, and then using factor analysis to establish construct validity of the domain subscale. Subsequently, 28 items were eliminated, leaving 47 items: Ergo, TK (7 items), CK (12 items), PK (7 items), PCK (4 items), TCK (4 items), TPK (5 items), TPACK (8 items) with high internal reliability of .75 to .92. It is to be noted that the original statistical validation of the instrument was not optimum, given that only 124 participants were involved as an acceptable minimum would be 375. This point is often overlooked in the literature.

Adapting the instrument

As stated previously, this instrument has been adapted and used by researchers in a range of contexts. Often this involved adapting the four content areas in the initial instrument to suit the particular curriculum context. For example Jordan (2011), replaced the four content areas with one generic content area, in an effort to suit the P-12 teachers in her study. In Singapore, Koh, Chai and Tsai routinely renamed content knowledge areas to reflect the teaching context in Singapore, in which secondary teachers were trained to teach in two discipline areas. They used a range of terms to describe these 2 disciplines. In one study they used the term ‘curriculum study 1’ and ‘curriculum study 2’ (Chai, Koh & Tsai, 2010), while in another they used ‘first teaching subject’ and ‘second teaching subject’ (Chai, Koh & Tsai, 2011). They also used ‘Curriculum Subject’ (Koh, Chai & Tsai, 2010) and ‘Curriculum Subject 1’ and ‘Curriculum Subject 2’ (Koh & Chai, 2011).

Another common adaption involved changing the research design from a single-test design to a pre and post-test design, as part of a larger effort to examine the effects of a particular intervention. Often this research involved pre-service teachers. For example, Schmidt et al., (2009a) used a pre and post design to measure the effect of an introductory technology course on 87 K-6 pre-service teachers' mean scores for each of the 7 constructs. In another study, this time in Taiwan, Liu (2011) adapted the instrument to

examine the effect of an integrated course on the TPACK knowledge of 401 pre-service teachers, some who were enrolled in the course compared to some who were not and 1 year following the enrolment. In Singapore, Chai, Koh and Tsai (2010; 2011) conducted 2 studies examining the effectiveness of a Teacher Education course, 'ICT for Meaningful Learning'. In Australia, Hu and Fyfe (2010) measured the impact of a new curriculum (Master of Teaching) on 172 pre-service teacher's TPACK knowledge using a pre-test and post-test design. Bos and Lee (2012) however turned attention to in-service teachers. Their study examined the effect of a training program (Elementary Mathematics Master Teacher) on 43 Kindergarten to 6th grade teachers' TPACK knowledge at three intervals: a pre-test, post-test and then 1 year following. In Taiwan, Chuang and Ho (2011) also studied in-service teachers, in this instance, 335 in-service early childhood teachers and the effects of teacher modelling in a Teacher Education program on later practice.

Several researchers made adaptations to the instrument so as to consider the possible influence of demographic factors on TPACK self-assessment. For example, in Australia, Jordan (2011) considered the influence of gender on 64 beginning teachers. In Singapore, Koh and Chai (2011) considered gender and age, while Koh, Chai and Tsai (2010) considered the impact of gender, age and teaching level.

A number of researchers made adaptations but did not explain why these adaptations were made. For example, Shin et al., (2009) in their study of 17 in-service teachers enrolled in a graduate course adapted the instrument, by adding items to CK, PCK and TPK, but offered no reasons for their actions. Bos and Lee (2012) renamed CK to Mathematical Content Knowledge in the in-text discussion and adjusted some items (deleting an item from TK, and relocating 4 TPACK items to TPK). Liu (2011) reduced the number of constructs to 3 and the number of items to 12, and used a 4 point scale without explanation. In Australia, Hu and Fyfe (2010) measured 3 constructs (TK, TPK and TPACK), with a fourth construct (TCK) omitted through an administration error. They included 8 items (the 4 items from TPACK, and 4 of the 9 items in TPK) and used a 5 point scale, made a minor wording change, substituting 'technologies' for 'ICT tools' used in the original instrument, but again offered no explanation.

As this discussion has so far shown, researchers when adapting the Schmidt et al., (2009b) instrument have often done so for similar purposes, such as to suit their particular curriculum context, their research design or their research focus. For the most part, this purpose did not involve considering the reliability and validity of their instrument. Indeed there is a seemingly lack of regard to this consideration. The number of studies that made adaptations to the instrument, but do not offer an explanation for them, adds weight to this view. Most of these unexplained adaptations involved significant changes to the constructs and items which therefore impact on the reliability and validity of the instrument.

Researchers, Koh, Chai and Tsai, undertook several studies in Singapore with this explicit goal. One strategy they used was to increase the Likert type scale from 5 to 7, in the belief that the larger the number of options, the increase in reliability (see for example, Chai, Koh & Tsai, 2010; Koh, Chai & Tsai, 2010; Koh & Chai, 2011). Another strategy they used on one occasion was to involve a large number of participants, in this instance, 1185 primary and secondary pre-service teachers (Koh, Chai & Tsai, 2010). On another single occasion (Chai, Koh & Tsai, 2010) the researchers decided to reduce the number of constructs to those which they thought could be more clearly defined. Previous studies had reported issues with differentiating the constructs of TCK, TPK and TPACK (see for example Archambault & Barnett, 2010; Lee & Tsai, 2010). In this study they reduced the number of constructs to four and the number of items to 18: TK (4 items), PK (5 items), CK (4 items) and TPACK (5 items). In this same study they were interested in trying to predict how TK, PK and CK contribute to TPACK using stepwise regression, concluding that a four component TPACK model is statistically robust, hypothesising that this may relate to the inexperience of the pre-service teachers undertaking the survey.

Exploratory factor analysis was a key strategy used by these researchers to examine the construct validity of their adapted instrument, and therefore test whether it did test what it was designed to do. In one study, Koh, Chai and Tsai (2010) concluded that five factors explained 75.75% of the total variance. These were: (1) Technology Knowledge, (2) Content Knowledge, (3) Knowledge of Pedagogy (KP), so termed as participants could not distinguish between general pedagogies and how these could be used

in specific subject areas, (4) Knowledge of Teaching with Technology (KTT), as participants interpreted items relating to technology, that is TPK, TCK and TPACK similarly, and (5) Knowledge from Critical Reflection (KCR), as two items relating to TPK and reflection grouped. The writers suggest that the inexperience of the pre-service teachers in understanding teaching practice may help to explain the findings around grouping PK and PCK. While they also suggest this inexperience may have contributed to the grouping of TCK, TPK and TPACK to become KTT, they also suggest that the lack of specific examples may also have contributed. Other studies such as Archambault and Barnett (2010) and the earlier one by Lee and Tsai (2010) also suggested that items in relation to overlapping TK constructs, that is, TCK, TPK and TPACK may group together.

In a another study (Chai, Koh & Tsai (2011), the researchers identified eight factors, seven of which were the TPACK constructs, however with CK divided into two constructs in relation to their first teaching subject and their second. In this study, participants were able to distinguish between TCK, PCK and TPK, that was an issue in Chai, Koh and Tsai (2010) and Koh, Chai and Tsai (2010), with the writers suggesting this was because the items were adapted to reflect constructivist teaching, and therefore had specific pedagogical approaches. They suggest also that as the Schmidt et al., (2009b) survey targets general pedagogies it may not distinguish how the technology is used. They suggest that for content validity, items in PK and TPK should focus on specific pedagogies, and that ‘without using technology’ should be added as a stem to items in PCK.

Summary and Conclusion

The development of the TPACK framework by Mishra and Koehler (2006) has appealed to a large number of researchers and generated a lot of research interest as a consequence. It has opened up considerable discussion about the knowledge that teachers need to integrate ICT into their practice, a discussion often in the past narrowly confined to technical know-how. Yet Graham (2011), as others, suggests there are a number of theoretical weaknesses that need to be addressed; weaknesses around ‘what’ factors define it, ‘how’ these factors relate to one another and ‘why’ this theory matters.

A quest to develop a valid and reliable instrument to measure TPACK knowledge has been one of the main areas of TPACK-related research. Yet, to date, theoretical weaknesses such as those described by Graham (2011) have hindered this development. One of the most influential instruments to be developed is the Schmidt et al (2009b) instrument, used and adapted by researchers in the United States, Taiwan, Singapore and Australia.

This paper provides a snapshot of how researchers have adapted and used this instrument as a means of exploring researcher efforts more broadly to develop a robust instrument to measure TPACK knowledge. It has shown that researchers frequently made several adaptations to the instrument: replacing the four content areas with ones which suited their curriculum context, altering the purpose from a single-test design to a pre and post-test design (in order to measure the effect of a particular intervention on TPACK knowledge), and changing the research focus to consider the influence of other factors such as gender on TPACK knowledge. It has also shown, that researchers did not always describe what in fact was adapted and why. As this sometimes involved constructs and items to be measured, this oversight has a significant impact on the overall validity and reliability of the adapted research instrument. The paper has highlighted efforts by Koh, Chai and Tsai, to tackle perceived theoretical weaknesses in the initial instrument, including increasing the level of the agreement scale from five points to seven, confining the constructs to those which could be more readily defined, and using exploratory factor analysis. Ultimately this paper demonstrates that the quest to develop an instrument to measure the seven constructs as identified by Mishra and Koehler is ongoing.

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iPADS IN A 1:1 PROGRAM: THE DILEMMA OF CHALLENGE

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Abstract

This paper explores the implementation of iPads into the curriculum at Years 7 & 9 at one school. Each student in Years 7 & 9 was provided with an iPad, as part of the 1:1 Program it commenced in 2011. This study follows previous research at the same school, which focused on their inaugural launch of a 1:1 Program using Netbooks in 2011. The school continued to implement Netbooks in 2012, however in 2013, replaced the Netbooks with iPads citing cost to be a major factor in this decision. This paper will examine how iPads were used in each subject studied and whether it enhanced teaching and learning. Parental perspectives were obtained regarding the 1:1 Program and its place in their child's education. Some parents were highly critical of the provision of the devices to their children, especially with respect to time management and the questioning of necessity, whilst others praised the program. The research findings are presented in a thematic style, and provide an insight into how the iPad is used in a variety of subjects at school and at home. The paper concludes with some recommendations to inform school leaders about the challenges of implementing an iPad Initiative.

Introduction

Attempts to infuse technology into education over the past 30 years have resulted in mixed success. Schools have chosen to implement computing in the curriculum through a variety of methods, highly dependent on the type of technology available at any given time. Initially, schools initially deployed computers in special purpose rooms which quickly became computer laboratories. Later on some schools opted for highly regulated 1:1 Programs. More recently, as technology has increasingly become mobile and affordable, schools are offering variations on traditional 1:1 Programs to accommodate the changing landscape of technology usage.

Traditional 1:1 Programs were typically highly regulated with top down structures in place, incorporating specified device and model, procurement, software, warranty, insurance and a help desk on site. All students involved in traditional 1:1 Programs were expected to work within the parameters the school had outlined as part of their program. In recent years, other types of 1:1 Programs evolved to accommodate the changing landscape of both affordable technology and budgetary constraints imposed on schools. Some schools have chosen to implement BYOD (Bring Your Own Device) Programs where students bring a mobile device of their choice. BYOD Programs foster a 1:1 student to computer ratio with limited regulation and cost to the school.

In between the highly regulated 1:1 Program and the deregulated BYOD Program, other permutations and mutations of 1:1 initiatives have arisen with varying degrees of intervention, regulation and cost. Depending on the school's implementation and their interpretation of a 1:1 initiative, other considerations are taken into account such as how the technology is going to be used in the classroom, school expectations, leadership and planning, professional development, hardware and software specifications, infrastructure, technical support, and funding (Bebell & O'Dwyer, 2010; Shapley, Sheehan, Maloney, & Caranikas-Walker, 2010). Whilst much research has documented the advantages and successes of 1:1 initiatives, not all programs have been positive (Holcomb, 2009) and in some

schools, particularly in the United States, the programs have been terminated (Hu, 2007; Sheppard & Brown, 2011).

In Australia, the uptake of 1:1 Initiatives has been steadily increasing since Federal Government funding was made available to improve computer to student ratios across all secondary schools. The vision of the Government's Digital Education Revolution (DER) was that "Australian students need greater access to, and more sophisticated use of, information and communications technology. They need a digital education that prepares them for the jobs of tomorrow" (Rudd, Smith, & Conroy, 2007). The funding provided by the DER meant that secondary schools have found it easier to provide computers to students.

Access to computers has been understood as one of the key barriers in the use of technology in education (Keane, 2012; Kennedy, 1991; Means, Olsen, & Singh, 1995). This has largely been addressed by schools through the provision of 1:1 initiatives. Despite the infiltration of technology in schools, both teachers and students consider the technology as a device that is additional to the paper-based operational mode of a school rather than the using the technology normally and seamlessly so that there is no emphasis on the technology itself. According to Lee (2013), this usage is described as "digital normalisation", where technology usage in the classroom is just an extension of its usage in the home and in society.

The research reported in this paper investigated the implementation of iPads in one school to determine their level of acceptance by students, teachers and parents. The next section presents a justification for the mixed methodology used as well as data analysis techniques. The findings are presented thematically and the final discussion focuses on the use of the device at both Year 7 and 9, determined from each of the stakeholder groups.

Research Method

This study follows previous research, which focused on the implementation of a Year 9 Netbook Program in 2011 (Keane, Lang, & Pilgrim, 2012) and the extension of the program into Year 10 in 2012 (Keane & Pilgrim, 2013) at the same educational institution. The previous studies compared Netbook usage by Year 9 students in 2011 and then by the same group of students in Year 10 in 2012. As the school changed the mobile device for their 1:1 Program in 2013 from Netbooks to iPads in Year 9 and added Year 7 students into the program, the study also changed focus and explored the use of iPads in Years 7 & 9. The aim of the research was to obtain perspectives from students, parents and teachers as well as to evaluate how the iPads were deployed in the third year of their 1:1 Program.

A mixed methodology was employed comprising qualitative interview data and questionnaires to provide quantitative responses. This enabled an exploration of the effect of the iPad on student engagement as reported by teachers, parents and the students themselves, as well as the exploration of a range of related issues, such as the value students and parents place on the role of information technology for teaching and learning as well as issues about the implementation of the program. Three questionnaires were administered online using Opinio; two for students in Years 7 & Year 9 and one for parents of students in either or both of these year levels. Teachers including the school's Principal were interviewed to get a holistic view of the 1:1 implementation. The interviews in this study were semi-structured (Wellington, 2000). This ensured that issues raised during the interviews could be further explored (Patton, 2002). Ethics approval was achieved for this study.

The data pool consisted of:

- 4 interviews with teachers and members of the school leadership teams (1 female, 3 male)
- 33 completed questionnaires from students in Year 7 (18 female, 15 male)
- 28 completed questionnaires from students in Year 9 (7 female, 21 male)
- 47 completed questionnaires from parents (35 female, 12 male)

The questionnaire that was given to students in 2013 included multiple scales, each comprising several statements to which participants registered levels of agreement on a 5-point Likert scale from strongly disagree (1) to strongly agree (5). The scales addressed interest and attitude towards using iPads and the 1:1 Program. Participants were given an option to provide further comments. Entries to survey tick data were compiled to provide quantitative data. Free text entries and interview responses were read repeatedly to enable the coding and categorisation of responses, then counted to enable quantitative comparisons. This qualitative data analysis method was informed by the work of Boyatzis (1998), and Bogdan and Biklen (2003).

Background of School E

In 2010, School E initiated a plan to commence a 1:1 Netbook program in 2011 for their Year 9 cohort of 210 students. The School was able to fund this initiative through the Australian Government's Digital Education Revolution (DER) – National Secondary School Computer Fund, whose purpose was to achieve a ratio of one computer to one student by the end of 2011 (DEEWR, 2008). Historically, School E had relied on the provision of computer labs to fulfil the Information Technology needs of the students. Often the computers were kept in operation for 5 years and the school did not have a strategic Information Technology goal. The DER funding was eagerly embraced to replace aging hardware as well as to provide notebooks on trolleys in various configurations.

Year 9 students were targeted because they were embarking on a new educational program in 2011 on a new external campus. The College promoted the new Program as being innovative and unique as students received a mobile device. New core subjects were specifically developed for this program *Creating Solutions* and *Mind and Body*, which specifically required the use of technology. The school was keen to adhere to the DER guidelines, of approximately \$1000 per computer. Netbooks were selected due to their size, weight and affordability. In 2010, the Principal, Assistant Principal (Teaching & Learning), E-Learning Coordinator and Network Manager met frequently to plan this initiative. As there was uncertainty whether this initiative would continue through to other year levels in the future, the College did not formulate a master implementation strategy for other year levels but rather a 'wish-list', which would be reliant on available funds. In 2012, the College continued their commitment to the Year 9 Program, and provided students with a Netbook, and allowed the Year 10 students to retain their Netbook from the previous year to continue using them in 2012.

In 2013, the College retained its 1:1 Program in selected year levels, however with a change of device at Year 9. The College decided to utilise iPads in Years 9 and 7, and continued to use Netbooks in Years 10 and 11. The College believed that they were not restricted to maintaining one type of device to achieve a 1:1 Program, given the large investment in their Wi-Fi network, meaning they were agile enough to change mobile devices as they deemed necessary. The school leadership indicated that the decision to discontinue the Netbook program was due to a number of related factors, including:

- the difference between the price of an iPad compared with a Netbook;
- parental and community perceptions that the school was keeping up with technological trends due to the use of iPads in neighboring schools 1:1 Programs;
- the significant increase in the range of educational applications for iPads that encouraged greater usage in the classroom for teaching and learning purposes;
- uncertainty about additional funding from the DER beyond 2013 meant the costs of any future program would have to shift to parents;
- concerns about the longevity of Netbooks in a 3 year life-cycle.

Given the school implemented a 1:1 Program as a direct result of the DER funding, the school Leadership decided that that they would continue with the 1:1 initiative, however pass the costs onto the parents. Nevertheless, serious consideration was given to keeping costs low, which in effect determined the type of device used at the school.

The iPad initiative

As part of the final installation of the DER Government funding, students in Year 9 were given their iPad at no cost to the parents, whereas students in Year 7 purchased their device. DER funding targeted students in Years 9 -12. The total cost of the device (\$500) included \$70 of “Apps”, a protective cover and some labour involved in configuring the device. For students in Year 7, costs were contained by providing the option of purchasing the previous generation of iPads. The option to purchase a current generation iPad, was available, however parents had to source the device, and pay the additional expense for the provision of *Apps*.

To support the implementation of the iPad program, teaching staff were provided with six professional development sessions. These sessions were held at the end of the previous school year, just prior to the commencement of the iPad Program. These sessions were conducted by the College’s Director of E-Learning and were attended by the vast majority of teachers who taught Year 7 and Year 9. The professional development sessions included a variety of both functional and operational demonstrations of the device as well as a walk through of the entire set of *Apps* that were preloaded on the iPads. Even though some teachers were part of the previous Netbook program and knew how to incorporate technology into their teaching and learning, they were challenged to extend their ideas on how to use the devices innovatively in their classroom.

Findings

General Use of the Device

Although the Year 9 devices were funded from the DER there were no additional restrictions or conditions imposed on them compared to those on the Year 7 devices. Similarly, the Year 9 students and the Year 7 students used their iPads at school for their scheduled classes and were encouraged to continue working on them at home. At home, most students had access to both a network and the Internet with varying degrees of restrictions imposed by parents. Year 9 students tended to use their iPads between 1-4 hours on a school day compared to Year 7 students who used theirs on average 5-7 hours a day. Upon further examination, it was apparent that Year 7 students used their iPads in many of their subjects, unlike Year 9 students who did not use the iPad consistently. Interestingly though, Year 9 students spent on average 5-7 hours on weekends using their iPads, whereas Year 7’s used it between 1-4 hours.

Some parents expressed concern about the use of the Internet on the iPad at home and restricted their child’s usage because they wanted their children to have face-to-face interaction with other people. Parents were generally concerned that their children were electronically socialising too much and were not engaging in human-to-human interaction. One parent stated, “I feel they need to interact with the family, sharing dinners together and time to chat together as a family.” Whereas others were apprehensive that they were being “set up to fail” as the “iPad become a source of conflict, fights and arguments at home” or that they had to “police” its use.

Technical Issues

Geographically, students in Year 9 were situated on their own campus while the Year 7 students were situated on the main campus. This meant that both campuses had different levels of Information Technology support, resources and professional development opportunities.

At the commencement of the school year, there were many technical issues, which arose particularly affecting Year 9 students. A dedicated Apple server was installed for Year 7 students, but not for Year 9 students as it was envisaged that these students could connect via the VPN to the server situated on the main campus. However, this became cumbersome and unworkable as it put a strain on the Year 9 campus’ Internet bandwidth. The vendors who sold the solution did not work closely with the school’s Information Technology Team. This ‘disconnect’ resulted in a number of largely unresolved technical issues.

Another major issue that took the College by surprise was the loss of student's work. After much investigation the cause was found to be students sharing Apple IDs. It emerged that students were entering other students' Apple ID's so that they could access particular Apps and songs they did not have, and thus confusing the device resulting in loss of Apps and work. This caused several issues, including the loss of data and the inability to backup the device. Many of the students and parents commented on the loss of data and criticised the College for not having measures in place to educate their children on how to use the technology without realising that some of this was because students ignored the technology guidelines that was put in place by the College.

Use of iPads

The College stipulated that a number of *Apps* were compulsory and the iPads were preloaded with general purpose applications (*Apps*) such as Keynote, iMovie, Numbers, GarageBand, Pages, Creative Book Builder, Explain Everything, Good Reader and Elocker. However not all of these *Apps* were used extensively or consistently across many of the subjects or year levels. 21% of Year 9 students were satisfied with the preinstalled *Apps* on their iPads compared to 84% of students in Year 7. The *Apps* that were used frequently by Year 9 and Year 7 students were Pages, Keynote and iMovie. Students at both levels reported using the iPad mainly for assignments, research (internet), presentations and emailing.

Use of iPad at Year 9 in Subjects

Table 1 shows the use of the iPad as reported by students for the core subjects in Year 9. The use of the iPad in all core subjects was not as widespread as anticipated. At best, most of the core subjects would use two of the preloaded *Apps*. The most popular *App* was *Pages*, which allowed students to take notes. It was used in all the core subjects with the exception of Mathematics.

Table 1: The use of the iPad as reported by for the students for the core subjects in Year 9

	iMovie	Keynote	Numbers	Garage Band	Pages	Creative Book Builder	Explain Everything	Good Reader	Elocker
Creating Solutions					✓				
English	✓				✓				
History/Geography		✓			✓				
Mathematics			✓						
Mind & Body	✓				✓				
Religious Education		✓			✓				
Science					✓	✓			

Students were asked to report their perceived usage of iPads in each key subject area. Figure 1 presents the percentage of iPad usage in core subjects. The iPad was used predominately in History/Geography, Science and English. This could be attributed to the nature of these subjects, their ability to lend themselves to use technology in a normalised way, and the motivation and enthusiasm of the particular teachers involved in the teaching of these subjects. According to the students, 37% of their teachers used a variety of activities in class using the iPad while only 29% let them find facts for themselves using the iPad.

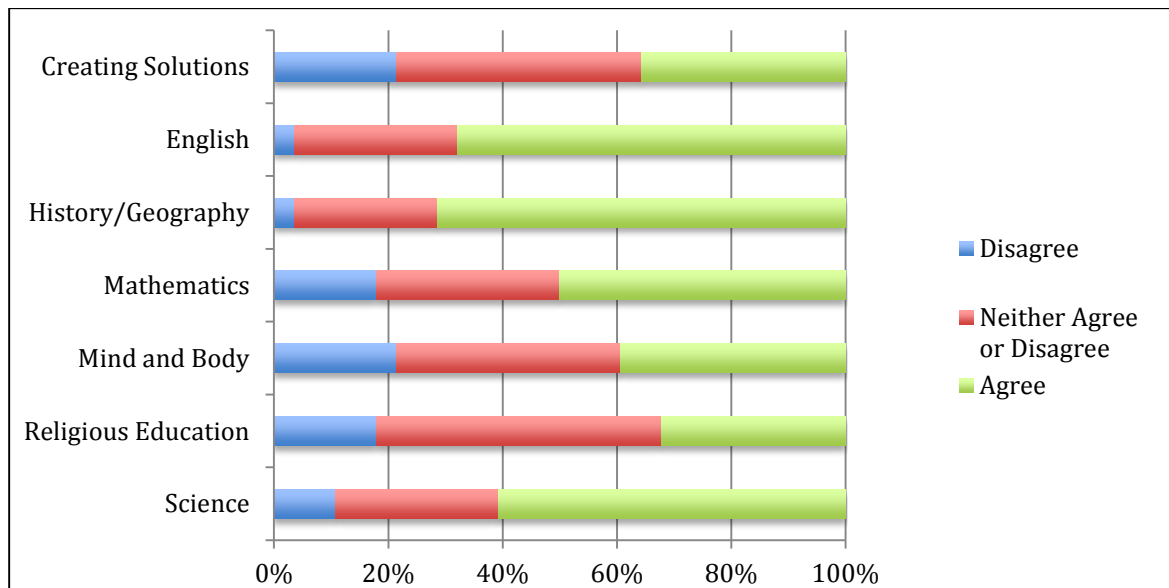


Figure 1: Indicates how beneficial Year 7 students rated the use of the iPad in each of their subjects.

Open-ended questions in the questionnaire gave the students the opportunity to elaborate on their responses. Typical responses from students included, “In English my iPad is used for assignments and sometimes note taking” another student stated that the iPad was used in Science “to look up information regarding my studies. I use Pages and Keynote in Science, plus I have my Science textbook on the iPad.” Other students noted that in History/Geography they used their iPad “as a research tool and for assignments.” The use of iPads by Year 9 students was not innovative, nor did they use their iPad for as much time as the Year 7 students on any given day. This could be attributed to the technical problems experienced by both students and teachers at the Year 9 Campus and the consequent lack of confidence in the devices, which made them seem unreliable.

Use of iPad at Year 7 in Subjects

Table 2: The use of the iPad as reported by students for the key subjects studied in Year 7.

	iMovie	Keynote	Numbers	Garage Band	Pages	Creative Book Builder	Explain Everything	Good Reader	Elocker
Drama					✓				
English		✓			✓				
Geography					✓				
German or Italian		✓			✓				
Health & Physical Ed	✓	✓			✓				
History					✓				
Indonesian		✓			✓				
Mathematics			✓		✓		✓		
Music	✓			✓	✓				
Religious Ed	✓	✓			✓				
Science					✓		✓		
Technology					✓				
Visual Art		✓			✓				

In contrast to Year 9, Year 7 students used their iPad widely in their studies. This can be attributed in part to having a reliable technical setup on the main campus of the College, and teacher accessibility to professional development and support from the Director of E-Learning. The iPad was extensively used in History, Geography, Science, English, Music, Religious Education and German/Italian. With the exception of Music, subjects that were particularly practical focused tended to use their iPad sporadically as can be seen in Figure 2. Students cited a few reasons why they did not use the iPad in practical subjects such as Drama, Health & Physical Education, Technology and Visual Art. One student commented, “we pretty much paint or do something artistic” or “we use school computers in Technology.”

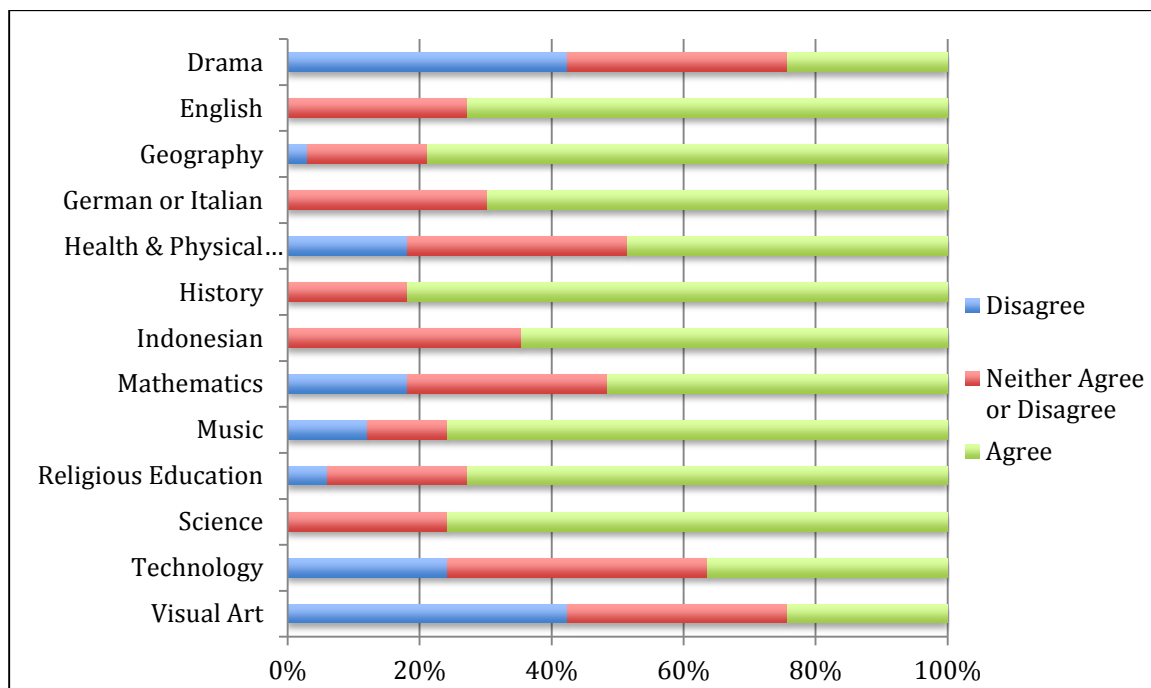


Figure 2: Indicates how beneficial Year 7 students rated the use of the iPad in each of their subjects.

According to the Year 7 students, 74% of their teachers used a variety of activities using the iPad and 85% commented that their teachers let them find facts for themselves using the iPad. Even though students in Year 7 experienced some technical issues due to identity swapping, their overall experience with the Year 7 initiative was positive with one student testifying “they are a good learning tool.”

Parental Perspective

When parents were asked about what they thought their children did in the classroom, many were at a loss to answer how the iPad was used. Others suggested that they were used as a “textbook” or for “researching”. One parent noted that their child used the iPad to “frequently take photos of what a teacher has written on the board.” Despite being able to broadly specify what students used the iPad for – many could not specifically provide examples. A few parents were concerned that the iPad was used “for entertainment rather than education” and they identified game playing and excessive socialising as major sources of concern. Whilst some acknowledged it was a beneficial tool for their children’s learning, others were unsure, “I am torn between the idea of it being the way of learning in the future versus the amount of time my child uses it for game playing at home.” Other parents were concerned about their child’s handwriting deteriorating and future eye problems due to constant screen exposure.

Conclusion

This study reported on the implementation of iPads for learning at Years 7 & 9 at one school. An analysis of the questionnaire results and interviews provided insights into the perceptions of students, parents, teachers and school leaders regarding the value of having an iPad program at Years 7 & 9. Given 1:1 Programs are unique in each school, the findings are pertinent to School E’s experiences.

Even though a 1:1 Program was in its third year at the School, the change of device was considered *new*. Many of the educators in Years 7 & 9 had prior experience in teaching with technology, and were given access to professional development to supplement their skill base. Moreover, Year 9 teachers were part of a specific and structured Program, with technology an integral component of it. Notwithstanding, only four subjects used the iPad constantly and the devices were not used as much during the school

day. Whilst acknowledging some technical issues plagued the Year 9 Program, teachers were not proactive in seeking other solutions and were reconciled to using the devices as functional, rather than innovative tools.

Unlike the Year 9 Program, Year 7's experienced success. There was high student satisfaction with the 1:1 Initiative. Educators played a significant and pivotal role in the how these devices were used and deployed in the classroom. The teachers' ability to confidently incorporate the iPad into the curriculum, supported by a stable and reliable technical infrastructure ensured that the Year 7's embraced the use of the iPad.

Parental comfort with the iPads was diverse. Many of the parents could not articulate how the devices were used in their child's education. Each subject area needed to clearly communicate to parents as to how the device was being used, so that parents can have an informed opinion about them, rather than unsubstantiated comments that the devices are destructive and intrusive. It is clear that teachers and parents have yet to acknowledge the normalisation of the iPad and the device is still considered *new*.

In conclusion, the key success factors for any 1:1 Program is to ensure that:

- Parents are constantly communicated with about how the device is used to support learning & teaching
- Professional Development is constantly delivered to support teachers in learning & teaching
- Students need support and guidance on how to manage their devices
- The technical infrastructure needs to be stable and reliable.

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BECOME YOUR OWN PERSONAL VIDEOGRAPHER: CAPTURE, REFLECT AND ANALYSE CLASSROOM INTERACTIONS WITH SELF-TRACKING VIDEO TECHNOLOGY USING MOBILE DEVICES AND 3G CAMERAS

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Abstract

Professional accountability and the provision of evidence of performance, aligned to industry standards are challenges faced by all professionals. This research investigates how a group of educators have used technology in an innovative way for professional learning. The goals of the TIPS-2 Professional Growth Project (TIPS-2) were to investigate cost effective and constructive ways to use video and a range of innovative technologies to monitor teachers' performance aligned to standards while supporting self-reflection and collegial learning.

Research was undertaken with a group of K-10 teachers as they used self-tracking video technologies, mobile phones, touch tablet devices and 3G cameras to document and reflect on their classroom practice. A community of practice model was used for teacher professional learning. Specialised software addressed the challenges of how to process and make meaning of complex, multi-layered, dynamic actions and reactions in time and space captured in classroom videos.

The findings include practical examples of cost effective tools and sustainable practices to monitor professional practice, promote personal growth and align performance to professional standards and indicators. Reflective protocols around the use of classroom video for sharing classroom practices in a community of practice model were developed.

Introduction

There is a growing body of research linking student learning outcomes to the quality of the teaching (Hattie,2003; Petras, Jamil,& Mohamed,2012). The overarching aim of this research was to investigate cost effective and sustainable ways for teachers to use technology to improve the quality of their teaching by gathering video evidence of their professional practice in the classroom as aligned to national standards. A community of practice model was used to support teachers to review and reflect on their teaching. In the analysis phase sophisticated video and audio capture of teaching and learning behaviour, combined with computer-based analysis, was utilised to investigate the relationships between teacher behaviour, student engagement in learning and learning outcomes for improved teacher effectiveness.

The TIPS-2 Professional Growth Project (TIPS-2) is a pilot study investigating how teachers use new video technologies for classroom observations to gather multi-modal evidence of their teaching over a period of time. This evidence was used for professional accountability and to improve the quality of their teaching. This paper shares project findings concerning the use of self-tracking devices for personal video capture, ways to use technology to support the integration of the Australian Professional Standards for Teachers into classroom practices and a selection of online professional learning resources developed for the teachers.

Literature review

According to Darling-Hammond (2004) teacher quality has a significant impact on students' achievement, in some instances overcoming socio-economic and language background factors. The Bradley (2008) and Gonski (2011) reviews foregrounded the importance of high quality teaching to lift levels of student achievements in schools. Teachers and school leaders are expected to provide tangible evidence that they are delivering high quality educational experiences in their classrooms. One way to

determine if quality teaching is occurring is through teacher observation, however it is time consuming and expensive to have a colleague in the classroom observing teaching. There are also limitations to the objectivity of feedback delivered by a peer. “Using evidence that represents teachers' practices over time is a much more accurate representation of instructional expertise than relying on one or two observations” (Pickering, 2012, p19).

Most teaching occurs behind closed doors and many teachers have not seen themselves teaching and few have observed their colleagues in action. The introduction of national professional standards for teachers (AITSL,2011) and a common curriculum means that all teachers can benefit from observing and reflecting on their own and other teachers' practices. The challenge addressed in this research is how to use ICT to facilitate teachers this observation of classroom practices and to develop supportive protocols to review and reflect on teaching in an unobtrusive and sustainable fashion.

What constitutes quality teaching?

Before beginning to observe and reflect on classroom teaching, teachers and school leadership must address this important question. “What constitutes quality teaching?” There are many opinions on what constitutes quality in teaching. Where teachers need to provide evidence that they are delivering “quality” teaching there needs to be a clear understanding of what determines that “quality” and a defined set of standards they need to uphold. The use of standards can help to distinguish teaching as a profession, in that teachers “are expected to acquire specialized knowledge, meet standards for entry, and uphold professional standards of practice in their work ”(Darling-Hammond, 2004, p. 1050). In an attempt to articulate what constitutes quality teaching, the Australian Institute for Teaching and School Leadership (AITSL) was commissioned by the Australian Government to develop a set of professional standards for Australian teachers. These standards aim to describe the professional behaviour, skills and practices required from teachers in Australian Schools (AITSL,2011). These standards are referred to as the Australian Professional Standards for Teachers (APST). In this research the APST are used for goal setting and classroom observations and as a framework for teacher reflection facilitated by the new video technology.

Professional Standards for Australian teachers

The APST provide a common framework and terminology for professional discussions about quality teaching. They have now been adopted and adapted by the education authorities in each state to make them relevant for all Australian teachers. For example, in Western Australia the Teacher Registration Board (TRBWA) amended the APST to include early childhood teachers working in childcare settings. The APST contain seven standards to be used over four levels of a teacher's career from a graduate level moving to proficient, highly accomplished and lead teacher (AITSL,2011). Initial teacher education curriculum in Australia, are under revision to include the competencies required in the graduate level of the APST and evidence of this alignment with the standards is now required for accreditation of teacher education courses (MCEECDYA, 2011). The higher levels contained in the APST, namely proficient, highly accomplished and lead teacher standards are used to guide and support the professional development of teachers throughout their career. They are used as criteria in job applications, promotions and performance management.

“Effective teachers are crucial for enhancing student engagement and achievement, and play a vital role in establishing productive and supportive school environments. The Standards will spark professional dialogue among teachers and principals regarding what is expected of effective teachers.”(Ms Sheree Vertigan, President, Australian Secondary Principals Association)

A number of countries including the England, New Zealand and the USA have introduced professional standards for teachers. It is interesting to note that Finland that has a highly acclaimed education system has not introduced standards for teachers. There are a wide range of opinions on the policies and governance of professional standards. Tuinamuana (2011) supports the commonsense view of the use of standards in Australian schools that “having ‘standards’ will be positive development. Who would

not want schools and universities to uphold professional teaching standards of some sort? ”(p. 74). There are others, who view the introduction of standards with suspicion seeing them as a “mechanism to control teachers and the teaching profession” (Sachs, 2003, p.177).

Although it is beyond the scope of this paper to discuss the perceived effectiveness and the political implications of The APST, it is relevant to discuss factors surrounding the use of the APST. Problems can arise in how teachers view the APST. There is evidence in the literature that teachers’ need to take ownership of the standards by actively engaging with them critically and evaluating them before applying them to their own teaching context. The researchers support the perspective of Petra, Jamil et al. (2012) who viewed teachers as change agents “In the context of reforms aiming at the improvement of educational systems, it has been widely acknowledged that teachers are to serve as essential agents of improving the educational system, rather than being one of the numerous 'variables' that need to be changed.”(p 52). This notion of teachers as change agents taking control of setting goals and gathering evidence of their achievement was central to the design of the project. According to Sachs (2003) teachers need to engage with the standards on a personal level and not feel that the standards are being imposed on them in a controlling fashion. This approach was adopted in the design of the intervention.

When new practices are introduced there is concern about slippage, which constitutes a lowering of standards or desired expectations. This can occur when theoretical constructs are translated into action. In regard to the APST an opportunity for slippage is when teachers interpret the standards and apply them to their own practices. Currently there is little evidence of how an APST standard or a sub-standard translates into classroom practice. Teachers have to interpret the APST and provide evidence that their own professional practice aligns and demonstrates mastery of the APST. The findings of this research will support all teachers and school leadership as they engage with the APST.

The use of technology for the observation of teaching

One of the attributes of being an effective teacher is the ability to set and monitor personal goals and to learn through connection and self-reflection (Baecher and Kung, 2011). This project directly addresses teachers’ needs reflect on their practice and to provide a range of tangible evidence indicating how their professional practice shows mastery of the APST. One focus of this research project was to investigate how the affordances of technology can be utilized to support teachers in their professional learning and professional accountability. Research indicates that the use of video to capture professional behaviours, combined with peer review and self- reflection can be an effective way to develop professional practice (Anderson and Nielsen,2011; Clarke,1997; Lane and Fetherston,2008).

The APST has three aspects namely professional knowledge, professional practice and professional engagement. This project focuses on professional practice because teachers have indicated it is a challenge to get useful feedback to improve their professional practice. Teachers’ professional practice is dynamically changing and evolving as they engage in complex professional interactions that take place among multiple characters in space and time. Because there are so many factors and variables these behaviours are very difficult to capture in one mode using only written descriptors. The technologies used in this research facilitate the capture and the analysis of complex behaviours that are influenced by a wide range of factors including space, proximity, time, language, gesture and social interactions.

However the researchers acknowledge that there are a number of limitations to using video to record teachers’ practices. For example Lane (2012) found that many teachers have never seen themselves in action and find the process of being recorded on video confronting and overwhelming. There are ethical considerations when using video in schools, for example signed consent needs to be obtained from all participants and from the parents and guardians of all minors. The needs of all participants have to be accommodated in the design of the intervention. In some instances where video has been used in classrooms it can be a disruptive influence because having additional people in the classroom to record the video can impact on student and teacher behaviour. In one study a research assistant was required to focus a camera on the teacher because the teacher is constantly moving in addition the researcher was

present in the classroom monitoring the other equipment (Clarke, 1997). The TIPS-2 research investigates how a new technology can be used to address the issue of the disruptive impact of the technology intervention.

According to Baecher and Kung (2011) “Inexperienced teachers “see” less of the complexity in classroom events than do experienced teachers, and those who have a scaffold with which to interpret their videos of teaching are able to go further in their interpretations”. (p.16). According to Baecher and Kung (2011) teachers need training to select a point of focus by knowing who, what and when to record. In the same way support is needed to view video in a critical and reflective way because a short clip of video contains so many elements on a number of levels (Baecher and Kung,2011). The process of viewing and video clips of classroom teaching and analyzing the clips using a framework and having a shared vocabulary can help teachers to critique video more efficiently (Newhouse, Lane, & Brown, 2007). The dual processes of reflecting individually and in groups “on action” and “in action” can lead to higher levels of metacognition (Lane,2012).

The use of TPACK in learning design

The teachers in the project requested support with the integration of ICT in the design of learning activities. A number of the teachers worked from a traditional base and designed a pencil and paper task and then added technology as an after thought, which did not add value to the activity. Thus the Technological, pedagogical and content knowledge (TPACK) framework was introduced to guide teachers as they designed their classroom activities in this project.

The TPACK Framework, was developed by Koehler and Mishra (2008) to conceptualise the skills needed by teachers in 21st century classrooms. TPACK represents the integration of three bodies of understanding: Technological Knowledge (TK) an understanding of how to use technology for learning; Pedagogical Knowledge (PK) the knowledge and skills of which instructional strategies to use in the classroom; and Content Knowledge (CK) the knowledge of the content and curriculum area (Koehler & Mishra,2008).

Methodology

The aims of the research

The research aimed to investigate cost effective and sustainable ways for teachers to use technology to gather evidence of their performance in the classroom. The evidence would be used for professional accountability, collegial sharing and to improve the quality of teaching.

Overarching research question

How can self-tracking video technology and professional learning networks be used to promote changes in teachers practice when using mobile touch tablet devices to deliver the National Curriculum and comply with the Australian Professional Standards for Teachers?

Setting the context for the research

The research was undertaken by a researcher from the Institute of Educational Research at XXX University, in collaboration with four Department of Education and Training (DET) schools in Western Australia.

The sample

The research took place in four primary schools. The schools were selected to represent a wide range of socio- economic profiles. Schools that wanted to increase the use of information and communications technology (ICT) in their teaching and who had an interest in using touch enabled tablet devices were invited to participate.

School A was a primary school that catered for students from a low social economic background with a high percentage of learners from indigenous backgrounds. School B was a primary school from a middle

class environment with students coming from migrant families who had high aspirations for their children. Thirteen different home languages were spoken in School C. School D was high achieving primary school, that a new principal and deputy with clear aims to increase the integration of ICT within the school. All of the schools had strategic aims to increase the use of ICT used in teaching in the school.

Research Plan and Timetable

The research took place over eighteen months from the planning phase to the end of the data collection phase. The data analysis phase took an additional six months.

Phase 1 Planning -December 2012- March 2013

This project required a lot of pre-planning and preparation. There were a number of factors that made the planning of this project difficult. The project was situated in Department of Education and Training Schools (DET) this required permission from the DET research office. The use of video in schools can be problematic so very careful protocols had to be followed to gain departmental permission. The wording on the information letters and had to be specific to make it clearly understandable for each year level. This process took over four months and delayed the start of the project. Ethics approval needed to be obtained from the university to do research involving human participants. In the months preceding the implementation of the project in the schools all survey questions, the data collecting instruments, the information letters and all permission letters were developed.

Once ethical approval was obtained the researcher applied to school principals for permission to undertake research in their school. The researcher visited the participating schools and presented to the staff about the project. Teachers were invited to participate. Two volunteers were selected from each school. The selection of teachers was done in collaboration with the school principal.

Phase 2 Implementation- April 2013- October 2013

Two pre-project professional learning network meetings were held with the participants these meeting took place at the university after school hours. The principals negotiated this time with the teachers this was part of the schools in-kind contribution to the project. The participants completed a pre- intervention online survey based on the first three standards of the APST focusing on professional practice. The participants set goals for the first month of the project based on one of the sub-standards from standards 1-3 of the APST. Participants worked together in their school teams to plan how they would use the technology in their literacy classes. The teachers indicated that they needed professional learning to assist them to use technology in their teaching. This was provided in the network meetings and a project blog with a range of online resources was provided for the teachers to use. This was supplemented by an Edmodo site containing professional learning resources, which the teachers could access online when it was needed.

The participants met each month in the professional learning network to share video clips, reflect on progress and plan how they were going to use the technology in their classes over the next two weeks. Participants were encouraged to meet weekly in their school teams to share their learning and support one another. Some of the schools used these staff members to become in school experts to lead change across the school.

Phase 3- Post intervention data collection and data analysis- October 2013-March 2014

The participants completed the post intervention online survey. A post-intervention professional learning network meeting was held with the participants. The researcher conducted individual post project interviews with the participants to gather data on the effectiveness of the technology and recommendations for further learning and the growth of the professional learning network.

The research plan

Two or more teachers were recruited from each school. The teachers were volunteers who wanted to develop evidence of their classroom practices aligned with the APST and to improve their skills to use ICT as a tool for teaching and professional development. The teachers set their own goals using the APST. The teachers distributed the project information and permission letters and signed consent was

obtained from the parents and guardians of each child in every class in the study. This needed careful monitoring and follow up from the researchers before the project could proceed.

Project Network Meetings

This project used a community of practice model to allow the teachers to take ownership of the project and lead the learning. A goal setting exercise led the teachers to set their own goals for professional growth that they could achieve through implementing a learning activity in their classroom. The teachers shared their goals and their proposed outcomes with the group.

To support the teachers taking control of their professional growth the teachers were given the equipment and the skills to “become their own personal videographer”. They learnt how to capture, reflect and analyse their own classroom interactions with self-tracking video technology using mobile devices and 3G cameras. All of the teachers were provided with a robotic self-tracking device called a Swivl and a wifi enabled touch screen device with an inbuilt camera to film their classroom practice. In this project a range of devices were used namely, iPad-2, iPad Mini, iPod touch and iPhones. This allowed the teachers full control of the videography process. Using the equipment provided they could video in their classroom at anytime. The device was operated remotely either from an application on a mobile phone or from a clicker worn on a lanyard by the teacher. The lanyard also contained a movement sensor, which activated the video tracker and followed the movements of the teacher over an area of ten metres. Although this sounds complex all of the teachers in the project managed to successfully install the devices and capture high quality video in their classes.

A community of practice approach was used in the network meetings, as school leadership, teachers and academic researchers, used the professional networks to engage, reflect about current practice and generate recommendations for future growth. The TPACK framework was discussed and the teachers worked with colleagues to plan a learning experience for their class that integrated ICT. The classroom activity needed to provide evidence that teachers were achieving a self-selected sub-standard of the APST. This project was not a top-down process the teachers led the sessions and initiated the sharing sessions.

The network meetings became successful sharing and observation sessions the participants shared their experiences and the short video clips (3-5 minutes) to demonstrate how they were meeting their goals and demonstrating their competency in terms of one of the National Professional Standards. The participants developed a protocol for viewing classroom video and giving supportive feedback.

Research questions

This research is important because it addresses the following four questions, namely:

1. How can school leaders and fellow teachers know what is happening behind the closed doors of classrooms?
2. How can teachers monitor and reflect on the quality of their own classroom teaching?
3. How can teachers provide tangible evidence of their professional effectiveness in the classroom that goes beyond test scores?
4. How can teachers use technology to analyse and reflect on classroom interactions?

Subsidiary research questions

Three subsidiary research questions were used to guide the study.

1. What were the teachers' levels of confidence to meet the APST before the intervention.
2. What levels of help and support did the teachers need to meet the APST?
3. What were the practices of teachers who indicate they are confidently meeting the APST?

Data Collection and analysis

The teacher completed a pre and post intervention online survey. The surveys collected qualitative and quantitative data on the teachers' levels of confidence related to the first three standards in the proficient level of the APST. A five point likert scale with one indicating "not yet competent and five indicating an "expert" was used for teachers to indicate their perceived level of confidence to deliver the outcomes described in the APST. The online survey tool collated the data and provided an initial analysis by summarizing the results and generating tables. The data was then exported as a CSV file to EPSS software for further analysis. The qualitative data was analysed using Nvivo and coded to generate themes.

In the pre-intervention survey the majority of responses were in the bottom end of the scale indicating that the teachers felt they were not yet competent to meet the standards at a proficient level of the APST. This was interesting because there were some highly experienced teachers in the group including two deputy principals. There were three new graduates in the group two of which rated themselves as a 1 not yet competent and one first year teacher self rated as a 4 across most standards which was one level below and expert. This teacher was the most confident in terms of learning about new technologies. The researchers are mindful of the limitations of self-perceptions of skills.

An additional a qualitative field was included for each standard. In this field entitled "your learning needs and goals" teachers were asked to fill in a text box related to the their response to the question they had just completed "Where you have selected 1 or 2 for an indicator, please indicate where you would like support.

I need development in all these areas!!!I would like to focus on 1.4 first off. Differentiating teaching to meet the specific learning needs of students across the full range of abilities. In particular increasing reading rate for my struggling readers through engagement with ICT.
(Teacher A response APST Std 1-3 pre-intervention survey)

Where you have selected 3, please set a goal for future growth. Where you have selected 4 or 5, please provide some examples of your current practice." Below is a comment from one of the teachers

I am differentiating in Maths using digital tools by giving students the chance to show what they understand using various apps. For students with lower ability this allows them to communicate what they know without the need to write it down by filming or narrating their understanding of a topic. Students with varying level of ability can present their understanding and provide an insight into their problem-solving process using the apps Explain Everything or Educreations.
(Teacher D response APST Std 1-3 pre-intervention survey)

When comparing the pre and post data from the surveys the general trends had moved from a 1 indicating a perceived lack of competence to a 3 indicating that they felt competent. In some sub strands for example items 1.5 (strategies for teaching Aboriginal and Torres Straight Islander Students) and 1.6 (strategies to support full participation of students with disabilities) and item 2.3 (curriculum assessment and reporting the average response of the group had moved from a 1 (not yet competent) to a 2 still indicating a lack of competence from the teachers. Yet encouragingly item 2.1 (content and pedagogy in the teaching area), 2.3 (literacy and numeracy strategies), item 2.6 (Information and communication technologies) shifted from an average score of 1 not yet competent to an average score of 4 indicating high levels of competence.

I would like to continue my learning/research for standard 1.5. How can I best support my aboriginal students through ICT, in particular which IPAD applications are most successful and engaging for those students who need further support with literacy skills and knowledge. (Teacher response post intervention survey)

This generated a rich set of qualitative data, which helped to shape the professional learning and the support provided to the teachers. Interviews were conducted with the participants after the intervention. During the interviews a series of structured questions relating to the teachers' experiences in the project, the use of the hardware, technology issues, the effectiveness of the network meetings and the effectiveness of the technology to as a classroom observation tool were discussed. The interviews were audio recorded and transcribed. They were analysed using Nvivo software and coded to see emerging themes.

Reflection as a tool for teacher professional growth

Reflection was used as an important tool in this project. The teachers were asked to reflect on their teaching when they shared their classroom video at the network meetings. The reflective protocols were developed by the group, ensuring everyone felt safe when sharing their classroom videos. This set guidelines for reflecting on personal and colleagues videos in a non-critical manner and how to provide constructive feedback. During the final interviews the teachers engaged in an individual video reflection session while viewing their video. This session was video recorded and provided rich data on how the teachers related to their own video and their levels of understanding and engagement with their own teaching practice. These videos were tagged and analysed by the research using specialised video analysis software.

Results

The analysis of the pre and post survey data indicated that most teachers made significant increases in their perceived levels of competence to deliver quality learning experiences as indicated in levels 1-3 of the APST. The teachers reported that the use of the self- monitoring video capture devices helped them to the to build their competence as they felt in full control of the videography process without the additional pressure of having another person in the classroom. The technology was cost effective and was easy for one teacher to operate using the remote device. This approach was more cost effective than the traditional approaches using video where another person needed to be employed to do the filming or regular classroom observation where teacher relief had to be paid to give a teacher the time to observe another teacher in action. There were complaints about the limited battery life of the devices. I recommend purchasing additional transformers plugs to enable use with the Australian electricity voltage.

Dissemination and sustainability were a major focus of the project. Social networking was used to support the professional learning network of teachers to help sustain the transformation of their teaching. The professional learning network was used to share video case studies and e-resources and to support future growth and innovation. A number of the schools have shared their learning in local network meetings. One school has a voluntary after school club for sharing pedagogy and ideas between the teachers. One of the participants has set up monthly breakfast meetings at the school to share learning and support other teachers.

The researcher plans to do further projects to extend and build on this research.

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ICT IN TEACHER EDUCATION IN THE AGE OF AITSL

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Abstract

This paper is drawn from a 2012-2013 OLT National Teaching Fellowship investigating the agencies impacting on whole-of course curriculum design in initial teacher education. The chief of these is AITSL (Australian Institute for Teaching and School Leadership) through the Australian Professional Standards for Teachers at Graduate level and the Program Accreditation Standards. This paper will begin with a discussion of the requirements on both beginning teachers and initial teacher education programs in regard to ICT (both content and pedagogy). It will then present case studies from four universities whose degree programs have been approved for implementation in 2014. It will focus on how each institution has responded to the APST as well as accreditation requirements. This will be based on responses to surveys to selected institutions and with one on one interviews to capture rich data. From this, it will draw a contemporary profile of how institutions are rising to the real requirements of ICT pedagogy within the regulatory constraints now in place. The methodology employed is qualitative and is based on document analysis enriched by interview data. It is important to know, as a profession, how future teachers are being introduced to and immersed in digital learning environments.

Introduction

AITSL is the Australian Institute for Teaching and School Leadership¹². It came into being in on January 1, 2010. Its beginnings were in *Teaching Australia*, established in 2005 as the national body for the teaching profession with funding provided by the Australian Government under the Australian Government Quality Teacher Program¹³. AITSL was founded with an “ambitious work program” which, as defined in its Letter of Expectations in 2013, included:

- defining and maintaining standards for teachers and principals;
- leading and influencing improvement in teaching and school leadership; and,
- supporting and recognising high quality professional practice

(AITSL, 2013, p. 9)

AITSL has made a significant contribution to teacher professional learning through formal courses as well as its innovative Illustrations of Practice¹⁴. Its development of meaningful frameworks such as the *Australian Teacher Performance and Development Framework* and the *Australian Charter for the Professional Learning of Teachers and School Leaders* have provided genuine career paths for Australian teachers. AITSL’s particular focus is on national consistency in all aspects of schooling, ranging from teacher registration to what is expected of teachers at all career stages. Much of what it provides is about a journey through a career where the more experienced help and mentor graduate and beginning teachers, while simultaneously, those with experience find structural scaffolds to affirm their practice or be offered ways to continue to learn. It can be contended that AITSL has changed the face of schooling in Australia and its impact is such that we can be said to be living – and running our schools– in the Age of AITSL.

Even a casual observer of the imposition of national regulations on schooling and teacher education in the United Kingdom would be aware of the controversy and criticism it has engendered, particularly in terms of compliance, perceived deskilling and “deprofessionalism” of teachers and the maintenance of the status quo (see, for example, Brindley, 2013; Smith, 2013). The UK experience raises fears that

¹² See <http://www.aitsl.edu.au>

¹³ <http://deewr.gov.au/australian-government-quality-teacher-program>

¹⁴ <http://www.teacherstandards.aitsl.edu.au/Illustrations>

national regulation is that all teacher education programs will “look the same” irrespective of where they are offered. However, as this paper will show, particularly in regard to information and communication technologies (ICT), AITSL has managed to avoid this and have, perhaps inadvertently, adopted the “balance of ‘informed prescription’ and ‘informed professionalism’” said to characterise high quality education systems (Luke, Weir & Woods, 2008, p. 1).

The small-scale research in this paper will, by default, question the public stance that “national accreditation adds value to and builds on the strengths of jurisdictional accreditation experience, and the considerable expertise that exists in Australian teacher education. It acknowledges the professional prerogatives of Australian universities” (AITSL, 2011a, p. 2). It will similarly question the flexibility embedded in the published advice that “initial teacher education programs may address these issues [the national elaborations for ICT] in specific units of study or by embedding them across the program of study” (SCSEEC, 2012, p. D4).

A further UK experience is also of interest in this paper. That is of how what has been called “ICT” in schools has come to be viewed and how it has seen a major overhaul from 2013 onwards (see, for example, Vasagar (2012), Wells (2012)). There are similar shifts in Australian education through the inclusion in the Australian Curriculum of ICT as a General Capability so that it is a common thread in all learning areas at all levels (ACARA. n.d.) to the more recent development of a dedicated subject called *Digital Technologies* within the Technologies Learning Area¹⁵. These curriculum initiatives have significantly changed the nature of what ICT looks like in Australian schools and, significantly, mapped out the parameters for teacher education. An addenda to the title of this paper might well be: *and in the Age of the Australian Curriculum*.

Background

This paper is primarily concerned with AITSL’s two core frameworks concerning teaching and teacher education – the *Australian Professional Standards for Teachers* (AITSL, 2011) and the *Accreditation of Initial Teacher Education Programs in Australia: Standards and Procedures* (AITSL, 2012) in particular how they describe what is expected of teachers’ knowledge and pedagogical use of information and communication technology. These documents, and the regulatory agency they represent - are intended to bring a more cohesive approach to how ICT education is offered in Australia’s 50 teacher education institutions. This will replace the well-intentioned but rather sporadic approaches reported in the comprehensive *Making Better Connections* report (Downes et al., 2001).

This paper will make reference, as needed, to the requirements for teacher education institutions to comply with the Provider Registration Standards put in place by TEQSA (Tertiary Education Quality Standards Agency) as well as the ICT requirements outlined in the *Initial Teacher Education - Elaboration of Priority Areas* (SCSEEC, 2012). It is clear that there are influences on how teacher education considers and includes ICT other than what has been prescribed by AITSL and that, serendipitously, these are in alignment. All can, in turn, be tracked to the antecedent *Melbourne Declaration of Educational Goals for Young Australians* (MCEETYA, 2008), which, in its Goal 2, describes that successful learners, amongst other attributes, will: have the essential skills in literacy and numeracy and are creative and productive users of technology, *especially ICT*, as a foundation for success in all learning areas (p. 8, emphases added).

The key understandings for this paper are drawn from a 2012-2013 OLT National Teaching Fellowship investigating the agencies impacting on whole-of course curriculum design in initial teacher education (Lloyd, 2013). Additional data has been sourced from the four participating universities following the accreditation of their respective initial teacher education programs.

¹⁵ See <http://www.australiancurriculum.edu.au/technologies/rationale-aims/digital-technologies>

Australian Professional Standards for Teachers (APST)

The National Professional Standards for Teachers (AITSL, 2011b) – renamed as the *Australian Professional Standards for Teachers* (APST) in early 2013 - comprise seven interconnected, interdependent and overlapping standards grouped into three domains of teaching: (1) Professional Knowledge, (2) Professional Practice; and, (3) Professional Engagement.

The APSTs outline what teachers should know and be able to do through focus areas at four professional career stages: Graduate, Proficient, Highly Accomplished and Lead. At the graduate stage, they “make explicit the knowledge, skills and attributes of graduates of nationally accredited programs” (AITSL, 2011a, p. 3). Teaching degrees, irrespective of being awarded at Bachelor’s (AQF¹⁶ Level 7), Graduate Diploma (AQF Level 8) or Masters (AQF Level 9), are required to meet the APST standards at Graduate stage. While the majority of teacher standards can be contextualised in ICT¹⁷, there are three standards where ICT is specifically named. Table 1 provides simple details of these standards which will, in this paper, be collectively referred to as the ICT APSTs.

Table 1

Standards (APSTs) at Graduate career stage with direct reference to ICT

APST	Focus Area	Graduate stage
2.6	Information and Communication Technology (ICT)	Implement teaching strategies for using ICT to expand curriculum learning opportunities for students.
3.4	Select and use resources, including ICT	Demonstrate knowledge of a range of resources, including ICT, that engage students in their learning.
4.5	Use ICT safely, responsibly and ethically	Demonstrate an understanding of the relevant issues and the strategies available to support the safe, responsible and ethical use of ICT in learning and teaching.

Elaborations of Priority Areas

It is of interest at this point to digress from the AITSL narrative to consider the corollary requirements set out by SCSEEC (Standing Council for School Education and Early Childhood) in its *Elaborations of Priority Areas* (SCSEEC, 2012). The priority areas are: Aboriginal and Torres Strait Islander education; Classroom management; ICT; Literacy and numeracy; and, Students with special educational needs. Each is explained through elaborations which provide a useful insight into how they might be covered in practical ways in teacher education programs. Each also has a direct connection to the APSTs.

The elaborations agreed for ICT – in terms of knowledge, teaching strategies, using information and technical skills - are presented in Figure 1.

¹⁶ AQF stands for Australian Qualifications Framework. This has levels from 1 to 10 with 7 being an undergraduate degree and 10 being a doctoral qualification. See <http://www.aqf.edu.au>

¹⁷ For ICT elaborations across the majority of APSTs at the Graduate stage, please see <http://acce.edu.au/sites/acce.edu.au/files/TTF%20-%20Graduate%20Teacher%20Standards%20-%20ICT%20Elaborations%20-%20200411.pdf>

KNOWLEDGE • Understanding of the underlying social and pedagogical implications of ICT and their application to education • Knowledge of responsible and ethical use of digital information including in relation to plagiarism, copyright, censorship, bullying and privacy	TEACHING STRATEGIES • Understanding of innovative use of information and communication technologies in enhancing student learning • Understanding of the capacity of ICT to support differentiated student-centred learning and the development of critical and creative thinking • Ability to select and evaluate ICT-based learning materials and software and integrate them into their teaching • Ability to effectively employ ICT applications to support specific syllabus outcomes, content and processes • Ability to design a range of ICT-based assessment tasks linked to curriculum outcomes • Understanding of the collaborative and student led nature of effective ICT-mediated learning
USING INFORMATION • Understanding of the issues of appropriate access to, and verification of, information gained from a variety of sources including the Internet and other digital resources • Ability to critically evaluate, retrieve, manipulate and manage the information from a range of digital sources including social media	TECHNICAL SKILLS • Understanding of the range of applications and adaptive technologies available to support students with special needs • Ability to construct and manipulate texts and images, create presentations and store and retrieve digital information for classroom and on-line learning • Ability to use appropriate digital resources for student profiling and reporting, lesson preparation and class/faculty administration • Ability to safely and effectively use ICT in online collaborative environments

Figure 1

Elaboration of ICT as a national priority (SCSEEC, 2012)

Program accreditation panels, comprising of teacher educators, and teachers and system leaders, are asked to comment on how the program being accredited has demonstrated the elaborations. Together, the Australian Professional Standards for Teachers, the Program Accreditation Standards (to be discussed in the following section) and the national Priority Area

Elaborations show how preparation to teach with, about and through ICT needs to be aligned to, included in and demonstrated by Australian teacher education programs.

Initial Teacher Education Program Accreditation Standards

As noted, all initial teacher education programs must be accredited by AITSL. It is mandatory for “all institutions seeking to prepare teachers for registration and subsequent employment in Australian school settings are responsible for submitting their programs to the Authority for formal national accreditation or re-accreditation at least every five years” (AITSL, 2011, p. 18). AITSL have launched a public database of all accredited teacher education programs¹⁸. The accreditation framework has seven standards, here to be referred to as Program Standards:

- 1 Program outcomes
- 2 Program development
- 3 Program entrants
- 4 Program structure and content
- 5 School partnerships
- 6 Program delivery and resourcing
- 7 Program information and evaluation

This paper is concerned with Program Standard 1 (Program Outcomes) and Standard 6 (Program Delivery and Resourcing).

Program Standard 1 (Standards 1.1 and 1.2) asks how all components of the Graduate Career Stage of the Australian Professional Standards for Teachers (APST 1 to 7) will be met. This paper looks specifically at the three ICT APSTs (see Table 1) may be and have been met. Program Standard 1 therefore provides the mechanism to ensure that graduates have the opportunity to meet these ICT APSTs.

Program Standard 6, comprising of Standards 6.1-6.4, are concerned with program delivery and resourcing. Those of particular interest to this paper are Standards 6.1, 6.3 and 6.4 (see Table 2). As with the APSTs in Table 1, these make explicit reference to ICT.

Table 2

Program accreditation standards with direct reference to ICT

#	Program Standard Descriptor
6.1	Programs must use effective teaching and assessment strategies (linked to intended learning outcomes) and resources, including embedded information and communication technologies.
6.3	Providers ensure that programs use contemporary facilities and resources, including information and communication technologies, which students can expect to be available in schools.
6.4	Providers ensure that their facilities conform to the general expectation for a contemporary higher education learning environment appropriate to the mode of delivery, including such matters as access to: • education-related library resources • information and communication technologies

¹⁸ <http://www.aitsl.edu.au/reports/accredited-programs>

Program Standards 6.1, 6.3 and 6.4 are comparable to the infrastructure requirements put in place by TEQSA (Tertiary Quality Standards Agency) and which govern all higher education institutions in Australia. Their explicit reference to ICT connotes the intended adoption of 21st Century pedagogy in tertiary education.

It is immediately clear that the requirements in Table 1 and Figure 1 refer to the technological pedagogical content skills that individual graduates have developed or are expected to develop through their program of study; and those in Table 2 refer to the pedagogical practice and resources available in the teacher education institution. The program accreditation process considers both and teacher education institutions are required to make submissions – to panels convened by state or territory teacher regulatory authorities - which explain how they will meet these requirements. At the time of re-accreditation (typically 5 years hence), the institutions are required to show evidence of how the requirements have been met and how their program has been implemented. This paper will share the solutions offered by four teacher education institutions whose initial teacher education programs were among the first to have been accredited in Australia.

Comparative case study – 4 universities

While the APSTs and the Program Standards are quite specific, there remains considerable flexibility in how universities may respond. The case studies presented here provide a snapshot of what is happening in teacher education and highlight the possible differences in approach despite adherence to national requirements.

The data for the comparative case study described in this paper has been drawn from document analyses, surveys and interviews with senior academics at each selected institution. They are referred to here as University A, B, C and D. The programs considered are: a Bachelor of Education, 4 years duration with multiple specialisations, that is, early years, primary and secondary; and Master of Teaching programs, that is, graduate-entry pre-service programs of 2 years duration. Table 3 summarises the offerings in each of the selected universities. It also provides a preview of the approach taken by each institution (discussed in detail below).

Table 3

Details of accredited graduate-entry programs (Universities A-D)

ID	Program Name	Specialisation	Approach
A	Bachelor of Education	Early Childhood, Primary & Secondary	Independent
B	Master of Teaching	Early Childhood	Embedded
C	Master of Teaching	Secondary	Hybrid
D	Master of Teaching	Primary	Modified hybrid

University A, in its undergraduate Bachelor of Education programs, with specialisations in Early Years, Primary and Secondary education, has opted to develop two dedicated compulsory semester-long ICT pedagogy units. These are: (i) one focussing specifically on early years and primary; and (ii) another focussing on middle years and secondary. Elective units are planned to look specifically at multimedia and robotics. These core and elective units cover technical competence as well as pedagogy. Students in these programs are encouraged to develop both appropriate digital artefacts as well as written responses such as lesson plans or critiques of research. University A has also opted to list the ICT APSTs in their practicum units, that is, where it is expected that these standards will be demonstrated or observed in school settings. It was stressed, in interview, that ICT was not then precluded from other facets of study and that there were numerous instances where assessment, particularly in curriculum methods units, included the option for a digital response. The approach taken by University A might, for the sake of argument, be described as **independent**.

In providing evidence for Program Standard 6, University A referred to its institutional commitment to blended learning and how it has made purposeful use of its Blackboard Learning Management System.

It also drew attention to its well-equipped classrooms, lecture theatres and computer laboratories and the universal wifi coverage across the campus.

University B, in its Master of Teaching (Early Years) program, elected to cover Program Standard 1, that is, the ICT APSTs, as a cross-curriculum or embedded activity. For example, it addresses APST 2.6 in five discrete units of study respectively concerned with literacy, language, technology, mathematics and the arts. The students are asked to demonstrate their ICT competence through such activities as developing:

- an online teaching resource to develop children's literacy
- a lesson plan, which makes use of ICT, to support literacy, and elsewhere to support mathematical concepts
- a multimedia presentation for a hypothetical audience of parents
- a lesson plan which demonstrates the responsible use of ICT in the teaching of Science.

Similarly, APST 3.4 is met through six semester units with some overlaps to those which also address APST 2.6. The additional units are in Health and Physical Education and Indigenous Perspectives. A unit in the Arts, which is repeated, uses a different activity to that which demonstrates APST 2.6. This pattern is repeated in the achievement of APST 4.5. This approach might, as a counterpoint the *University A's independent* approach, be described as being **embedded**.

In providing evidence for Program Standard 6, *University B* described how the program under review will be fully online. It speaks of how it will make use of a Learning Management System (LMS) which makes effective use of content display, sharing and creation as well as interactive communication tools. The rationale for this mode speaks of a "digital core" of high quality content and the use of technology to afford the social construction of knowledge. These are, in and of themselves, a fine example for students to use to hone their understandings of new learning environments.

University C, in contrast to *Universities A and B*, has adopted a **hybrid** approach in designing a Master of Teaching (Secondary Education). It has developed a core *Digital Learning* unit of study that asks students, in response to:

- APSTs 2.6 and 3.4, to critique and adopt appropriate pedagogical approaches using ICT to engage teenagers in authentic, active and collaborative learning.
- APST 4.5, to investigate contemporary issues and current trends in ICT in education through an inquiry project.

In addition to this, other units of study are used to address differing aspects of the standards. An example of this is the application of ICT in Physical Education and Health (APST 2.6) and in Science (APST 3.4). The ethical component of APST 4.5 is embedded in broader understandings of professional conduct and demonstrated in the practicum.

University C, in its response to Program Standard 6, referred holistically to its adoption by teaching staff of digital resources as well as to specific infrastructure resources, such as its library. As with *University B*, it also made mention of its online Learning Management System (LMS) but, by contrast, this was described as supporting on-campus students and affording opportunities for blended learning.

Finally, *University D*, in its Master of Teaching (Primary Education) program has adopted a **modified hybrid** approach. It differs from *University C's* hybrid approach in that it offers a partially dedicated or shared unit, that is, one which addresses the teaching of both Technology and the Arts. It also places a strong emphasis on ICT in units dedicated to the teaching of English, Social Education, Mathematics, and Health and Physical Education. This program interestingly combines with an Engineering Faculty for the teaching of robotics.

Discussion and conclusion

This paper has identified differing approaches taken by four Australian universities in meeting AITSL requirements. These are: independent, embedded, hybrid and modified hybrid.

The four universities' initial teacher education programs discussed here are a clear indication that difference is possible and "professional prerogatives" (see AITSL, 2011a) have not only been exercised but encouraged. It has also shown that the suggested options of "specific units" versus "embedding" (SCSEEC, 2012) are not binaries and may, as in the case of University C and University D, demonstrate that hybrid options are both possible and feasible. While the universities have (unsurprisingly) asked for similar assessment types such as lesson plans, there was considerable variety in what was being requested. Similarly, where critiques of research or policy were requested, the focus of the critique was appropriate to the schooling sector or based in a relevant discipline-based context.

Importantly, in no instance have these institutions offered, or demanded, units of study which were confined to technical or operational skill. In each instance, and down to the level of individual summative assessment items, students were required to think, act or design as teachers. It was clear that, despite the different formats, the unit designers were aware of and enacting the need for pedagogical as well as technological knowledge. Despite their differences, each of these programs will, in its own way, achieve its goals and support beginning teachers in developing meaningful ways of working and teaching with ICT in their future classrooms.

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DIGITAL PORTFOLIOS FOR SUMMATIVE ASSESSMENT

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Abstract

The collection and scoring of creative practical work for summative assessment across a large jurisdiction such as Western Australia is challenging. An alternative approach would be to submit digital representations as online portfolios. However, to give a valid and reliable measure the representations would need to be of adequate quality. Further, judgements of creative practical work are necessarily subjective giving concern about the reliability of scores for high-stakes assessment. The paired comparisons method of scoring lends itself to addressing this problem and is feasible where the work is in digital form. This paper reports on a three-year study to investigate the representation of student practical work in digital forms for the purpose of summative assessment in the Visual Arts and Design courses. This study set out to determine whether the digital approach was feasible and adequate fidelity could be achieved in order to use the paired comparisons method of scoring. The study found this process was feasible, and the results were acceptable. However, the approach lacked support from Visual Arts teachers and students who wanted the original artworks to be assessed. By contrast the attitudes and perceptions of Design teachers and students were very supportive.

The summative assessment of performance on creative practical components of courses is difficult and therefore typically is either avoided or attempted in an inadequate manner. In particular the management and logistics of giving assessors access to the performance and the need for them to make highly subjective judgements reduces the reliability of the measurement (Dillon & Brown, 2006). It is likely that these challenges may be addressed through using digital technologies and comparative, rather than absolute, methods of scoring (Heldsinger & Humphry, 2010; Lin & Dwyer, 2006; McGaw, 2006; Pollitt, 2012). Further, if some of the obstacles to using portfolios for high-stakes assessment can be overcome by using digital technologies and modern psychometrics then this will better align assessment with preferred pedagogy (Clarke-Midura & Dede, 2010; Stobart & Eggen, 2012).

The assessment of creative practical performance has typically required students to submit a portfolio of work that includes created artefacts and process documents (e.g. Madeja, 2004). The assessor(s) judge this against a set of criteria to allocate a score or grade. This approach is problematic for widespread high-stakes implementation due to the difficulties in management and measurement (Clarke-Midura & Dede, 2010). This paper reports on some of the findings from the first two phases of a study that sought to address these difficulties through using digital technologies and the applications of modern psychometrics with portfolios in the *Visual Arts* and *Design* senior secondary school courses in Western Australia (W.A.).

Using portfolios for assessment purposes is not new but has had limited application for high-stakes summative assessment probably due to the costs of management and a lack of confidence in the reliability of the measurement. Masters (2013, p. 38) explains that, "When assembled over a period of time, portfolios can provide a valid basis for establishing current levels of achievement and for monitoring progress over time". Dillon and Brown (2006) point out that in the Arts the assessor needs to be provided with adequate evidence to make a balance of judgements between the technical and expressive quality of the work submitted. Thus the assessor needs to be given comprehensive access to the portfolio that is difficult when they are in physical forms but less so when they are in digital form. Dillon and Brown (2006) argue that digital technologies, "present the opportunity to capture, store, and manage multiple forms of evidence about artistic products and processes" (p. 420). However, if a digital form is used then this must adequately represent the performance.

The scoring of portfolios for summative assessment purposes has typically employed an analytical method that requires assessors to make absolute judgements. Each assessable quality is described as a criterion with a set of quantified levels of performance, often represented in a rubric, and then use some form of Item Response Theory such as Rasch modeling to generate a score or grade (Humphry & Heldsinger, 2009). Although this is preferable to just adding up the scores on the criteria, psychometricians such as Pollitt (2004) argue that this will not accurately measure a student's "performance or ability" (p. 5) because the nature of the performance is holistic and therefore a holistic method such as the paired comparison judgement method is "intrinsically more valid". However, until recently this has not been feasible for large-scale assessment but may be with the use of purpose built software, computer networks and digital representations of performances (Pollitt, 2012). Applied to the assessment of creative work it could be argued that,

Advances in assessment theory, notably evidence-centered design (ECD) and new statistical techniques and technology tools for supporting the use of ECD in assessment development, are making the assessment of complex cognitive components that are exercised in multiple subject matter contexts much more feasible. ... Embedding assessments in digital learning systems opens up possibilities for assessing features that are important but that could not be measured reliably and efficiently in the past. (U.S. Department of Education, 2013, p. 53)

The main purpose of the study was to determine the efficacy of digital representations of student artwork for the paired comparisons method of marking for the purposes of high-stakes summative assessment. The processes and resulting artefacts of student activity needed to be represented in digital form to measure their performance for summative assessment purposes. The study built on concerns that in courses where portfolio assessment is used judgements are not comparable between contexts, are not reliable due to the subjectivity of assessors, and are not cost-effective for large groups of students spread across large jurisdictions. The questions were whether adequate fidelity of representation could be achieved using common digital technologies in typical school settings and whether the paired comparisons method of scoring would provide adequate reliability for high-stakes summative assessment purposes.

Method

The study addressed questions concerning the adequacy of digital representation, scalability, and moderation and standard setting in three phases. In the first phase we digitised student work that was submitted for high-stakes summative assessment, in the second students digitised their own work to be submitted online for external assessment, and in the third we tested the feasibility of using our online scoring systems to support moderation and standard setting. The senior secondary W.A. courses of *Visual Arts* and *Design* were used as the contexts for the study. The study employed an action research design that involved the collection of a range of data analysed from the perspectives of students, teachers and assessors. Students were surveyed and interviewed, teachers and assessors were interviewed, and the scores from marking were analysed and compared. The analytical marking criteria provided for the course were used by the study and initially the technical specifications for digitizing the portfolios were determined through an analysis of syllabus requirements and a review of portfolios submitted in the previous year. For more details of these data collection processes refer to Newhouse and Tarricone (2014).

In Western Australia (W.A.) for many years the summative assessment in the senior secondary courses *Visual Arts* and *Design* has included analytically scoring a physical portfolio. For the *Design* course this was a collation of 15 A3 sheets of paper and for the *Visual Arts* course was a resolved artwork supported by a document containing an 'artist statement' and photographs of intended presentation of the artwork. All of these portfolios were required to be sent to a central location in Perth to be assessed and then be returned to the students after they are scored. In a large jurisdiction such as W.A. this approach provides many logistical and management challenges to add to the limitations of measurement and the lack of an adequate enduring record for confirmatory purposes.

The first one-year *Development and Pilot* phase involved 75 *Visual Arts* portfolios from 10 schools and 82 *Design* portfolios from 6 schools being digitised by our research team and scored using both an analytical and a paired comparisons method. The efficacy of the digital representations was interrogated through interpreting the responses of students, teachers and assessors, and through a comparison with the scoring of the original physical portfolios. The sample was purposefully selected for experienced teachers who had taught the course for a few years; many were experienced assessors.

The second one-year *School-Based Implementation* phase involved 138 *Visual Arts* students from 13 schools and 110 *Design* students from 14 schools, with all students from the penultimate year of secondary schooling. This sample of schools was initially selected to ensure a representative range of typical schools were involved including two from country areas and some from each of the three school systems (government, Catholic and independent). Researchers supported teachers to facilitate students in digitizing their own portfolios and uploading these to an online repository. As Dillon and Brown (2006) suggest it was likely that with students digitizing their own work a more accurate representation would be formed.

A third *Moderation and standard setting* phase involving 15 *Visual Arts* teachers from W.A. country schools is underway. These teachers are being supported in the use of our online scoring tools for analytical marking and paired comparisons judging to view the digitised portfolios from the first phase of the study. The purpose is to determine the feasibility of teachers using the tools from anywhere with no face-to-face support to develop their understanding of the standards of work submitted and provide a form of moderation at a distance. At the time of writing this phase had not been completed.

Phase One – digitisation by researchers

From meetings with experts to review the course syllabus requirements, and examples of student work, a set of requirements for digitising were drawn up (refer to Table 1). Researchers were trained to digitise the portfolios at the central location to which all portfolios for W.A. had been delivered. The resulting files were checked, where necessary edited and uploaded to an online repository to be accessed by assessors. For details of the processes of digitisation and the results of implementation refer to Newhouse (2014). While all required files were created for each portfolio for *Visual Arts* it was not possible to fully implement the intended procedures and guidelines to ensure the highest fidelity of representation due to time and space constraints.

All digitised portfolios were scored using an analytical marking method and a paired comparisons judgement method facilitated by online systems. For the former we used a custom-built Filemaker Pro database system and for the latter a commercially available system called the Adaptive Comparative Judgements System (ACJS) (Pollitt, 2012). In addition the raw scores awarded for the original physical forms of the portfolios for the WACE (W.A. Certificate of Education) were obtained so that each portfolio had three scores (i.e. WACE, Analytical, and Pairs). For details of the processes of scoring, the assessment criteria and the analysis of the resulting scores refer to Newhouse (2014). The results of scoring indicated that assessor could readily use online tools for both methods of scoring for both courses and that the scores from paired comparisons judgement correlated strongly with the WACE scores. However, for both courses the inter-rater correlation for analytical marking was only moderate and for *Design* the scores from analytical marking did not correlate strongly with the other two scores. It was concluded that for *Visual Arts* the typically high level of subjectivity found in judging artworks could be counteracted by the combining of the judgements of multiple assessors, as best represented by the paired comparisons method. Whereas for *Design* this did not occur to the same extent because the scanned portfolios were too dense making it difficult for assessors to consistently locate information relevant to assessment criteria.

Table 1

Requirements for the digitising of the portfolios by the researchers.

Type	Digitisation Requirement	File type
Visual Arts 2 Dimensional	ID number and match-box visible in each photo/video Photo of 'Artist Statement' and proposed installation if provided One full size hi-resolution photo of 4 megapixels giving 300dpi at a reasonable size. Additional photos for multi-piece artworks. 4 x close ups - extracted from main photo(s) All photos combined into one document HD Video (pan & zoom) - 10 secs	.jpg .jpg .jpg .pdf .wmv
Visual Arts 3 Dimensional	ID number visible in each photo/video Photo of 'Artist Statement' and proposed installation if provided Full size photo + size object such as a match-box At least 4 x angle photos (L, R, top, bottom) 4 x close ups - extracted from main photo All photos combined into one document HD Video (pan & zoom) - 10 seconds 3-D Animation for some works	.jpg .jpg .jpg .jpg .pdf .wmv .mov
Design	Colour scan of all A3 sheets	portfolio.pdf

Students and teachers viewed the digital representations of their own work, and then answered some questions. For details of the results of analysis of student and teacher responses refer to Newhouse (2014). From the survey of students it was clear that the two groups of students differed substantially in their previous experiences, skills, attitudes and perceptions regarding the digitisation of their work. In general the *Visual Arts* students were negative about using digital representations to replace marking of the physical artworks. They did not think the digital representations were adequate to mark in place of the original artworks. They had had very little previous experience in digitising their work and had less skill in using ICT than the *Design* students. In comparison the *Design* students were generally very positive about submitting work digitally, most had had some experience in doing so, and in fact most had produced some of their portfolio on computer. Unlike the *Visual Arts* students they would have liked to have a digital portfolio assessed, rather than a paper-based one, provided they could create and submit it digitally themselves. The two groups of teachers tended to mirror the attitudes and perceptions of their students in that the *Visual Arts* teachers were very negative about the potential of using digital representations for summative assessment whereas the *Design* teachers were very positive and perceived it to be more consistent with the intentions of the course and the realities of the relevant workplaces.

The first phase of the study demonstrated the potential for using common technologies for representing all the students' submissions as digital portfolios and scoring them using online tools. However, for both courses central digitisation was not feasible or desirable and it was likely that better portfolios could result from students creating and submitting their own equivalent digital portfolios. It appeared likely that *Design* students would have adequate ICT skills to accomplish this but it was likely that many *Visual Arts* students may not and therefore would need some support in doing so. This would be investigated in the second phase of the study. It was also determined that there were difficulties with the reliably scoring the *Design* portfolios probably due to the structure of the portfolios and the nature of the assessment criteria and therefore changes were recommended (Newhouse, 2014).

Phase Two – digitisation by students

For the second phase students were assisted to create a digital representation of their own work, similar to that for the first phase but with some enhancements. They used technical specifications based on those used in the first phase, however, for both courses they were given the opportunity to explain their work to the assessors through a video recording. For the *Design* portfolios (refer to Table 2) the students created one PDF file comprising 15 screens and for the *Visual Arts* portfolios students took their own photographs, including close-ups. This also meant that the *Design* portfolios could include considerably richer communication with more focus on images and layout than text, than was possible for paper submissions. Wherever possible students followed written instructions to create and submit their portfolios online. For more details of the processes involved in digitization refer to Newhouse and Tarricone (2014).

Table 2
Requirements for the Design digital portfolios produced by students.

Type	Digitisation Requirement	File type
Design	15 screens (guide is A3 size maximum)	portfolio.pdf
	Up to three projects included and only the best examples	
	PDF size should be approximately 12MB	
	Single PDF (Any software can be used to produce the portfolio as long as the maximum file size of 300dpi is not exceeded when saved as a PDF)	
	20 seconds of video supported by annotated audio descriptions focussed on the design process	video.avi
	Up to 12 MB in size	

All digital portfolios were scored using the two methods from the first phase, that is, analytical marking and paired comparisons judging.

For the Design portfolios, an analysis of the scores from analytical marking showed that although the two assessors had very similar means, standard deviations and ranges this only resulted in a moderate to low significant correlation between them ($r=0.47$, $p<0.01$). This would tend to indicate that the assessors were not very consistent between themselves and that the marking criteria were difficult to interpret consistently. Rasch analysis showed that whereas there was good fit to the model and good overall discrimination, with a person separation index of 0.94 and the Chi-square probability of 0.94, all item locations were on the lower half of the person locations, probably indicating that it was too easy to score highly on all criteria. For the Visual Arts portfolios there was a strong and significant correlation between the three assessors ($r=0.73$, 0.73 , 0.75 , $p<0.01$) and Rasch analysis found a high Cronbachs Alpha coefficient (0.96). However, this analysis did indicate the criteria were ‘too easy’ for the range of quality of the work.

The paired comparisons judging was facilitated by the *ACJS* online system. For the Design portfolios the Cronbach Alpha coefficient was 0.90 after the 13th round of marking that indicated a high level of reliability. In total it was estimated that assessors took from 4:33 to 9:22 minutes per judgement and that 689 judgements had taken on average 6:33 minutes per judgement. For the Visual Arts portfolios the reliability was also good ($\alpha=0.953$). There was a strong correlation between the two sets of scores (analytical and pairs) for the *Visual Arts* portfolios ($r=0.84$, $p<0.01$) but only moderate for the *Design* portfolios ($r=0.64$, $p<0.01$). For Visual Arts this probably indicates that while the judgement of individual assessors is highly subjective their combined judgement is more reliable as represented by the paired comparisons scores and average of the analytical scores. It is likely that the lack of consistency in analytical marking of the *Design* portfolios was still mainly due to the quantity and complexity of information in the portfolios making it difficult to sample to make judgements.

Students and teachers were surveyed using questions similar to those used in the first phase. For more details of the analysis of these data refer to Newhouse and Tarricone (2014). To a large extent their

responses were similar to those in the first phase in that there was a contrast between the two courses with *Visual Arts* teachers and students generally negative and inexperienced and *Design* teachers and students generally positive and experienced.

The *Visual Arts* students generally were happy with the digital representations of their work. Of significance was that most indicated that the processes of digitisation and submission were easy to follow. They wrote that it was “easy”, “fun” and “good to have a digital copy”. Some had a number of pieces which made up one artwork and they found it helpful to capture all of the pieces together. They also considered that the close-ups showed the detail in their work and “emphasised tonal modulation”. They felt that digitisation provided “quality clear images” and “good light, shadow and colour capture”. Some commented that it would be useful for markers to know their ‘reasons/points of view/hidden messages’ about their work as provided in the annotated video. Despite this half would have preferred someone else to do the digitising, and most would still prefer an assessor to mark their original artwork, and in doing so they would receive a higher score. Some considered that digital images “hide faults” and “can make [the] artwork look better”. Many indicated that the video was too short and that they did not enjoy talking on the video (Note: the video was of the artwork not of the student). Some felt that the digitised work “wasn’t necessarily a true or good representation” of the original work and that their artwork would “have more impact and meaning if it was marked personally” by the markers as it “doesn’t look impressive in digital form”. They also felt concerned that digitisation did not show “fine details, texture and doesn’t capture the essence” of the original artwork.

The *Design* students were not as positive as expected with some of this likely to be due to a perception that the video was not worth the effort and that collating the portfolio was time-consuming and in some cases difficult to locate the pieces. There were statements such as, “time consuming -- more confident with paper portfolio”. However, in one school students wrote,

*a lot easier and quicker to create
show full understanding of design as the digital portfolio
digital portfolio included everything
happy with it*

Overall the *Visual Arts* teachers were still not in favour of digital representations being marked in place of the original artwork but were a little more positive. They perceived value in students being able to represent their work in this way and tended to be impressed with the photographs their students had taken. In addition two country teachers conceded that there were some logistical and security advantages to using digital portfolios in place of physical ones. One teacher explained the difficulties she had in transporting student work to Perth and commented that, “For the logistics of schools in this area, this is brilliant”. Further, a Perth based teacher commented, “I have been very against this, but after some terminal damage to work for external examination I can see the benefit”. Another teacher summed up the benefits,

There are TWO benefits with the digitalization process. One being it prevents student’s work from the risk of being damaged during external assessment. The second benefit will be for teachers to have a record of all of their student’s artworks. This is it’s main potential and it is a process that can be done quite easily. This can also help with create portfolio of works that represent different grades, this could be used for training new markers and new teachers.

Generally the *Design* teachers were in favour of students submitting digital portfolios although they recognized that many students would need to be better organised and improve some of their technical skills. A typical comment from a *Design* teacher was,

Most students were able to present their work really well after creating the first couple of pages. They looked much more professional than traditional cut & paste method. File management was the main problem for them but having gone through

this process for the first time I would approach it differently for some students next time. Possibly creating the pdf at the end of the portfolio process. Merging all of their pages together.

Phase Three – moderation and standard setting

For the third phase the aim was to evaluate the suitability of our approach for implementation across the state for the purposes of moderation and standard setting by demonstrating that all teachers could be involved in scoring through our online systems. From the second phase we knew that students could upload their portfolios and that local Perth teachers could use the online systems supported by one or two face-to-face workshops. However, to be implemented statewide teachers from country areas would need to participate and thus all support would need to use online technologies. We could demonstrate the feasibility of this by recruiting a sample of country teachers to score the submissions from the first phase, identify the minimum support required to use our online systems to achieve results similar to those in the first phase. The phase is currently underway and not completed at the time of writing and therefore it is not possible to report results at this time.

Conclusions

At this stage our study has shown that visual artworks can be adequately digitised for the purposes of summative assessment and that students can do this using relatively inexpensive equipment, systems and software. However, teachers and most students in *Visual Arts* are not persuaded of the adequacy, although if faced without the choice of centralised marking of the physical forms of the work this may change. The lack of experience of students, probably because there is currently no need to represent their work digitally, is a likely explanation of the negative perceptions of many students. In comparison teachers and most students in *Design* are enthusiastic of the potential for digital submission of the portfolios. The limitation to static text and graphics meant that there was little difference between the digital and paper representations and the focus and structure of the existing portfolio appeared to make it difficult to mark because there was too much information to synthesise across too many projects and in too many variations of layout and location. Therefore the content of the portfolio would need to be reviewed to gain the affordances of being a digital portfolio.

In Australia as the trend continues towards a national curriculum with accountability requiring comparability of assessment it is almost certain that online judgement or marking systems will need to be used to be cost-effective. This approach will improve manageability (e.g. marking from anywhere, less use of physical space and time), increase the reliability of the scores from marking, maintain an enduring record, and provide knowledge of assessor perceptions. Using various forms of digital portfolios this can probably be achieved in any curriculum area, even difficult areas such as visual arts. Our study is demonstrating the viability of the technology so now political will and informed community attitudes are needed to make the key decisions to move all aspects of assessment into the digital age.

Acknowledgement

The study discussed in this paper was conducted by a research team, for the Centre for Schooling and Learning Technologies (CSaLT) at Edith Cowan University. The team was led by Paul Newhouse and includes researchers Jeremy Pagram, Mark Hackling, Pina Tarricone, Martin Cooper, Alistair Campbell, Alun Price, Lisa Paris and a number of research assistants and advisors. The research was conducted with the Schools Curriculum and Standards Authority in Western Australia and partly funded by the Australian Council for Research.

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REDEFINING EDUCATION: SUSTAINING 1 TO 1 COMPUTING STRATEGIES IN WESTERN AUSTRALIAN SCHOOLS

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Abstract

In 1993 the first WA private school adopted a 1 to 1 computing strategy and then ten years later the first government school did so. With the advent of the Digital Education Revolution initiative many schools in WA commenced 1 to 1 strategies and it has almost become an expectation in secondary schools. Our Snapshots studies involved two new government schools and a long established elite private school that had a similar vision for learning with digital technologies. The two government schools had 1 to 1 strategies, but had found that their chosen tablet PC was not robust enough, and had concluded that the current policy was not sustainable. They were debating the merits of BYOD or BYOT strategies in the light of constraints and the nature of their clientele. The private school, unlike most of its peers, had not had a 1 to 1 strategy but was planning to do so using iPads. However, it appeared that they already had an informal BYOT strategy. In this paper we discuss the differing situations these schools have found themselves in, the vision they have for learning with digital technologies, and the issues they are debating that will allow them to implement and sustain this vision.

Context

Schooling in Western Australia (W.A.), has a long and proud history of initiatives aiming to provide one-to-one (1:1) portable computing. The first whole school programs were at the beginning of the 1990s and with these successes others were encouraged to follow suit; a more detailed account is provided by Newhouse (2014). Australian educators also learned from the experiences of schools in other countries, particularly the U.S.A. and U.K. (e.g. Cox, 2012; Gardner, Morrison, & Jarman, 1993; Sandholtz, Ringstaff, & Dwyer, 1992). It has now become typical for an Australian school, particularly a secondary school, to organize 1:1 portable computing in some form. In the past, this was almost always achieved by either requiring parents to buy or lease a particular portable device, or by the school buying the devices to loan to students. More recently the option of Bring Your Own Device (BYOD) or Technology (BYOT) (Lee, 2012) is being considered, in recognition that many students already have a suitable device and in response to the availability of so many devices that are likely to adequately fulfill the needs of students at school (The Office for Standards in Education, 2011).

Over the past 40 years of research into the use of computers in schools, it has been recognized that the extent to which the potential for positive learning outcomes is realized depends on an array of enablers and barriers (Hew & Brush, 2007; Newhouse, 2014). Two oft cited factors are the leadership in the school, and the organization of the curriculum. In fact Tondeur, Cooper and Newhouse (2010) found that the connection between leadership and the curriculum was a critical factor. While visionary leadership and support of the Principal was necessary, it was the organization of curriculum leadership and its connection with the provision of Information and Communications Technology (ICT) that was important. In particular the role of a curriculum ICT leader was pivotal to success.

Perhaps unsurprisingly, for a decade almost all of the examples of 1:1 portable computing initiatives in Australia were in higher fee-paying private schools with laptops costing around \$2000 and expensive technical support and infrastructure such as networking (Newhouse, 2014). There was always some unease about initiatives that could not provide every student in the school with a device (Narracott, 1995) and therefore only a few government and low fee-paying private schools were involved. However, with the arrival in 2008 of the Australian government Digital Education Revolution (DER) funding, and

cheaper mobile devices, many of these schools moved to 1:1 provision. The DER funded secondary schools, or school systems, to provide a computer per student in whatever way they chose; for example, in New South Wales state government schools the system decided these funds would be used to purchase a particular laptop for every student in Years 9 to 12 (Howard & Carceller, 2010). In Western Australia the decision was left to the school and thus in some schools the funds were used for a 1:1 program. As the DER funding ends they are debating how to sustain 1:1 provision whilst ensuring satisfactory levels of equity of access for students.

In this context, research such as the Snapshot Studies is timely (refer to http://edfutures.net/Research_Strategy). Increasingly the questions in schools are not whether to have such a provision but rather, what is the best approach to take for the school's situation. It is likely that there will not be a definitive solution so schools need access to information about a range of options, in the way that the Snapshot Studies set out to provide. The themes and associated questions are important for all schools as they plan to bring a vision to reality.

Methodology

The three cases reported here form part of a series of 13 studies carried out in Australia between September and December 2013, which are referred to as the Snapshot Studies (see http://edfutures.net/Technology_Strategy_Case_Studies#The_Snapshot_Studies). These complement 22 studies carried out in England between September and December 2012, which are referred to as the Vital Studies (see http://edfutures.net/Technology_Strategy_Case_Studies). The Snapshot Study schools were selected based on the researchers' local knowledge of schools that were engaged in the implementation of mobile device strategies. Table 1 provides a summary of these Snapshot Study schools.

Table 1
Summary of the Snapshot Study schools reported here

	School A	School B	School C
Type	State	State	Independent girls
Phase	Secondary	Secondary	K - 12
Approx. no. students at school	300	250	1100
Digital technology strategy	1:1 Tablet PC	1:1 Tablet PC	BYOT
Year group(s) observed	8	8	9

The Snapshot Studies used a cut down version of the methodology used in the Vital Studies (see http://edfutures.net/Research_Strategy). The Snapshot Studies involved data collection prior to and during one day spent in school by the researchers. The key data collection tools included: questionnaires, semi-structured interviews, an observation with follow up interview, and a focus group with four students. One of the purposes of the questionnaires, which were sent to participants to fill in before the researchers came in to the school, was to ensure they had had time to think about the issues prior to the interviews. As one might expect given the practicalities of doing research in schools, there were minor variations from the standard methodology in each of the Snapshot Study schools. These are summarized in Table 2.

Table 2
Variations in the methodology

School A	No School Leadership Team questionnaire The Principal, Deputy, ICT Coordinator and other staff were interviewed together There was no parent interview
School B	No School Leadership Team or ICT Coordinator questionnaires 3 parent questionnaires (rather than 1) 3 student portfolios (rather than 4) No ICT Coordinator interview (the SLT had led on the digital technology strategy)
School C	No ICT Coordinator questionnaire No student portfolios

Clearly the data collection could only provide a partial glimpse of practice within the school. Nonetheless surprisingly rich pictures of practice emerged from the multiple perspectives of the reports of the principal, ICT coordinator, Teacher, parent, and students, and the researchers' classroom observations.

Data analysis

Emergent Themes Analysis based on Wong and Blandford (2002) was used to identify 'emerging trends' from the 22 Vital Case Studies (Twining, 2014). This analysis was then extended to include the 13 Snapshot Studies in Australia including the three discussed in this paper.

The three schools had different approaches to providing student access to computing. In School A and B there was a 1-to-1 strategy with each student provided with a Samsung Slate, a tablet PC with a removable keyboard, which were supported by a school technician and connected to the school WiFi network. In School C students were permitted to bring any device they owned to school, including some with 3/4G connectivity. Students were provided with usernames and passwords for the school WiFi network. A teacher commented that the student's devices were often better quality than those the school provided; which included hubs of desktop computers in shared areas and sets of laptops on trolleys. Most students preferred to bring their own devices. School C planned to introduce a BYO iPad strategy.

Discussion of results

There were many ways in which the three schools differed with two being new government schools in aspirational suburbs, and the third being a long-established elite private school. All three wanted each student to have their own device and were grappling with different constraints to that provision and its equitable sustainability. The results are now discussed under the main themes emerging from the analysis of the data across the three schools.

Visionary leadership

Each of the three schools had a new Principal who had a strong vision that included student use of computing devices, which they endeavoured to communicate throughout the school. In each school this was connected to curriculum leadership, but in different ways. In School B the Principal had good technical IT skills and knowledge and he had taken responsibility for leading the 1:1 initiative and connecting it with the curriculum. In School A this leadership was delegated to an Associate Principal who had responsibility for all curriculum matters. She had formed a committee to support her that included the network manager and teachers with high levels of technical capability. In School C the Principal had appointed a teacher, new to the school, as the Director of Information and Learning Technologies. This position reported to the Principal, managed the technical support personnel and liaised with the curriculum leadership. We noted in each school that much of the success with the 1:1 strategies was due to the role of the senior curriculum leaders and the enthusiasm and capability of a large proportion of the teachers.

In School A the digital technology vision was to have ‘a computer lab in every classroom’. Thus every student and teacher had access to a Samsung Slate running Windows 8, and most rooms had a large flat screen display. This vision was largely exemplified in a Year 8 Science lesson at the start of a project to design a planet within the solar system, which was observed by the researchers. The teacher started by displaying a topical video from Mars One on the large screen and then demonstrating Spacecraft 3D – an app from NASA that allows you to explore 3D models of spacecraft such as the Mars Lander. Then the students worked in pairs or small groups using a simulation called My Solar System, in conjunction with a paper-based worksheet.

In School B the vision was that the devices would allow for more collaboration and mentoring between staff, leading to a more cross curricular approach to teaching. All students and teachers were initially provided with a Samsung Slate running Windows 8 and each classroom had a large flat screen display. In the observed lesson the teacher and students used an application called Geogebra to work on a number of problems related to graphing linear equations.

In School C the emphasis was on learning, focusing on higher order thinking skills through critical discussion and content creation. The technology was viewed as an essential but invisible tool. The students were encouraged to bring any technology they needed to get the task done. In the lesson viewed by the researchers the students shared video resources that they had created. This generated discussion on how the video techniques were used to convey meaning from the story of Romeo and Juliet. There was no instruction on the technical aspects. It was assumed that as the students had brought their own devices they knew how to use them. The researchers noted some peer-to-peer support on technology use.

Best means of provision

In each school the vision of the leadership needed to be supported by the provision of access to portable computing. In Schools A and B this was through the school providing Samsung Slates. For these schools the two over-riding issues were: the robustness of the devices; and having a financially viable plan, for parents and the school, for providing every student with a device. In School C the strategy was for parents to provide devices and the main issue had become whether to allow any device or require parents to provide a particular device, an iPad.

Robust Devices

In School A the main concern was the inadequacies of the chosen devices, principally that they were too easily damaged. Thus at any one time up to 50% of the devices were being repaired. This had led to a negative cycle of staff not feeling able to use the devices because many students wouldn’t have one with them, which reduced the incentive for students to bring the devices into school, which increased the proportion of students who didn’t have a working device available in lessons. As a result the school had reverted to providing separate computer labs for those lessons where everyone needed computer access. Similarly, School B had problems with damage to devices, with more than 20% being repaired at any one time. The school maintained an expectation that students would bring their devices to every lesson unless they were broken. Whilst staff couldn’t rely on the class having a full set of devices, they still maintained a positive feeling toward the 1:1 strategy and some teachers were implementing more engaging and interactive lessons using the technology.

In the observed lesson in School A only 10 students had slates available and thus they had to work in groups. In School B in the observed lesson 22 of the 26 students had their device with them although a small number had issues with running out of battery charge as the lesson was late in the day. Clearly it is essential to ensure that the devices are robust enough to withstand the normal wear and tear involved in being used in school, including in the playground, as well as being transported to and from home. In both School A and B the student WiFi only provided access to the Internet, because Windows 8 was not supported by the Department of Education (the sites were being used to trial this newer operating system). This meant that student’s devices couldn’t be connected to the Department’s services. School B addressed this problem by using a cloud based virtual learning environment.

These Snapshot Studies raised questions about the most appropriate device for use in schools. The majority of staff and students who we spoke with at School A and B thought that having a physical keyboard was essential, and indeed almost all of the use of the slates that we observed did involve use with the keyboard attached. However, this contrasts with the views of staff and students in other schools (including School C), which have chosen to go down the tablet route. They argue that for 90% of the things students use their devices for in school a physical keyboard is not necessary, and immediate on and long battery life are more important factors. Ultimately it is clear that no single device is suitable for all educational purposes, and that one needs access to a range of devices, suited to different tasks. Thus, for example, you need high specification desktop machines to do sophisticated CAD/CAM work; a physical keyboard is advantageous if writing extended essays; and a tablet is ideal for general use around the classroom, where its form factor, immediate on and long battery life lend themselves to spontaneous use as a natural part of the learning process. This led to the addition of the 'What device' dimension to the 'emerging trends':

What device	Desktop	Laptop	Tablet	Tablet +
Category	Explanation			
Desktop	Desktop machines			
Laptop	Laptops, netbooks, Tablet PCs			
Tablet	Tablets and other devices with a touch screen (but without a physical keyboard)			
Tablet +	Recognition that no one device is suitable for all tasks and students therefore need to have access to different devices for different activities.			

In School C the class observed by the researchers was in a specifically designed building for the middle school. This consisted of a number of classrooms with one glass wall, which faced the shared technology hub. The majority of the students in the observed class had brought their own devices or sharing a device that one of them had brought in. There was a mix of PCs and Apple devices. These were used for the writing tasks and for editing the video footage that was filmed using a range of handheld video cameras.

BYOD/T or 1:1

The three schools were wrestling with the question about whether students should all have the same device, a 1:1 approach, or should be permitted to bring any device they owned that would do what was needed to support their learning at school and home. Schools A and B had a 1:1 strategy but were considering BYOD, whereas School C had a BYOT approach and was considering 1:1. In essence they had to balance their vision for portable computing supporting learning with the constraints associated with their environments.

In Schools A and B the main constraint was cost and the ability of middle-income parents to pay for devices. It was known that the vast majority of students already had one or more devices at home but these varied in quality, age and operating system. It was thought unlikely that many parents would be happy buying another device specifically for school. However, there was concern that if students brought in a range of devices this would counter the vision because they may not all be able to access the software and services teachers planned for lessons, and teachers would not be able to help them with their devices. School B's Principal believed that it was inevitable that the school would eventually move toward a BYOD strategy, with the school providing laptops that could be borrowed for use in school by students who didn't have their own device.

In School C the main constraints were the power of the parent body and concerns about controlling access to software and online content. The school's aim was to provide a robust, fast WiFi network so that student would choose to connect their own devices to the school network rather than to unfiltered

connections available via their smartphones or the free local council network.

The distinction between 1:1 and BYOD/BYOT is not so much to do with who pays as with who specifies what devices can be used from home and whether every student will have a device. So 1:1 requires that every student **MUST** have the same specification of device (e.g. Schools A and B mandated a particular make and model; other schools have a whitelist or specification in terms of Browser/WiFi/Apps). If School C moved to its iPad strategy and required every girl to have one then that too would have fitted better into a 1:1 strategy; if they had said you can bring an iPad if you like then that would be BYO iPad (the distinction here being about whether or not every child would have a device – BYO implies not everyone will have one; 1:1 expects everyone to have one).

Sustainable Plans

All three schools were working on sustainable plans for providing portable computing to support learning. This included concerns for equity of access that in Schools A and B were to do with whether parents could afford the cost, and in School C was whether each student had access to the most appropriate device.

In School A parents were asked to make a voluntary contribution of A\$200 per year towards the cost of the devices. This entitled their child to have a device that they could take home each evening, but would have to return at the end of the year. The small proportion of students whose parents did not pay the A\$200 were able to borrow a slate from the library for a particular lesson or activity, but could not keep it overnight. In School B parents were asked to pay a levee of \$175 per year, however, some parents had refused to pay due to the unreliability of the device. These parents indicated they were supportive of the initiative but not of the particular device.

Due to the inadequacy of the devices the school leadership had begun to debate plans for the following year; whether they should persevere with the current device which cost A\$1400, get cheaper laptops, or allow students to bring their own devices (possibly from a list of acceptable alternatives). The cost of the device had become an issue because with the demise of the DER funding the school could not afford to continue to subsidise the cost of devices. At the same time there was evidence that most students already had a suitable device that they could bring to school; effectively transferring the full cost to parents, though without requiring them to spend any more money. However, there were questions about how to provide for the student whose parents didn't buy them a device and how to support teachers in coping with a range of devices with varied software. School B was having similar discussions amongst their leadership team and they were planning to move to a model where the devices were not taken home, or a mix between BYOD and school provided machines (that stayed at school). These were seen as the only financially sustainable models.

In School C trolleys of laptops and access to desktop hubs were maintained to guarantee that all students had access to required software and services. In addition students were provided with technical support to connect their own devices to the school network. The school was introducing a 1:1 bring your own iPad policy so that they could focus their technical and pedagogical support, but said that students would still be allowed to bring other devices as well, in recognition that students had multiple devices and different devices were suitable for different activities.

Conclusion

Despite their different contexts, these three schools raised a number of common issues facing any school implementing a mobile technology strategy. They were all grappling with questions about the most appropriate devices and approaches – laptops, Tablet PCs or tablets; 1:1, BYO, or reverting to more traditional models of loan machines for use in school. What was clear from all the schools was they aspired for every student to have their own mobile technology, with the school supplementing provision for those who needed additional support. In government schools financially sustaining a 1:1 program is unlikely to be feasible without at least some parental funding. Schools grappling with this issue should start by finding out the extent to which their students already have mobile devices that they could use in

school (using a free service such as Your Own Technology Survey <http://www.yots.org.uk>) because if, as appeared to be the case in School A, most students have at least one laptop or tablet at home they could bring to school then moving towards a BYO approach may be the only viable solution. However, this would need varying levels of pedagogical support for staff and a shift in school system policies in W.A. to facilitate a move towards cloud based solutions to complement the use of students' own mobile devices.

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TEAM TEACHING WITH TECHNOLOGY: UPSETTING THE TPACK APPLE CART

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Abstract

In contrast to the pedagogical solitude experienced by some teachers working with their students behind closed doors, teams of teachers collaboratively teaching larger groups of students is a practice becoming more frequently employed with junior and middle years classes. The research literature examining team teaching reports a number of benefits that lend support to the decision of schools who have adopted a team teaching approach; however, studies also report a number of challenges that have also been commonly identified with this practice. In particular, research indicates difficulties associated with the formation of effective teaching teams due to the differences in teachers' professional knowledge and skills. These differences can manifest themselves in a number of key areas including pedagogical approaches and content knowledge. The efficacy of teaching teams is further complicated by the increased availability of digital technologies and the tensions created by the different skill levels and pedagogical choices made by teachers in the same team. In this paper we consider the ways in which TPACK is challenged by the complex nature of team teaching and propose the notion of developing a communal TPACK for improved team effectiveness.

Teaching with technology

Secondary school teachers' pedagogical adoption of technology is a *wicked problem* (Rittel & Webber, 1973) characterised by complex, contradicting and changing interdependencies between technological, pedagogical and content demands that are mediated by the situated social contexts that bound teachers' practice (Archambault & Crippen, 2009; Cox, 2008; Mishra & Koehler, 2006; Mumtaz, 2000; Shulman, 1986; Somekh, 2008; Straub, 2009). Research investigating this multifarious problem reports that technology integration is either not happening, happening too slowly or happening with little or no effect on student's learning (Cuban, 2004; Dynarski et al., 2007; Howley, Wood, & Hough, 2011; Selwyn, 2010).

Factors influencing the diffusion and adoption of technology into teachers' pedagogical practices have been the focus of considerable academic research (Barron, Kemker, Harmes, & Kalaydjian, 2003; Birch & Irvine, 2009; Graham, 2011; Mishra & Koehler, 2006; Mumtaz, 2000; Somekh, 2008; Straub, 2009; Webb & Cox, 2004). A number of studies in this field have applied recognised adoption-diffusion theories whose genesis have been from fields as diverse as political science, public health, communications, history, economics and information systems (for example, see: Birch & Irvine, 2009; Christou, Eliophotou-Menon, & Phillippou, 2004; Davis & Roblyer, 2005; Hall, 1979; Rogers, 1962; Sahin, 2006; Straub, 2009; Taylor & Todd, 1995; Venkatesh & Davis, 2000; Venkatesh, Morris, Davis, & Davis, 2003). However, the application of these models to the pedagogically dependent technology adoption decisions facing secondary school teachers' fails to provide researchers with effective explanations or frameworks as they are too generalised and do not take into account the specific requirements of secondary school teachers (Somekh, 2008; Webb & Cox, 2004).

The complex factors contributing to teachers' technology adoption and integration choices have been considered in Mishra and Koehler's (2006) work that considers teachers' technological, pedagogical and content knowledge (TPACK). Mishra and Koehler (2006) proposed that good teaching with technology involves a combination of technological, pedagogical and content knowledge or TPACK. Mishra and Koehler (2006) represented their TPACK framework as composed of three overlapping knowledge domains, with each representing a different component of teachers' professional knowledge. This framework results in increasing overlap seven potential forms of teachers' professional knowledge

with the aspirational TPACK positioned at the nexus combining all three forms of knowledge. Bounding these different forms of knowledge is the context in which teachers' acquire and exhibit their knowledge as shown in Figure 1.

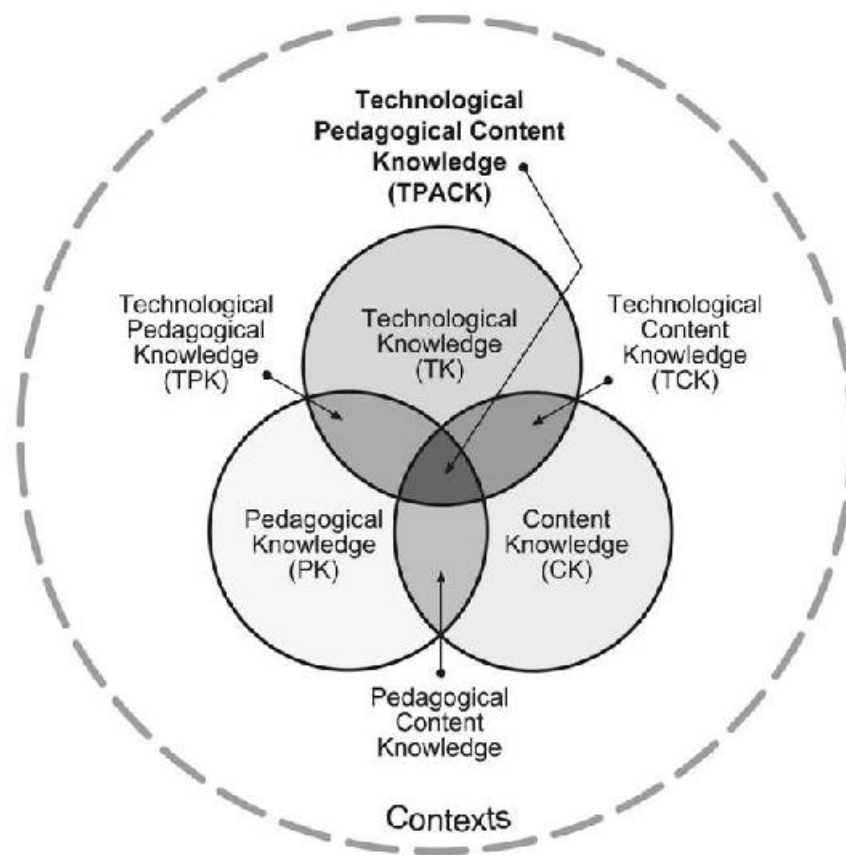


Figure: 1.

The TPACK framework from <http://tpack.org/>

The impact of the TPACK model has been profound and widely used in hundreds of studies examining teachers' professional knowledge (Graham, 2011), with the majority of these using surveys to measure the extent and sophistication of teachers' TPACK (Jordan & Dinh, 2012). With such a proliferation of TPACK based research, it comes as little surprise that there is marked variation in the contexts in which investigations have examined TPACK and include international examinations of the TPACK development of pre-service teachers (for example, see: Albion, Jamieson-Proctor, & Finger, 2010), distance educators (for example, see: Archambault & Crippen, 2009) and primary teachers (for example, see: Chai, Ling Koh, Tsai, & Lee Wee Tan, 2011). In Australia the most recent, large-scale use of the TPACK framework was in the nationally funded Teaching Teachers for the Future (TTF) project. While these investigations have made valuable contributions to our understanding of the interplay between forms of professional knowledge in a variety of settings, in-service teachers' TPACK acquisition in their workplaces remains an under-explored context (for example, see: Jordan & Dinh, 2012). Moreover, the increasing occurrence of team teaching in primary and secondary school settings further challenges our understanding of TPACK.

Team teaching.

Thomas (1992) reported that the ideas underpinning team teaching date back to the early 1960's and first gained prominence after an insightful address given by Professor William M. Alexander at Cornell University in which he encouraged a rethinking of the existing structure of junior high schools in America. Alexander's original 'middle school reform' proposal was to establish teams of three to five

teachers to work with 75 to 150 students organised as either a single-class or on a multi-class basis to operate in large open learning spaces. As a result of this and other reforms, there has been a growing acceptance by educationalists of the need for changing the role of teaching from one of imposed classroom isolation (Little, 1990; Liebermann, 1995; Lortie, 2002) to one which is far more encouraging of professional collaboration and collegial practice (Mills, Powell & Pollak, 1992; Fullan, 1993, 2001; Newman, & Wehlage, 1995).

Team teaching is now a common term and widely used to describe a broad collaborative approach to learning and teaching. In Katherine Main's (2007) yearlong investigation into the formation and development of middle years' teaching teams she found that the educational research literature showed a confusing range of terms associated with team teaching that are often used interchangeably. She noted that "taking into consideration these differences, team teaching can look very different across grade levels, within grades, and from setting to setting within schools" (p22). For example, McIntyre & Salas, (1995) pointed out that the terms 'team' and 'group' are used to describe a broad collaborative approach to learning and teaching. Co-teaching, collegial teaching, collaborative practices, communities of practice, co-operative teaching, complementary instruction, teaming, working parties and learning communities are all terms that are encountered in the literature when researching in this area. In his book, *Team Teaching: What, Why, and How?* Francis Buckley (2000) proposes a broad working definition for team teaching. Buckley describes team teaching as "involving a group of instructors working purposefully, regularly, and cooperatively to help a group of students learn" (p.4). Although Buckley's definition provides a useful starting point to explore team teaching, it is deliberately broad and has more to say about the intended objectives rather than providing guidance on how the approach is to be implemented and supported within schools.

Buckley's original intention was to support teachers to make the shift from working as individuals in isolation to working purposefully in collegial teams with shared objectives or as Shulman (1993) describes, a transition from "pedagogical solitude" to the notion of classroom practice as "communal property" (p.6). The sense of communal practice inherent in the notion of team teaching presents a number of challenges and benefits. In particular, research indicates involvement in team teaching can lead to a sense of collegiality and professional dialogue with fellow teachers (Hargreaves, 2002; Hargreaves & Dawe, 1990; Newman & Wehlage, 1995), a greater sharing of professional classroom practices and resources (Sandholtz, 2000), deeper levels of discussion and a richer understanding of content and pedagogy (Harris & Harvey, 2000) along with particularly rich learning experiences and professional growth for novice teachers (Jang, 2006; Roth, Tobin, Carambo, & Dallard, 2004). Additionally, research has shown that working in a team can result in teachers being placed in a position where they have shared authority and expertise on a range of topics is a shift from being the 'expert' to being an 'expert learner', for in the collaborative classroom, teachers and students can join in a shared process of intellectual discovery (Wentworth & Davis 2002). It is generally accepted that being prompted to look at a familiar topic in a new way or with a different pedagogical approach can be one of the most rewarding experiences of working in a team.

Despite the possibilities suggested in literature promoting team teaching approaches, research also highlights a number of common challenges associated with team teaching. These include mismatches in the personal pedagogy and/or personality of team members (Achinstein, 2002; Kruse & Louis, 1997; Minonopoulos & Fordred, 1997) which can lead to potential conflict (Davis & Roblyer, 2005), teachers remain anxious when teaching with a colleague and the rejection of continual personal evaluation by a colleague (Geen, 1985; Hargreaves & Dawe, 1990; Smylie, 1999).

While team teaching has been the focus of academic research for some time, very few studies have investigated how the attributes and skills of team members can influence the short and long term effectiveness of teaching teams. Moreover, there is no research that examines the ways in which team teaching in a school workplace influences teachers' understanding of their professional knowledge, identity or their social position in their workplaces that may be impacted by teaching in a team. It could be argued that in many schools the adoption of team teaching although well intentioned has been implemented with little understanding of the potential difficulties teachers and leaders are likely to

encounter and the importance of teacher selection for team success. The lack of clarity facing those looking to implement team teaching in school settings is further complicated by the professional demands to use new digital technologies that ultimately disrupt the pedagogical stability resulting from the pedagogical solitude offered by individual teaching practice.

It would appear that TPACK may be an appropriate framework to use as the basis for investigations examining the effectiveness of teams of teachers working together in digitally enabled classroom settings. While TPACK has been used to explore the effectiveness of digital technologies in individual teacher's classrooms, it is not immediately apparent how this framework could be used in a team teaching context. The remainder of this paper illustrates some theoretical challenges likely to be encountered when considering TPACK in a team teaching context.

Upsetting the applecart: Considering TPACK as communal property

As indicated earlier in this paper, the TPACK framework has regularly been utilised to examine individual teachers' effectiveness. Despite the wide use of TPACK in hundreds of investigations, there have been some researchers who have questioned the effectiveness of the TPACK framework (for example, see: Archambault & Barnett, 2010; Graham, 2011; Parr, Bellis, & Bulfin, 2013). Many of the concerns raised by authors have focused on the lack of theoretical clarity underpinning TPACK (Graham, 2011; Parr et al., 2013) and while these apprehensions are valid, the effectiveness of TPACK is further problematized by the increasing occurrences of teaching teams in schools. In particular, we would like to highlight additional epistemological challenges to the TPACK premise which are brought into focus when considering the balance of the different forms of knowledge required for effective team teaching with technology.

In changing the focus from individual teachers to teams of teachers, the TPACK framework appears to be ill-equipped to examine the complex, situated and socially mediated negotiations that shape the collective knowledge and practice within teaching teams. While recognising the interplay between technological, pedagogical and content knowledge does not produce a single solution for all teachers (Mishra & Koehler, 2006), the TPACK framework does portray teachers' knowledge as an individually acquired attribute (Phillips, 2013). This individual acquisition of TPACK is challenged by the introduction of team teaching in schools where an individual's understanding of "the complex relationships between technology, content, and pedagogy" (Mishra & Koehler, 2006, p. 1029) can no longer be considered in "pedagogical solitude" but instead as "communal property" (Shulman, 1993, p. 6). In this sense, TPACK may be considered as knowledge that grows and develops through participation, knowledge sharing and negotiation as a productive member of a team and therefore as knowledge "as something outside of the individual's head, or even body" (Hager, 2005, p. 833).

To advance the concept of TPACK as communal property, we propose that researchers might consider situated learning theories, in particular Communities of Practice (Wenger, 1998), to better understand how TPACK might be understood from a communal perspective. Communities of Practice (CoP) may be potentially helpful when examining teaching teams as it provides a framework within which researchers can consider the contestation and negotiation of different TPACK elements through mutual engagement in a joint enterprise with mutually accepted objectives and utilising a shared repertoire.

Mutual engagement is dependent on participants undertaking things with a shared purpose and allowing them to develop a sense of collegiality and belonging. This sense of belonging in turn influences a participant's perspective of the practices within the community or teaching team and enables them to take on a new meaning. The development of this common frame of reference or joint enterprise can then form the basis of common understandings within the teaching team for identifying and prioritising activities and resolving problems as they occur (Wenger, 1998). The interrelationship between the elements of mutual engagement, joint enterprise and shared repertoire in a CoP is summarised by Wenger (1998) in Figure 2.

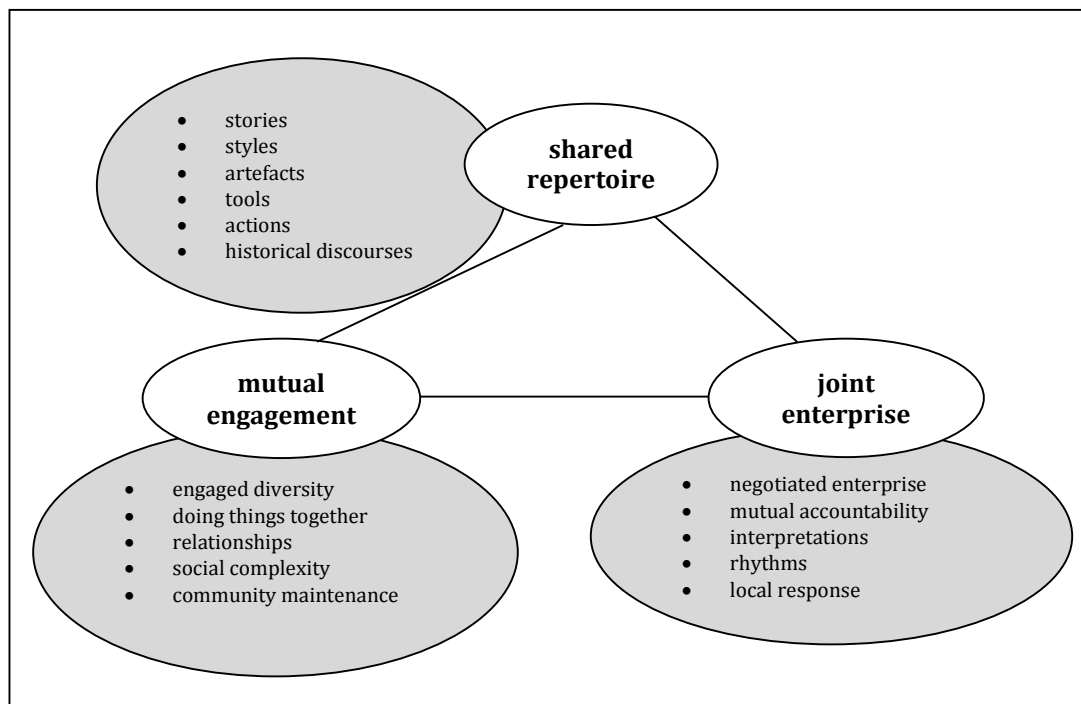


Figure: 2 Dimensions of practice as the property of a community.

The interrelationships underpinning this situated learning framework could then be utilised to explore the negotiations whereby teams prioritise certain forms of TPACK knowledge and ignore others, where particular pedagogical approaches are privileged and aspects of content knowledge stifled, where certain uses of digital technology take hold and grow when others wither and die.

While this approach has potential, we recognise the need for research to support a number of the notions put forward in this paper. In particular, areas of future research may include:

- 1) How the effectiveness of team teaching is influenced by measurable differences in the individual TPACK of the participating teachers
- 2) How the implementation of team teaching influences the building of a shared and richer understanding of TPACK through professional learning and shared classroom practice.
- 3) How the practice of shared reflection on lesson pedagogy encouraged by team teaching may impact on the setting of shared TPACK goals and improved understanding.

Conclusion

In contrast to the pedagogical solitude experienced by some teachers working with their students behind closed doors, teams of teachers collaboratively teaching larger groups of students is a practice becoming more frequently employed with junior and middle years classes. The research literature examining team teaching reports a number of benefits that lend support to the decision of schools who have adopted a team teaching approach; however, studies also report a number of challenges that have also been commonly identified with this practice. In particular, research indicates difficulties associated with the formation of effective teaching teams due to the differences in teachers' professional knowledge and

skills. These differences can manifest themselves in a number of key areas including pedagogical approaches and content knowledge. The efficacy of teaching teams is further complicated by the increased availability of digital technologies and the tensions created by the different skill levels and pedagogical choices made by teachers in the same team. This paper has presented the ways in which TPACK is challenged by the complex nature of team teaching and has proposed the notion of developing a communal TPACK for improved team effectiveness.

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TPACK AS WORKPLACE LEARNING

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Abstract

Technological, pedagogical and content knowledge (TPACK) has been used as a theoretical lens which identifies the nature of knowledge required by teachers for technology integration in their teaching. While there have been hundreds of studies that have used TPACK to examine what teachers need to know about technology as part of their classroom practice, there has been little research specifically investigating how in-service teachers acquire this knowledge. This paper builds on earlier reviews of workplace learning literature and suggests that Communities of Practice (CoP), in particular notions of a socially formed identity, may provide an alternate lens through which teachers' TPACK development can be understood.

Introducing TPACK

Academic research into the knowledge separating teachers' professional knowledge from the knowledge used in other professions has been reported in research literature for almost a century (for example, see: Kayser, 1916). While many investigations have contributed to our current understanding of teachers' professional knowledge, Shulman's (1986) delineation of teachers' professional knowledge as pedagogical content knowledge (PCK) has been particularly powerful. The PCK framework differentiates teachers from content experts as expert teachers have a balanced blend of pedagogical knowledge (PK) and content knowledge (CK) collectively labelled pedagogical content knowledge (PCK) in contrast to content experts' deference to CK. Shulman's (1986) conception of PCK has been utilised in different educational contexts (for example, see: Bennett & Dewar, 2012; Benson & Brack, 2009; Berliner, 1988), particularly in the education of Science teachers (for example, see: Loughran, Mulhall, & Berry, 2004).

Koehler and Mishra (2005) have added to Shulman's PCK framework in an attempt to understand how the increasing use of digital technologies in schools might impact on the development of teachers' professional knowledge. In doing so, they proposed two questions:

- 1) What do teachers need to know about technology?
- 2) How can teachers acquire this knowledge?

To explore their first question, Mishra and Koehler (2006) expanded the PCK framework through the addition of technological knowledge (TK). In doing so, Mishra and Koehler (2006) proposed that good teaching with technology involves a balanced combination of technological, pedagogical and content knowledge or TPACK. Mishra and Koehler (2006) represented their TPACK framework as three overlapping circles, with each circle representing a component of teachers' professional knowledge. This framework resulted in seven potential forms of teachers' professional knowledge with the aspirational TPACK positioned at the nexus of these circles. Bounding these different forms of knowledge is the context in which teachers' acquire and exhibit their knowledge as shown in Figure 1.

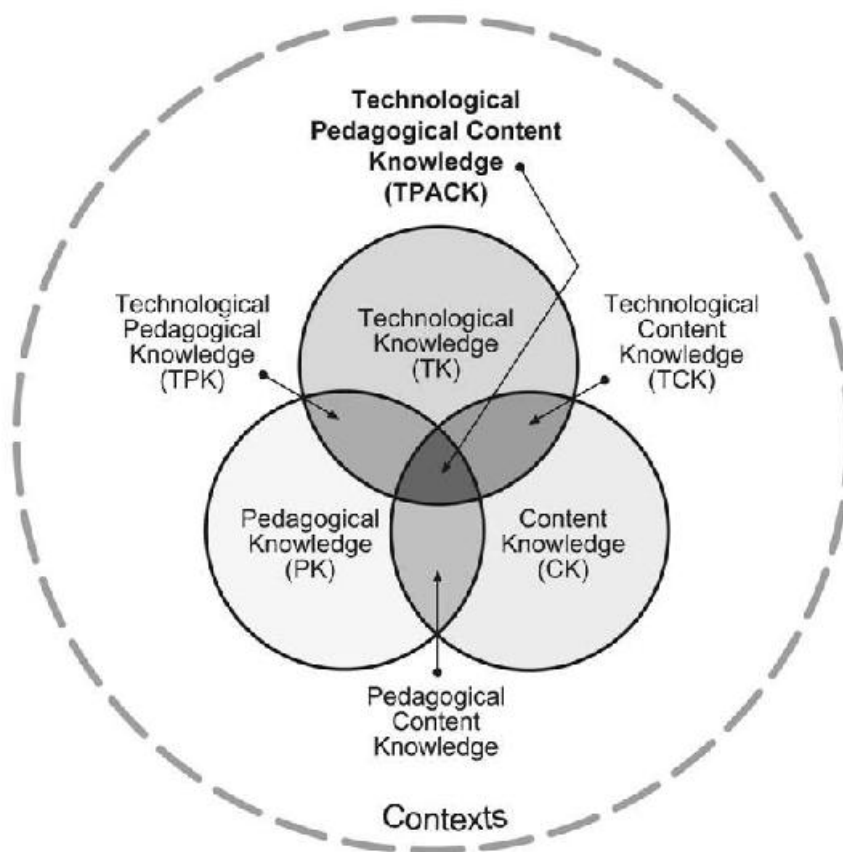


Figure: 1

The TPACK framework from <http://tpack.org/>

The impact of the TPACK model has been profound and widely used in hundreds of studies examining teachers' professional knowledge (Graham, 2011), with the majority of these using surveys to measure the extent and sophistication of teachers' TPACK (Jordan & Dinh, 2012). With such a proliferation of TPACK based research, it comes as little surprise that there is marked variation in the contexts in which investigations have examined TPACK and include international examinations of the TPACK development of pre-service teachers (for example, see: Albion, Jamieson-Proctor, & Finger, 2010), distance educators (for example, see: Archambault & Crippen, 2009) and primary teachers (for example, see: Chai, Ling Koh, Tsai, & Lee Wee Tan, 2011). In Australia the most recent, large-scale use of the TPACK framework was in the nationally funded Teaching Teachers for the Future (TTF) project. While these investigations have made valuable contributions to our understanding of the interplay between forms of professional knowledge in a variety of settings, in-service teachers' TPACK development in their workplaces remains an under-explored context (for example, see: Jordan & Dinh, 2012).

Considering TPACK as workplace learning

Workplace learning theories have contributed much to our understanding of professional knowledge development in a broad range of contexts (for example, see: Argyris & Schön, 1978; Beckett & Hager, 2002; Schön, 1983, 1987; Winch, 1998) and researchers have also used workplace learning as a lens to explore teachers' professional knowledge development (Butler, Lauscher, Jarvis-Selinger, & Beckingham, 2004; Cochran-Smith & Lytle, 1999; Feldman, 1994; Garmston & Wellman, 2013; Krajcik, Blumenfeld, Marx, & Soloway, 1994; Musanti & Pence, 2010; Wilson & Berne, 1999; Zottmann et al., 2013). Despite the numerous studies that have used workplace learning theory to examine teachers' professional knowledge development, the use of such frames to consider teachers' TPACK development is a notable absence in the research literature (for example, see: Jordan & Dinh,

2012). Phillips (2013) recently began to explore the suitability of workplace learning theories to examine in-service teachers' TPACK development and, in doing so, argued that in order for us to better understand teachers' workplaces as the context for TPACK development, "it is necessary to have a detailed understanding of workplace learning theories" (p.23).

Phillips (2013) provided an extensive review of workplace learning literature that outlined how workplace learning theories can be considered as being from one of two research traditions with theorists generally subscribing to learning in a workplace via an acquisitional or participatory perspective. This understanding was developed from Hager's (2005) argument that early accounts of workplace learning "were strongly influenced by the [concept of] learning as a product..." (p.829) in which knowledge was considered as an individually acquired novel attribute. In contrast, more recent accounts of workplace learning focus "more on learners developing [knowledge] by actively engaging in the processes of workplaces" (Hager, 2005, p. 829). These two categories mirror many aspects of the learning metaphors of acquisition and participation that Sfard (1998) argued underpin much educational thought.

Many of the early theories of workplace learning focused on the notion of knowledge as a product that can be acquired by individuals. Such ideas stemmed from the fields of organisational psychology, action learning, experiential learning and management theory (for example, Argyris and Schön (1974, 1978); Schön (1983, 1987); Marsick and Watkins (1990)). Despite variations in early workplace learning theories, Hager (2005) claims that these concepts have a range of common features:

1. *They centre [on] individual learners.*
2. *They focus mainly on the rational, cognitive aspects of work performance*
3. *Work performance tends to be conceived as thinking or reflection followed by application– this is especially evident in Schön's work.*
4. *Learning itself is taken for granted and not theorised or problematized. This means in practice that, as Elkjaer (2003) points out, it tends to assume that workplace learning is formal learning, thereby traditionally associated with the acquisition metaphor.*
5. *The social, organisational and cultural factors in workplace learning and performance are downplayed. (Hager, 2005, pp. 832-833)*

The individual, rational and cognitive aspects of work performance common to these theories takes little account of the social, cultural and political dimensions that may be argued as important aspects of workplace learning. As such, it can be suggested that early workplace learning theories may be of little assistance when trying to understand the socially mediated contexts in which in-service teachers' develop TPACK in their school workplaces. It is worthy to note that the majority of investigations into TPACK take little account of the workplace setting in which in-service teachers continue to develop and refine their professional knowledge; however, research studies too often consider TPACK as an individual attribute or possession. This approach has attracted criticism from researchers such as Bereiter (2002) who argued that many forms of research investigating learning too often carry with them unreflective assumptions about what such learning is like, and instead rely on the 'common-sense' or 'folk theory' perspective of learning dominated by the acquisition perspective.

In contrast to the acquisitional theories of workplace learning another conception of workplace learning theories is evident in the literature. These theories broadly recognise that workplace learning and performance are embodied phenomena that are shaped by social organisational and cultural factors that extend beyond individuals. Key theorists from this perspective include Lave and Wenger (1991), Engestrom (2001; 1999), Billett (2001) and Eraut (2000). Given the body of research indicating the growing importance of collaborative knowledge development in schools (for example, see: Butler, Lauscher, Jarvis-Selinger, & Beckingham, 2004; Feldman, 1994; Garmston & Wellman, 2013; Krajcik, Blumenfeld, Marx, & Soloway, 1994; Musanti & Pence, 2010; Wilson & Berne, 1999; Zottmann et al., 2013) it is not surprising to find "that the participation [theorists] ha[ve] been extremely influential" (Hager, 2005, p. 844).

In particular, this paper will specifically consider the potential contributions offered by the frameworks developed by Lave and Wenger (1991) and Wenger (1998). These researchers have made important contributions to the conception of participatory workplace learning through their development of notions such as legitimate peripheral participation and Communities of Practice (CoP). These concepts provide a stark contrast to the view of learning as acquisition and emphasise learning through relationships.

CoP and TPACK: Considering identity as an aspect of workplace learning

The ideas underpinning the CoP framework have their origins in Lave and Wenger's research in situated learning in the 1980's. The term CoP was first coined in the Lave and Wenger's (1991) book *Situated Learning: Legitimate Peripheral Participation* which places emphasis on learning in a shared, situated and culturally mediated context. Wenger's (1998) subsequent and more detailed examination of CoP provided a greater insight into the factors that underpin this complex socially mediated practice and it is in this work that the distinction is made between a CoP and other forms of 'community'.

This distinction has been highlighted by other researchers using CoP as a theoretical lens including Skerrett (2010) who stated that "communities of practice are groups of people that are mutually engaged in a joint enterprise and who share a common repertoire ... for engaging in their work" (p. 648). CoP's differ, therefore, from other definitions of 'community' such as 'communities of learners', 'discourse communities', 'learning communities', 'school communities' and 'teacher communities' (Branch, Jones, & Orey, 2010) as membership of a CoP is not necessarily based on formal notions of membership rather a sense of belonging to the particular community which is reflected in mutual engagement, a joint enterprise and shared repertoire (Wenger, 1998). These three concepts regularly appear in CoP literature and are often described as the core CoP concepts which "associate practice with community" (Wenger, 1998, p. 72).

While there is little doubt that these concepts can add to our understanding of how teachers' develop knowledge in workplace settings (for example, see: Brouwer, Brekelmans, Nieuwenhuis, & Simons, 2012; Hartnell-Young, 2006; Henderson, 2007; Hodgkinson & Hodgkinson, 2004; Phillips, 2012; Printy, 2008) it is hoped that the remainder of this paper can draw attention to an additional aspect of the CoP framework that remains comparatively underexplored: identity.

Identity

While mutual engagement, joint enterprise and a shared repertoire in a school CoP are inevitably implicated in the development of secondary school teachers' professional knowledge, Wenger (1998) also points out, "the formation of a community of practice is also the negotiation of identities" (p.149) and "issues of identity are an integral aspect of a social theory of learning and are thus inseparable from the issues of practice, community and meaning" (p.145). Identity in this sense is defined socially; that is, it is produced through participation in a community and "expands the focus beyond communities of practice, calling attention to broader processes of identification and social structures" (Wenger, 1998, p. 145). Changing the focus from individuals to a broader conceptualisation of identity challenges our understanding of TPACK as we are required to consider TPACK not simply as an individually acquired attribute (Phillips, 2013) but as part of a broader set of social forces that suggest TPACK may also be thought of "as something outside of the individual's head, or even body" (Hager, 2005, p. 833).

The individual acquisition of TPACK is therefore challenged by situated, workplace learning frameworks such as CoP where the influence of knowledge on participation and identity can no longer be considered in "pedagogical solitude" but instead as "communal property" (Shulman, 1993, p. 6). In this sense, TPACK may be considered as knowledge that grows and develops through participation, knowledge sharing and negotiation as a productive member of a community and therefore as knowledge "as something outside of the individual's head, or even body" (Hager, 2005, p. 833).

If one accepts the connection between TPACK development and the negotiation of identity development within a CoP, then this brings additional challenges to the theoretical concepts underpinning the TPACK

framework. Such challenges are typified by Wenger's (1998) notion that identity cannot be considered an object but a "constant becoming" (p.154). Wenger argues that our identities are constantly changing, moving in a trajectory that ties both the past and future. In this way we identify ourselves as much by where we have come from and where we believe we are going as by our current competence as members of the CoP. In doing so the concept of trajectory within the CoP framework is used to argue that:

1. identity is fundamentally temporal;
2. the work of identity is ongoing;
3. because it is constructed in social contexts, the temporality of identity is much more complex than a linear notion of time;
4. identities are defined with respect to the interaction of multiple convergent and divergent trajectories. (Wenger, 1998, p. 154)

If this is the case, then TPACK also needs to be considered as a fundamentally temporal, ongoing, and multifaceted concept. The complexity that is brought to the TPACK framework when considering it in light of the CoP notion of identity is considerable and challenges the idea published in previous research that TPACK represents an aspirational end point, acquired by individuals.

This reconceptualization of TPACK has only been suggested in this paper and requires a great deal of additional research to further develop our understanding of the benefits and limitations of such a perspective. Future research is needed in a number of areas including: to examine how TPACK may be measured by different members of a CoP, how differences in TPACK are negotiated and reconciled within a CoP and the ways in which teachers incorporate TPACK dimensions into their repertoire and identity and different career points.

Conclusion

Examinations of teachers' professional knowledge have been ongoing and have recently reflected the increasing prevalence of digital technologies in teachers' practice. The TPACK framework has provided a valuable lens through which researchers have been able to examine teachers' knowledge. Despite the proliferation of empirical research using TPACK, in-service teachers' development of TPACK in the context of their workplace remains under represented in the research literature. Highlighting the complex context in which professional educators work and learn, this paper has suggested workplace learning theories, in particular CoP, as a different backdrop against which in-service teachers' TPACK development can be more clearly comprehended. Further research incorporating the temporal, ongoing and multifaceted dimensions of identity from the CoP framework in reconsidering the concept of TPACK have been suggested.

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ACEC2014- PARTICIPATORY CULTURE AND STUDENT KNOWLEDGE SHARING IN AN ONLINE LEARNING ENVIRONMENT

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Abstract

The advent of web-based learning technologies allows students to connect and share their knowledge rapidly and conveniently in different forms from online discussion to digital resource sharing. However, this power of connectivity and ease of access does not necessarily mean that students who communicate and learn within an online learning environment are equipped with the participatory culture typically associated with the learning technologies they are using. This article explores the relationship between participatory culture and student knowledge sharing in an online learning environment. It is based on a larger research project looking into the integration of online learning environment in an academic program of a Cambodian tertiary institution. Data presented in this paper were collected from student focus groups and were analyzed through thematic analysis to understand student perceptions and practices of knowledge sharing within an online learning environment. Data analysis revealed three interrelated concepts: values, practices, and cultural context, which help explain the relationship between participatory culture and online knowledge sharing. Implications of the study indicated the need to make participation a more conscious practice and to openly discuss hidden cultural challenges in online knowledge sharing among students.

Introduction

From January to August 2013, a research project was conducted to introduce an online learning environment in the Master of Arts in Teaching English to Speakers of Other Languages (MA in TESOL) program of the Royal University of Phnom Penh and to study its integration process and impacts on the teaching and learning practices within that context. The MA in TESOL is a graduate program aiming to provide advanced professional training to teachers of English as a Second Language in Cambodia. Students in the program come from different education institutions such as public schools, private English language training institutions, and tertiary institutions. Realizing the importance of knowledge sharing for student professional development, the program introduced an online learning environment EDU2.0 as a platform for socialization, resource sharing, and learning support between students in addition to their regular face-to-face classes. The platform not only allowed students to communicate with their classmates through their class online groups but also allowed them to connect with other students outside their classes but within the same program.

The development of this online learning environment was inspired by the concept of connectivism (Downes, 2007; Siemens, 2004) in which learners develop their personal learning networks by actively seeking new connections to share and construct their own knowledge. In the context of the academic program where learning resources are scarce, this initiation of online knowledge sharing was deemed to be essential for fostering both individual and collective knowledge construction. However, one of the key challenges in fostering knowledge sharing within the online learning environment was that although tools for resource sharing and collaboration were readily available, getting students to participate in the learning platform voluntarily and to share their knowledge with one another required more than effective design of the online learning environment. Various factors came into play when students started using the online learning environment. This paper looks at the cultural factor of knowledge sharing – participatory culture in particular – from student perspectives and how it might influence knowledge sharing between students in an online learning environment.

Literature Review

Participatory Culture and the Rise of the Web

Jenkins, Purushotma, Weigel, Clinton, and Robison coin the term *participatory culture* to explain the rise of a cultural phenomenon along with the collaborative Web 2.0. They define it as “a culture with relatively low barriers to artistic expression and civic engagement, strong support for creating and sharing creations, and some type of informal mentorship whereby experienced participants pass along knowledge to novices” (2009, p. xi). Key attributes of participatory culture include affiliations, expression, collaborative problem solving, and circulation. Apparently these attributes do not appear to be any different from the concepts of collective intelligence (Lévy, 2001), community of practices (Lave & Wenger, 1991), or collaborative learning (Dillenbourg, 1999). As noted by Delwiche and Henderson (2013), the discussion on learning communities, collaboration, and sharing has been going on for decades. Jenkins, et al. and other studies related to participatory culture (Delwiche & Henderson, 2013; Fischer, 2011; Larabie, 2011) do not mention what distinguishes participatory culture from other concepts, but upon reviewing this literature it appears that the difference lies in the view of participation as a property of culture. To have people participate means to build a culture that values contribution and sharing, and this requires a broader understanding of the ecology of technology and the cultural communities surrounding it (Fischer, 2011; Jenkins et al., 2009).

Another interesting aspect of participatory culture is its concurring rise with the emergence of the web. Looking back at the history of participatory culture, Delwiche and Henderson (2013) categorize the evolution of participatory culture into four phases: emergence (1985-1993), waking up the web (1994-1998), push-button publishing (1999-2004), and ubiquitous connections (2005-2011). Fischer’s (2011) graph of major cultural changes caused by new media also illustrates the rise of participatory culture around 2010. These timelines suggest that although the discussion on key concepts related to culture of participation might have started long ago, the advent of the web might accelerate the growth of participatory culture. In *The Connecticon: Learning for the Connected Generation*, Rennie and Mason compare the web to a mixing bowl that “takes [its] mixture into a virtual format that has a more tenuous relationship with time and space. Ubiquity, speed and global scale provide the heat to cook this into something we have not tasted before.” (2004, p. 5). Underneath this unprecedented speed and efficacy, it is important to note that it is the human collective power that builds the web (Oinas-Kukkonen & Oinas-Kukkonen, 2013). By participating and sharing information and knowledge on the web, we become part of the global digital network, and some studies (Larabie, 2011; Squire, 2011) also go further to suggest that web users have adopted participatory culture through participating in online activities and sharing their knowledge online.

Knowledge Sharing and Cultural Influence

According to Wang and Noe, “knowledge sharing refers to the provision of task information and know-how to help others and to collaborate with others to solve problems, develop new ideas, or implement policies or procedures” (2010, p. 117). Due to its focus on collaboration and support, knowledge sharing is considered to be crucial for the development of collective intelligence (Lévy, 2001) and has been widely discussed in relation to organization knowledge management (dePaula & Fischer, 2005; Hwang & Kim, 2007) and communities of practice (Ardichvili, Maurer, Li, Wentling, & Stuedemann, 2006; Cheung, Lee, & Lee, 2013; Kim & Stefanone, 2010; Sharratt & Usoro, 2003). Key questions raised in those studies include what motivates people to share their knowledge, what factors influence knowledge sharing, and how to foster and sustain knowledge sharing. Different studies might suggest different factors influencing knowledge sharing, but individual decisions to share or not to share knowledge remain perplexing as they not only link to individual characteristics but also to contextual and cultural factors.

Some studies (Ardichvili et al., 2006; Hwang & Kim, 2007; Li, Ardichvili, Maurer, Wentling, & Stuedemann, 2007; Wang & Noe, 2010) have looked into cultural influence on knowledge sharing. In Wang and Noe’s (2010) review of knowledge sharing research, they conclude that both organizational and national cultures play vital roles in knowledge sharing success. Within these broad cultural scopes

are smaller cultural characteristics such as trust, reciprocity, and competition that can influence knowledge sharing decision. Other cultural aspects associated with knowledge sharing include collectivism versus individualism (Hwang & Kim, 2007) and the power relationship between individuals within an organization (Ardichvili et al., 2006; Li et al., 2007). Although different cultural dimensions are reviewed in the literature, discussion on the role of participatory culture in knowledge sharing research is still limited, and more research is needed to examine the interrelationship between these two concepts.

Participatory Culture and Knowledge Sharing in Relation to the Current Study

This study is situated in the context of Cambodian society in which participatory culture is believed to be restricted (Im, 2011) not only in the media landscape but also in educational practice which is predominantly teacher-centred (Howes & Ford, 2011). A traditional view of knowledge sharing where knowledge is carbon-copied to preserve its purity and passed from one generation to the next like a commodity (dePaula & Fischer, 2005) is still strongly held among Cambodian educators and students.

An aim of introducing an online learning environment to the MA in TESOL program was to promote student knowledge sharing. The two figures below show examples of different spaces that students could participate in knowledge sharing within the online platform. The first example (Figure 10) is a resource sharing space where students could upload miscellaneous learning resources so that other students in the program could access them. The second example (Figure 11) is a class discussion forum where students could participate in online discussion with their peers.

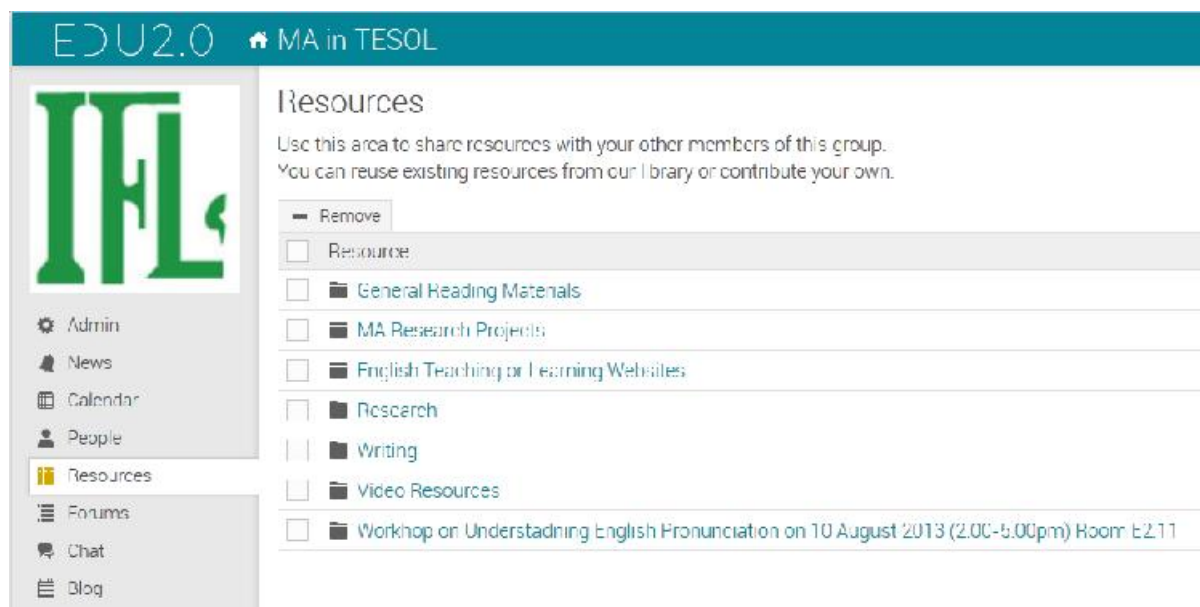


Figure 10: Resource sharing space

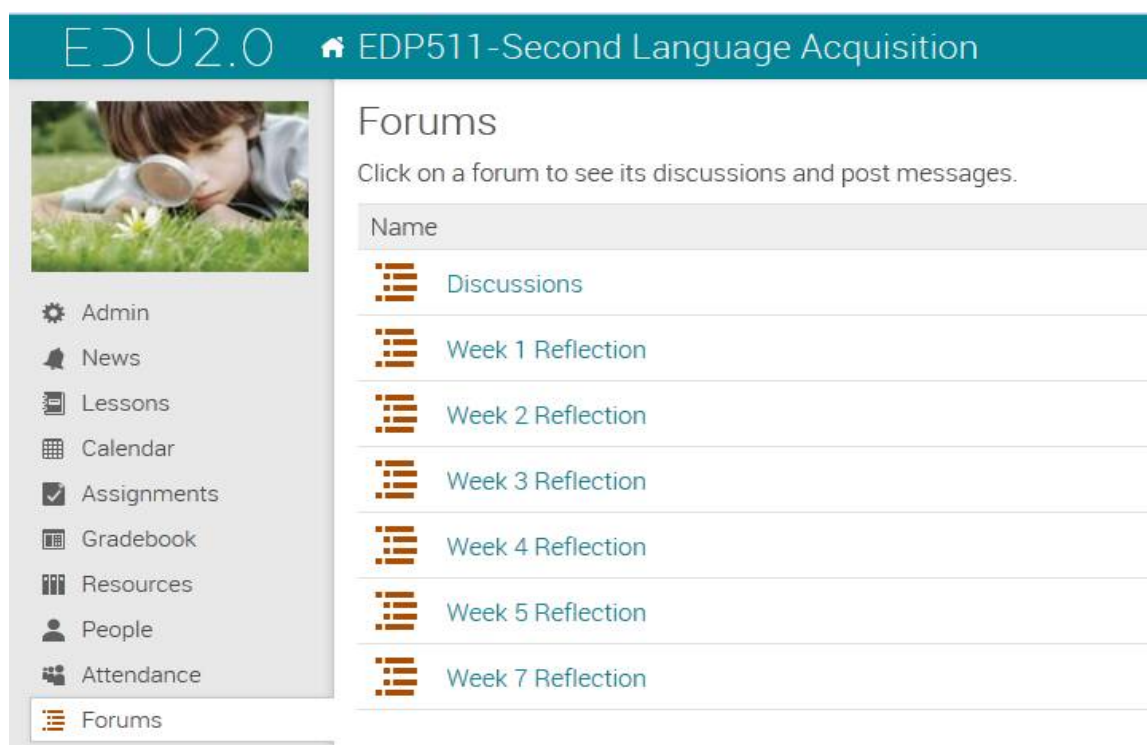


Figure 11: Online discussion space

Methods

The investigation of the relationship between participatory culture and knowledge sharing in this paper is part of a larger research project on the integration of an online learning environment in the MA in TESOL program. This study employed a design-based research framework (McKenney & Reeves, 2012) as its methodological approach. Participatory and iterative design and evaluation are the principles of design-based research methodology, and these influenced subsequent choice of methods used in the study.

The key method employed for gathering student perspectives and feedback on the online learning environment was through focus groups (Cousin, 2009; Morgan, 2002). Four, monthly focus groups were conducted with each group consisting of three or four participants. Students were randomly selected from the pool of 55 students who participated in the online learning environment. The focus groups were led by the researcher using guiding questions that focused on what students thought about the online learning environment, how they participated in it, and what were the challenges they encountered. Although the general purpose of the focus groups was to allow students to participate in the design and evaluation of the online learning environment, one key aspect of the focus groups looked into student participation in knowledge sharing which was an aim of the online learning environment and a challenge of this technology integration project. Students were asked about their experience in knowledge sharing, their perceived benefits and values of knowledge sharing, and the challenges in participating in knowledge sharing within the online learning environment. The discussions were voice-recorded and later transcribed by the researcher. Phrases or sentences were labeled using theming technique (Saldana, Leavy, & Beretvas, 2011) and emergent themes were then grouped and organized into a concept map.

Findings and Analysis

Perceived Values of Online Knowledge Sharing

Most student participants reported that this was their first time in using an online learning environment like EDU2.0. However, many of them used to participate in knowledge sharing between friends through social networking sites like Facebook. When students started to employ the new online learning environment, they recalled their experience in knowledge sharing using a similar tool as reported by students in the first focus group below.

Moderator: "Is this the first time you use an online platform for learning purpose?"

Student1.1: "To me I can say that it is the first time I use an online platform for learning purpose, but as I have experienced before, most of the students in Cambodia are familiar with Facebook. Most of my lecturers in previous year created groups for learning purpose. Last year, I joined a group called IFL teaching practicum [...] I used those groups for sharing experience or doubt. For example, one lady she was curious about whether it's okay for teachers to have bad writing skill, and then we started to discuss and share ideas, tried to comfort her, and gave her as much good advice as possible."

Student1.2: "I am partly active in Facebook as well because in my class since the beginning of the first year until fourth year in the university, we have created a group so that we can share documents and questions. Lately I have shared some documents too. [...] The purpose of that is that we can learn from each other. Sometimes we don't know the information, but when we login to the group we can learn mutually."

The students used examples to show that although they are new to EDU2.0, the concept of online knowledge sharing is not novel to them as it is embedded in their social learning practices via other platforms like Facebook. Their responses also reflected their valuing of mutual support and resource sharing which they associate with online knowledge sharing.

For other students the benefits of knowledge sharing was not limited to peer-to-peer support but also extended to indirect learning. In the extract below from the second focus group, students elaborate on their participation in their class's online discussion forum.

Student2.1: "If there is something I really don't understand. I can post [on the forum] so that my friends and lecturers can share with me. Yeah, I can learn from that. This is a kind of communicative learning, right? Yeah, and we can share and talk about that."

Student2.2: "Someone's question may help you to research more [...] [For example Student2.3] doesn't understand a key point of a lesson. [Student2.3's question] encourages me to read more in order to help him. This is a good point that I need, and I did it by helping him. [...] Sometimes listening to your classmates explaining things to you is much easier to understand than the explanation from lecturers."

According to Student2.1's response, learning, like sharing, is a two-way communication process, and from the perspective of those seeking support there is an expectation that others also think the same way. Student2.2, speaking from the perspective of those who are willing to provide support to their peers, illustrates the indirect learning benefits of reading their peers' questions and comments. Both of these examples demonstrate the mutual benefits of sharing and how students exercise control over their learning.

Participation and Online Knowledge Sharing

Student participants were also asked to discuss their participation in online knowledge sharing such as how they engaged in the online learning environment and what they thought about their online sharing experience. A few students commented on how online knowledge sharing in the forms of online posts and discussions allowed equal opportunity for student participation and encouraged introverted students to participate more actively in the discussion.

Student1.1: "Face-to-face class is often occupied by talkative and active students while the online platform gives equal opportunity to everyone."

Student3.2: "Some students cannot talk well, but when it comes to writing they can do well. They do better than speaking. So, [in the online learning environment] they have more to share in group discussion."

Communicating online might be a preferred method for some students, but the absence of face-to-face discourse could be a frustration for others. Students in the fourth focus group compared online to face-to-face discussion and revealed some difficulties that they encountered.

Student4.3: "It's sometimes hard to interact and give feedback online."

Student4.2: "Some students aren't active, so it's hard for other students to discuss together. In class, we can discuss face-to-face."

Despite the contrasting views on the modes of communication and knowledge sharing, there seems to be a consensus among focus group participants on the role of active participation as driving force behind knowledge sharing in the online learning environment. In the third focus group, a student expressed the importance of participation in relation to what could be done to improve the online learning environment.

Moderator: "How can the online learning environment be improved?"

Student3.4: "The site shouldn't be improved, but the human should. The participation of our lecturers and students is very important. It is the mechanic force. Even if we have a good site, but people don't use it then there's no use at all."

This viewpoint was similar to another student in the second focus group.

Student2.2: "The online platform is just a tool, and it depends on how people want to use it."

From these responses, it can be inferred that participation did not necessarily come with the tool and that the human factor played an important role in the design of an online learning environment. To improve students' learning experiences requires looking at the challenges and barriers that prevent them from participating in online knowledge sharing activities.

Challenges of Knowledge Sharing Within the Online Learning Environment

In the fourth focus group, students pinpointed some reasons behind individual decisions to participate or not in resource sharing or online discussion.

Moderator: "What do you think are the challenges that might prevent you from sharing resources or participating in online discussion?"

Student4.3: "I think it's the lack of interest. Just like [Student4.2] said she was not a computer person, and many students study in the course said they rarely login."

Student4.2: "For me the lecturers or those who are involved in the platform should post or attach useful or interesting documents. People do it when they think they can take advantage of that thing."

The above responses suggest that the challenges of online knowledge sharing could be related to other personal factors such as individual motivation, attitude towards technology, and perceived benefits of participating. Besides these personal factors, students in other focus groups also referred to other socio-cultural related factors such as reciprocity and power relationship that might influence knowledge sharing. A student in the third focus group conveyed a sympathetic understanding of why some people are reluctant to share.

Student 3.3: "I think it's might be related to the culture of sharing. Some like to share and others don't like to share. It is really hard when we talk about sharing. Some feel inferior to share."

Although the student did not elaborate more on the *culture of sharing*, it could imply that individual decisions to share knowledge are not entirely based on personal choice but also on the perceived social relationships between oneself and other people in the society. As Cambodia is a relatively collectivist society with a strong social hierarchy, on one hand there is a cultural value embedded in the practice of sharing; on the other hand, social norms might also dictate who has the authority to share.

Although cultural framework might influence personal choice, individuals also have different interpretations of their culture. In the following conversation between the moderator and a student in the second focus group, the cultural inference of knowledge sharing is framed in a different way.

Moderator: "One of the aims of this online learning environment is to encourage knowledge sharing between students [...] we want to encourage students to share resources with each other without just depending on the lecturers. If you need anything, just ask out. Maybe other students can help you with that."

Student2.1: "I think it's not easy to do in Cambodian culture [...] they don't want anyone to be more superior to them. When they have resources, they don't want to share."

Moderator: "Do you support or against that?"

Student2.1: "I don't. Okay, for the first time I used to be like that. When I had something good, I didn't want to share with anyone. But when I studied at [...] I met a lecturer who explained me the benefits of sharing. When you give something to someone, he or she will give you back. This is the benefit of sharing."

The student argument conveys a critical stand point of the stereotypical cultural mindset and how individuals could be liberated from that mindset. Socio-cultural factors such as superiority/inferiority and reciprocity are presented and interpreted based on personal experience.

Discussion

The results of the focus groups indicate some similar valuing of online knowledge sharing among the student participants. These include social values like peer-to-peer support and educational values like indirect learning that comes from the practice of sharing. Students' responses suggest that these perceived values of online knowledge sharing are not fixed to a particular platform but might be transferrable across different platforms as students make connections between their prior practices and their current practices. This finding supports Larabie's (2011) and Squire's (2011) argument that participatory cultural values develop through individual engagement in different online activities. From this point of view, students are not confined to their institution's online learning platform, but they are seen as web users who are exposed to other social platforms on the web.

The fact that knowledge sharing practices in the context of this study are conducted online in the forms of online posts and discussions has triggered discussion among student participants about the pros and cons of online versus face-to-face interactions. The convenience of being able to share and participate equally is weighed against the issues of delayed response and lack of face-to-face interaction. Although the mode and platform of communication is important for students, the act of participating is believed to be even more crucial as the platform is of no use without participation. Student participants seem to have optimistic views and high expectations of participation and sharing in general. Meanwhile, there is also an understanding among student participants that knowledge sharing is a two-way process that requires some level of self-directed learning and active participation from other people in the group. In addition, perceived values of sharing might not directly translate into practice. As indicated in the students' responses, both personal and cultural challenges could hinder the practice of participation and sharing.

The findings also show the influence of socio-cultural related factors in individual decision and perception of knowledge sharing. The *culture of sharing* which is related to collectivist cultural framework is raised to support the claim that the individual is a product of national culture. However, according to student responses individual choice might not always align with social norms, and there could be conflicting values of knowledge sharing. These findings suggest that both individual and cultural challenges need to be considered in order to understand the dynamic of online knowledge sharing practices.

Conclusion

The purpose of this paper is to examine the relationship between a participatory culture and knowledge sharing in an online learning environment. Although the research is limited in its scope, the findings have provided some new insight on the connection between these two abstract concepts based on students' perceived values of online knowledge sharing, their participation in knowledge sharing practices, and individual and cultural perceptions that influence their decision to participate. Knowledge sharing within an online learning environment could benefit from making participation a more conscious practice by asking students to pinpoint the activities they consider as knowledge sharing and how they participate in and benefit from those activities. Open discussion about individual and cultural challenges should also be encouraged to gain a better understanding of individual decision-making to participate in knowledge sharing practices.

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ACEC2014- SOCIAL NETWORKING AND TEACHER PROFESSIONAL DEVELOPMENT

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Abstract

In 2012, a research project was implemented to investigate the possibility and effectiveness of instituting a personalised and virtually networked mode of professional development to promote teacher confidence and competence with Information and Communications Technology (ICT) and its use as a key component of their pedagogy. The aim of the project was to examine the advantages of online modes of professional development where an online network of teachers was built without any face-to-face contact and where the approach for professional development was personalised and self-directed. Six geographically removed schools in Queensland were involved, with twelve teachers participating over the school year supported by a mentor. A Social Networking Site- wall.fm was used to facilitate private and public communication. Findings reveal that if demand driven dialogue and a sense of presence is created to support the development of an online network it can sustain engagement without the need for face to face interaction, and that varying levels of instructions are required of the mentor to support teachers' personal agency within a self-generating professional development model.

Worldwide, teachers are gaining access to ICT, online tutorials are available, and digital curriculum resources are accessible and are continually being developed - the digital classroom is a reality. However, teachers' ability to use digital tools in their classrooms, that is, practicing the digital pedagogies required for the effective implementation of ICT, is not yet in evidence amongst the majority (Dunn & Rakes, 2010; Ertmer & Ottenbreit-Leftwich, 2010; Al-Zaidiyeen, Mei & Fook, 2010). Teachers are expressing the need for effective professional development that will enable them to create new visions, teaching practices and learning spaces that are technologically enhanced (Goldman & Lucas, 2012). It has long been established that teacher change in pedagogy when using ICT will not come about through a training approach (Watson, 2001). This study will suggest, supported by evidence, that effective professional development is driven by the teacher through self-directed pathways supported by an online networked community that includes teachers from all educational levels. Such a professional development approach provides teachers in any school across Australia with the ability to utilise current technologies such as social networking sites (SNS) to research and direct their engagement through self-generating content at any time during the school day. The link between the Australian Curriculum and the enacted Australian Curriculum is the support provided to all Australian teachers so they can design and implement effectual 21st-century learning opportunities. To understand the process of teacher professional development underpinned by social networking, the following research questions were formulated:

1. Can online professional development in a SNS sustain engagement without face to face contact?
2. Can professional development involve self-generating content instead of course work?

By moving professional development into a context that is not limited by time or space, or the need for face-to-face communication, it is anticipated that professional development can become an embedded part of teachers' everyday practice. Two literatures will be reviewed to frame the research. These include an exploration of professional learning through SNS and elements of effective professional development.

Background Literature

Social networking sites

The advent of Web 2.0 tools has generated, among other things, social networking sites (SNS). Boyd and Ellison (2007, p. 211) provide a clear definition: “SNS are web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system”. The term ‘network’ carries with it an important disposition to the way communication tools are used within sites. Networking does not necessarily mean that people are looking to meet new people; rather, they are primarily communicating with people who are a part of their extended social network or professional circle. What is important with SNS is that people are able to make visible their social connections and therefore, provide potential connections between individuals that would not otherwise have been made (Haythornewaite, 2005).

In regard to primary and secondary education, one of the first moves to learning online has been to employ a learning management system (LMS) because of its use in higher education systems. LMS like the Blackboard platform direct students to engage in ways that are different to SNS. LMS serve as management systems that support administrative concerns and use communication management tools more frequently than interactive tools (Dalsgaard, 2006). LMS also engender teacher-centred pedagogies for distributing course content. This has impact on how content and user interaction occurs. In a LMS the instructor provides the content, which is central to activity, whereas in a SNS the content is generated by the user and interaction is the central activity (Mott, 2010).

Engagement between user and the content is also different. For example, an instructor in a LMS may pose a question in an online discussion board and each student posts a response, replicating traditional question-and-answer mode. In contrast, discussion in a SNS is self-directed or student-centred (Brady, Holcob & Smith, 2010). Veletsianos, Kimmons & French (2013) suggest that a SNS fosters the use of participatory pedagogies and are able to support interactive discussions. Interaction and content are more free-flowing and therefore are more difficult to control. This is why tensions arise when SNS have been used in higher education as personal and professional boundaries for instructors collapse (Marwick & Boyd, 2010) and the sites are not conducive to teacher-centred pedagogies.

Developing a sense of community is critically important to student engagement in any online learning environment – LMS or SNS – especially if students do not meet face to face. The tools used in a SNS facilitate the sharing of information. This, plus personal profiling and a user’s sense of social presence are key factors that promote a networked community (Cobb, 2009; DeSchryver, Mishra, Koehler, Francis, 2009). LMS have been described as tools that fail to provide users with the social presence necessary for more robust and valuable networking experiences that are essential for learning (Minocha 2009; Velesianos, Kimmons & French, 2013). Therefore, social presence and its critical relationship to building a sense of community online indicate the potential of SNS in teacher professional development.

Elements of professional development

There are many similarities in the research identifying the essential elements of professional development. First and foremost, when professional development is concerned with transformative outcomes, that is, enabling a change in teacher beliefs and practices, teachers’ current mindsets need to be made conscious so that through professional activity these beliefs can cause tension to enable reformation and inform new practices. Teacher change (in belief and practice) occurs during professional development when teachers’ verbal reflection, supported by written reflection, is actioned with critical discourse that is based in collegial formations. Teacher action is best embedded within an investigative context such as a classroom-based inquiry. These elements of investigation, reflection and constructive dialogue are represented in action research models of teacher professional development (Herbert & Rainford, 2013; Prestridge, 2013; Subahan Mohd Meerah et al., 2010).

Bannan-Ritland (2008) offered a model based on teacher-led research involving the design and cyclic testing of instructional materials (that include the use of technologies). The model is called 'Teacher-led Design-based Research' (TDR). The teacher is considered a researcher, implementing action research methodology. The TDR process consists of: teacher immersion in experiences that involve deep learning; constructing meaning from current experiences; focusing on how students learn; developing sustainable innovative practices and developing collaborative research competence. Markauskaite and Reimann (2008) also developed a design-based inquiry model to support teachers' engagement with ICT. They describe a similar process for teacher-led research: problem-design-implement-monitor-evaluate-reflect-disseminate. Their model is encapsulated in three spaces: design space, collaboration space and decision-making space. Each of these spaces includes a range of interconnected digital tools that can help with the inquiry process.

Summary of literatures

The rise of the SNS with its disposition for a sharing and knowledge-producing exchange logically suggests a merge with teacher professional development. Teachers are not restricted to time and place, their classrooms can be the sites of investigation with reflection and constructive dialogue enabled though tools embedded in a SNS. Teachers can create their own social presence through personal profiling and interest groups can be formed that enable further social networks to develop. A networked community has an opportunity to grow within the SNS through participatory pedagogies. These features of SNS for professional development will be examined in the remainder of this paper.

Method

This study drew upon data from the 'Virtual Professional Development: enabling teachers to engage with digital pedagogies' project funded by Griffith University and six Queensland schools as Industry Partners. The project investigated the possibility and effectiveness of instituting a personalised and virtually networked mode of professional development to promote teacher confidence and competence with ICT and its use as a key component of the teachers' pedagogy. The aim of the project was to examine the advantages of online modes of professional development where a networked community was built without any face-to-face contact and where the approach to professional development was personalised and self-directed. This project aligned with the implementation of the Australian Curriculum, which was used as a premise for examining teachers' technological pedagogical content knowledge (TPACK). The schools were chosen to represent all educational levels, from primary to secondary and included independent and Catholic colleges, single sex and multi-campus sites and were located across Queensland. Twelve teachers participated over the school year.

The professional development program utilised an action research model where the elements of investigation, reflection and constructive dialogue were actualised in a year-long program. Teachers were asked to develop an Action Learning Project where ICT was considered as a central tool in the learning phase. The professional development program was designed to support the flow of the school year. Term 1 required teachers to make conscious their beliefs and practices through an online survey; Term 2 involved the introduction of the SNS with opportunity to develop and plan the Action Learning Project; Term 3 involved each teacher implementing and monitoring their Action Learning Project and Term 4 involved redesign and reflection. A mentor was enlisted to facilitate the professional development. His role was to establish a sense of community within the SNS, to encourage engagement with and among the teachers online, to guide and direct pathways for learning associated with a teachers' inquiry and to challenge and make teachers' think deeply about how their students learn and their own ICT beliefs and practices. Table 1 presents examples of teachers' Action Learning Projects:

Table 1 Action Learning Projects

Prep/year 1	Use of iPads with specific apps to support literacy and numeracy development in the early years.
Year 5	Use of Twitter as a collaborative tool to build students' knowledge about communicate globally.
Year 7	How can student blogs be used as a reflective tool during the planning of Kids Connect Project?
Year 10	Does the use of a online class environment to support student engagement at any point support their learning of subject matter?
Years 11 and 12	Create a connected Learning Community so students can receive peer and community feedback on their films in development stage to inform production.

A range of communication and Web 2.0 tools were used to implement the online professional development. These included email, a discussion list through Google Groups, Skype for one-to-one teacher and mentor discussions and wall.fm as the project SNS. Wall.fm provides an environment where both public and private online communities can be created. This became the central site where teachers created their personal profiles, published and shared curriculum materials and blogged their Action Learning Project progress and commented on each other's reflections.

Case studies were the primary form of data collection to study teachers' engagement in the professional development program. Case study is well recognized as an approach to support the investigation of particular phenomenon (such as professional development) within a real-life context while employing multiple sources of evidence. It provides a framework for allowing researchers to "engage with and report the complexity of social activity" and "to represent the meanings that individual social actors bring to those settings and manufacture in them" (Stark & Torrance, 2005, p. 33). For this paper, three teachers were chosen based on their divergent approaches to engagement in the professional development program. Data is drawn from pre and post surveys, teachers' personal profile pages, discussion forum transcripts and teacher's final reports collected over the one-year period.

Following transcription, a broadly based thematic approach was adopted for the analysis of the data. In the approach chosen, a theme is "a pattern found in the information that at the minimum describes and organises possible observations or at the maximum interprets aspects of the phenomenon" (Boyatzis, 1998, p. vii). Coding of the data was approached with knowledge of the elements of professional development derived from the literature- investigation, reflection, constructive dialogue, networks. During this process attention was paid to the identification of levels of engagement in the online professional development activities and the progress of the Action Learning Projects. Anonymity is gained through the use of pseudonyms for all participants.

Results

Case study 1- Working with the mentor

Amy was a year 4 teacher who described her use of ICT as embedded in all facets of her teaching. She believed strongly in the use of ICT as it "*changes how and what students' learn*". She felt confident to try new approaches and rated herself as highly competent. She described the way she used technologies:

I would use ICT daily in my classroom for a variety of things – research, blogging, Imovie, podcasts, and everything else in between. We have recently invested in a 'green screen' which I'm excited to test out and use in the classroom. This year and

last year my class made and updated a web page, which was a big success. The students uploaded work samples and podcasts, made videos that posted to Youtube which then embedded into their page, uploaded photos, wrote weekly blogs and commented on other students' pages.

In this excerpt Amy is confident to try new technologies and uses ICT to enable students' to present their work with some evidence of student collaboration. This would be considered as supporting existing curriculum outcomes (Downes, et al., 2001) through the use of a mix of teacher-centred and student-centred pedagogies (Ertmer, et al., 2012). Through this professional development opportunity Amy wanted to try something different, she wanted to authentically use communication tools as she felt this was missing from her ICT pedagogical approaches. Her Action Learning Project was to:

...move towards more collaboration through ICT in my teaching for the students to not just 'post' or 'find' information, but to share, work with and engage with the digital world through the global community.

Amy in her planning documentation expressed an interest in using Twitter (a new tool) in the context of the 2012 Olympics games, as this could be leveraged for communication on a global scale. She had no idea on how to set up a Twitter account and thought it would be like an email account.

Her approach to the professional development program could be considered as underpinned by the mentor. Amy was quick to provide her planning material for the mentor. She was focused on using Twitter, which helped her limit and direct her engagement with her colleagues online and or with further materials and opportunities. She engaged with the mentor through Skype sessions regularly to re-develop her plan and once the connection was made with an Australian Olympic diver, worked in unison with the mentor on how best to facilitate the Twitter exchange with her students. There was a period of intensity where Amy, the mentor and the diver worked as a triad to ensure the communication with the students was effective. This involved the use of hashtags and Twitter handles to filter conversations from the rest of the Twitter stream. Through Amy's reflection on the project outcomes her professional learning was not solely about Twitter, and surprising herself, it was about the development of students' substantive questioning techniques:

We learnt about open and closed ended questions, which I didn't predict would come from the inquiry. We learnt to ask questions that didn't have a yes or no response. I also learnt about using Twitter or other social media mediums to ask questions that kids are asking in the classroom.

It can be seen that Amy engaged in all elements of professional development- investigation, reflection and constructive dialogue with the support of the mentor who used participatory pedagogies. However, she did not take advantage of the social networking opportunities. She preferred to engage in substantive dialogue with the mentor. Planning documents from other teachers gave her ideas but she did not comment or build connections with other colleagues in the SNS. Her sense of a networked community came from her contributions about her project. Overall, she "felt less pressure" with this mode of professional development as there was no face to face meetings as it fitted into everything else she had to do.

Case study 2- School approach

Led by Wilma, the Teacher Librarian supported by the school curriculum co-ordinator, Kate, and engaged in collaborative planning with classroom teachers, a whole school approach was adopted for this online professional development opportunity. As the key driver for the Action Learning Project, Wilma situated the project within her teaching context, the school library. She considered herself as moderately confident with implementing ICT with some technical competencies. Her main goal for using ICT was for "developing student content understanding, extension activities and information gathering". This would be considered as using computers as an information tool (Tondur, et al., 2007)

primarily driven by teacher-centered pedagogies (Ertmer, et al., 2012). With this leadership direction a collaboratively constructed Action Learning Plan was submitted to the mentor and posted on the SNS for peer review. The goal was:

Does a library wiki encourage engagement with reading and lead to improved student learning outcomes? This will be achieved through collaborative curriculum planning with classroom teachers to link the use of Web 2.0 tools with the learning intent of the Australian Curriculum that has been planned for the term. A particular focus will be developing a library site that students and teachers can contribute to in order to promote reading and literature in the library.

Wilma and her team expressed an interest in building a library wiki that would be a repository for student work. Her plan was to “explicitly teaching literature content from the year level planned units of work incorporating appropriate ICLTs during library lessons and establishing the library wiki/blog so that staff and students can post work”. This evidences her current ICT beliefs and practices for productivity outcomes (Prestridge, 2012).

Their approach to the professional development program was different to Amy. The team formulated the plan and sought the mentor’s help mainly for refining their initial planning and getting some practical advice on implementation. The mentor led two Skype sessions for this refinement process. The main advice provided by the mentor was on the design of the project related to using wikis to create opportunities to transform student learning, particularly by building a sense of community among students and enabling students to co-create knowledge rather than using the wiki as a transactional tool. Originally, Wilma intended the wiki to be more or less a broadcast space that the library staff would use to promote books, reading activities etc, with student interaction limited largely to rating and commenting on books particularly for Book Week. This intent was enacted and in Wilma’s words:

This inquiry enabled students and teachers to engage in the study of literary texts. They examined literature by analysing the ways in which authors use particular devices and techniques to influence readers. They then responded to literature using a variety of online tools to represent their ideas, experiences and opinions. These were displayed on the library wiki to be shared with the whole school community. They included book trailers, book reviews and photo galleries. Through participation in these experiences, students were enthusiastically engaged with literature.

Evidenced here is the implementation of ICT that matches Wilma’s existing beliefs and pedagogies. It has been established that teachers’ adopt ICT into their teaching without changing their practice (Donnelly, et al., 2012; Ertmer et al., 2012; Kim, et al., 2013). The project outcomes shows some level of transformation about the wiki tool based on the fact that Wilma and her colleagues had never created or managed a wiki before. However, the greatest outcome for Wilma came at the end of the project evidenced in her reflection. She stated that:

Towards the end we explored the idea that wikis can be used to give learners both agency and ownership (individually and collectively) of learning particularly if they can be supported to develop and publish more sophisticated forms of responses to texts and even have ownership of the structure, policies and publishing processes for the wiki.

It can be shown here that once Wilma had experimented with the wiki tool and gained more confidence and competence, she began to open up to the idea that the mentor had seeded that is, the wiki as a collaborative knowledge building space. With regard to professional development, Wilma and her school team made limited use of the social networking opportunities, only benefiting from the sharing of project ideas, and for Wilma the sharing of technical problems and how these were overcome. Their main orientation was to gain knowledge and understanding in the planning phase of the project through

reading other teachers' projects and through Skype sessions with the mentor. Reflective contributions only took place at the end of the project.

Case study 3- Independent approach

Coming into this project and being a recent graduate, Jackie sees herself as a competent and confident user of ICT who tries to embed technologies into all aspects of teaching and learning. She states that she uses "teacher-directed tasks that require students to analyse, experiment and think about the concepts under study". Her goal for this project was to extend her pedagogies by focusing more on student use and specifically reflective task. Her Action Learning Project and description follow:

How can blogging be used as a reflective tool during the planning of Kids Connect? Each week students were asked to write a blog post reflecting on their learning experiences during the planning of Kids Connect - a 2 day ICLT conference completely organised and run by the students and attended by around 200 teachers and students from schools around Queensland. The aim was for students to reflect upon the challenges they faced each week and how these were overcome, as well as the new knowledge and skills that they were developing each week.

There are two items of interest here. Firstly, based on Jackie's competency with her use of ICT in her classroom and even though she was a recent graduate, she was asked to take on this major role for an ICT conference. Secondly, the use of reflection to support the learning process through blogs could be considered innovative based on the fact that the major task is management/administrative. Jackie's pedagogy and underlying ICT beliefs represent Mama and Hennessy's (2013) diversifying approach in that it encourages autonomous learning and reconceptualises the teacher's role in view of students' needs.

This confidence in both her competency and pedagogy enable Jackie to be an early adopter (Rogers 1962, 2003) in the professional development opportunities. She was a key participant in the SNS through dialogic activities such as the forums and comments on other teacher's projects. She also had a Skype session with the mentor to further develop her plan. This was mainly focused on the difference between blogs and other authoring spaces (e.g. wikis) and what kinds of blogging models would support the kind of student participation she had in mind. At the beginning phase Jackie was concerned with how to enable student reflections, seeking advice on how to direct, monitor and provide feedback on blog posts. In this planning phase she was most active connecting with her peers in the SNS, but once it got to implementation, she took an independent route.

The constructive dialogue in the professional development program made Jackie think critically about her use of ICT as she states at the end of the project she was able to authentically use ICT to engage students in real world issues and solve authentic problems that inquire into student generated questions. She states that:

I found some students were keen bloggers and others were more reluctant. Similarly, some students were very open and honest in their reflections, while others were somewhat superficial. However, I believe that overall, the students were successfully engaged in reflecting on their learning and experiences.

Her reflection indicates a diversifying pedagogical approach and demonstrates different beliefs and pedagogies to what she used prior to this professional development. Constructive dialogue was the key to Jackie's engagement and helped her think more deeply about her use of ICT. She stated that the online professional development fitted well into her classroom activities. Jackie's approach to the professional development could be considered as independent in the fact that she was intensive through social networking at the planning phase and quickly tapering off though implementation and reflection. This may be due to her confidence and competence with ICT.

Conclusion

This study has investigated a model of professional development that had two innovative components: the use of a SNS as a platform and underlying process for professional development, and the opportunity for self-generating content rather than modularised content. The professional development model appropriated core elements of professional development, through teachers' engagement in investigation, reflection and constructive dialogue. Each teacher designed and implemented an Action Learning Project based on their own pedagogical needs and interests and situated within their school based curriculum and constraints. An online networked community was established virtually through teachers' engagement in forum discussion, Skype sessions, emails and profile pages that included reflective posts, professional information and planning documentation. Responding to the two key research questions, it was found that the content free demand drive model of online professional development enabled teachers to engage in ways that were responsive to their needs and interests and professional school contexts and sustained teachers involvement to varying degrees without any face to face contact. The opportunity to enable professional development without limits of time and place was considered beneficial. This demand-driven model influenced both the nature and timing of the support activities and services provided as the onus for endorsing and authorising activities was on the teachers rather than on the mentor. Activities and services could be offered but not mandated and teachers' responses were critical to informing decisions about what further activities and services were to be offered.

This study contends that professional development can effectively be implemented in a SNS where a networked community is established to support the elements of investigation, reflection and constructive dialogue and the development of social presence to enable teachers to embrace the advantages of online networking without the need for face-to-face communication. Online professional development can be considered a mechanism for self-renewal where teachers' beliefs and practices become the focus and influence of the design of professional development through self-generating content and self-directed pathways for learning. Finally, this study proposes that effective professional development is driven by the teacher through self-directed pathways supported by an online networked community that includes teachers from all educational levels.

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WHAT DO AUSTRALIAN UNIVERSITIES WANT IN STUDENT ICT SKILLS?

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Abstract

This paper reports on a study that sought to identify the information and communications technology (ICT) used daily in Australia higher education institutions (HEI). Four hundred and one educators from fourteen Australian universities ranked the importance of sixty-two ubiquitous and emerging hardware, software and online applications to determine what student ICT skills were necessary to successfully complete their particular curricula. These sixty-two skills were apportioned according to their common usage and divided into ten categories: communications & email; content management systems (CMS); database management; graphics; hardware; interactivities; multimedia presentations; research; spreadsheets; and, word processing. This paper presents quantitative data collected on the use of these ten categories across the faculties of Arts, Business & Commerce, Education, Health Science, Library & Research, Social Science and Science, Technology, Engineering and Maths (STEM). The study revealed that students need advanced ICT skills in seven of the ten categories to successfully engage in university studies.

Keywords: ICT skills, International Students, Foreign Students, Australian Higher Education

REVIEW OF THE LITERATURE AND THEORETICAL FRAMEWORK

As a member of an academic knowledge-based society, a student's ICT skills are equally as important as their language skills. Of what value are science, maths, research or critical thinking skills if the student cannot express their knowledge in an acceptable academic format, using the communication tools ubiquitous to higher education? When considering the foreign student, schooled off-shore, what assurance do educators have that she possesses the necessary ICT skills to undertake a rigorous tertiary program? Without an ICT assessment tool applied pre-enrolment, the lecturer becomes responsible for identification and remediation of any ICT skills inadequacies. This study polls university ICT to help inform educators' assessment and remediation decisions. The literature reviewed below supports the need for such a study and recommends the results be seriously considered to the advantage of all university stakeholders.

The global economic crisis of 2007 has caused higher education institutions to rethink traditional business models into forms that can more rapidly respond to changes in global dynamics. The Organization for Economic Co-operation and Development (OECD), suggested these new model must also depend on the calculated use of ICT. In September 2012, the OECD presented a discussion paper at the Institutional Management in Higher Education General Conference entitled Higher Education in a World Changed Utterly – Doing More with Less (Kearney & Yelland, 2012). The OECD put forth eight topical areas, in twenty-four questions, to guide members when drafting a new scenario for the advancement of tertiary education. Of these eight topics, three directly impact this research study as they are grounded in the ubiquitous use of ICT: *funding, governance and measuring/improving quality, relevance and effectiveness.*

Funding changes require that administrative policies are developed that resolve the mismatch between who pays and who benefits from tertiary education. This mismatch was a focal subject of The 2013 Inside Higher Ed Survey of College and University Business Officers. Edited by

Jaschik & Lederman, this survey reported that 457 American College and University Business Officers (CUBO) expressed a lack of definitive information when costing-out, adding or enhancing technology-related services or delivery systems. The data is not there. Instead these CFOs fall back on traditional pragmatic factors such as cutting costs, boosting enrolments, streaming delivery systems, increasing tuition fees, increasing teaching loads and curbing staff development expenditures. While 65% supported academic collaboration with other institutions they admitted that without valid data to guide the process, implementing these priorities might be short-sighted. In the same year, over two-thousand American members of the Association of Governing Boards of Universities and Colleges (AGBUC) were surveyed. Only 19% said that their boards are prepared to decide which ICT to invest in with an additional 20% admitting that their boards exhibited “poor execution of this area of oversight”. Between one-half and two-thirds of respondents said they received “fair”, “poor” or no information and indicated they are not even aware of the ICT initiatives taking place on their own campuses. While 57% think massive online open courses (MOOCs) will have a positive academic impact, 56% say MOOCs will have an adverse economic effect at a time when they are defending tuition increases for coursework delivered online or by distance learning system (AGBUC, 2013).

Governance changes require institutions to increasingly become demand-driven, affecting their core missions, management and strategies. Education is Australia’s fourth largest export industry behind iron ore, coal and gold, and ahead of tourism, natural gas and crude oil, generating about \$15 billion in revenue annually (ABS, 2013). Table 1 lists the 2013 figures for the top five contributing and the top five growth countries in the Australian student population. Students from these countries will present Australian HEIs with distinct adaptation and assimilation challenges.

Table 1: Foreign student enrolment across all education sectors

Five Top Country Contributors of Foreign Student Populations (52.3%)		Five Top Countries of Growth in Foreign Student Populations (Oct, 2013)	
Peoples’ Republic of China (PRC)	28.9%	Philippines	+26.3%
India	9.2%	Colombia	+19.4%
Republic of Korea	5.2%	Pakistan	+17.6%
Vietnam	4.9%	Brazil	+16.3%
Malaysia	4.1%	Taiwan	+12.6%

Both the OECD and the International Monetary Fund (IMF) classify eight of these countries as either early- or mid-level developing nations. The exceptions are the Republic of Korea and Taiwan. This is an important distinction because literature suggests that assimilation into an English-language, European-based educational culture is very challenging for students from non-European, third-world and/or Eastern countries. Many studies have chronicled the problems of long standing adaptation and assimilation stemming from cultural, social and political differences (Klein, Miller & Alexander, 1981; Liu 1984; Yan, 2006; Yingyi, Austin & Liu, 1995). At 28.8% of the total foreign student population, PRC students are a concern, with Yan and Berliner (2009) noting these may experience more problems than other students. These students’ have been recognized for their exemplary performance in general curriculum attainments but their ICT skills training and their subsequent ability to engage in rigorous university studies, has not been investigated. Given the growing dependence of tertiary education on ICT across all areas of interaction, it is now time to determine if foreign students, who currently underpins the education export industry, possess the ICT skills expected by Australian universities.

Changes in measuring and improving quality, relevance and effectiveness requires the creation of a baseline of ICT skills and the assessment tools that can measure the student’s entry-level ICT skills as well as their educational progress in developing the knowledge and skills needed

to enter the 'knowledge society'. Present-day knowledge society is based on the increase in data creation and information dissemination that results from the innovation of information technologies (UNESCO, 2005). By definition, ICT is the driving component of a knowledge society. But the creation of a knowledge society is not necessarily complex. It can be as simple as an exchange between individuals, such as a student and a teacher, in which both parties are imbued with the need to create new knowledge. In 2012, the OECD overlooked this dynamic when it did not recognize the role of ICT or the two primary beneficiaries of ICT use: the teacher and their student. In each exchange between instructor and student a primary knowledge society is created. On a daily basis, the educator is the de-facto implementer of ICT change. The student, if adequately prepared and able to adopt to change, is the ultimate beneficiary. The university instructor's personal choice and use of ICT, the individual students' ICT skills and adaptability add up to a much larger academic configuration: the ability to partake successfully in the higher education process and enter the knowledge society. This process provides considerable justification for an ongoing assessment of how and what ICT are used in higher education.

RESEARCH DESIGN AND DATA ANALYSES

A pilot survey of student ICT skill needs at the University of Tasmania and the University of Wollongong was conducted in July, 2012. Twelve additional university systems were then selected to take part in a second survey in March, 2013. Together, these fourteen HEI represent the six Australian states and the Australian Capital Territory. Accessing public records available through each university's website, the researcher compiled an email data base of over 3,000 contacts. Of these, 401 viable responses were collected. The survey was distributed online via the UTas-provided Qualtrics Survey Software[®] provided to academic and professional staff. Selecting this delivery method was an intentional test of the efficacy of the data gathering process using university-recommended security and online applications. The development of this email data base and the subsequent availability of the data in both .xlm and .spss format would be considered a viable *usability study* of the various university websites.

The survey design was based on a compilation of previously conducted academic surveys instruments (Crisp et al., 2009; Davies, 2008; van Braak & Goeman, 2003). Emphasis was placed on quantitative questions using the Likert scale to allow for future comparisons. Survey content was based on the current ICT criteria for primary through secondary education in the New South Wales K-10 technology education (NSW, 2013), the Standards for Students (ISTE, 2007) and the Texas Essential Knowledge and Skills (TEKS, 2013). All aspects of the email collection, the contact methods, the online survey presentation, the data collection, maintaining the anonymity of respondents and the data analysis were pre-approved, monitored and conducted according to the University of Tasmania Social Science Human Resource Ethics Committee (HREC).

The survey included twenty-eight questions, an introduction and a closing note of appreciation. ICT skills were grouped into ten categories, based on similarities of use:

1. Communication & Email;
2. Content Management Systems;
3. Database Management;
4. Graphics Manipulation;
5. Hardware;
6. Multimedia Presentation;
7. Online Applications;

8. Data Retrieval and research;
9. Spreadsheet Calculation; and
10. Word Processing.

The respondents were asked to rank the importance of specific ICT skills in relation to their field of study. The Cronbach's alpha reliability coefficient ($>p$ value) for the ICT skills questions ranged from .776 to .956 with a mean of .856. Therefore the questions were considered to be highly reliable with a high level of internal consistency since a figure of Cronbach's alpha >0.8 is taken to assure validity (DeVillis, 2003; Kline, 2005). Each question was introduced using the same general phrase "How important is it that your students have these..." and then offered from three to twelve demonstrable skills to aid in the respondent's selection. The respondent was given prompts on a Likert scale of (1) Very Unimportant; (2) Unimportant; (3) No Opinion; (4) Important and (5) Very Important. To conclude the survey, the respondent was asked to rank the value of crafting an assessment tool to measure student ICT skills and, if necessary, developing a skills remediation program for students found lacking required skills.

RESULTS AND DISCUSSION

During the analysis process the Likert prompt of *no opinion* was recoded to the value of one and the remaining responses adjusted accordingly: (1) No Opinion; (2) Very Unimportant; (3) Unimportant; (4) Important and (5) Very Important. From the data collected, Figure 1 indicates the importance placed on each of the ten categories. Educators indicated seven of the ten categories were important with Data Retrieval, Word Processing and Content Management Systems skills ranked very important.

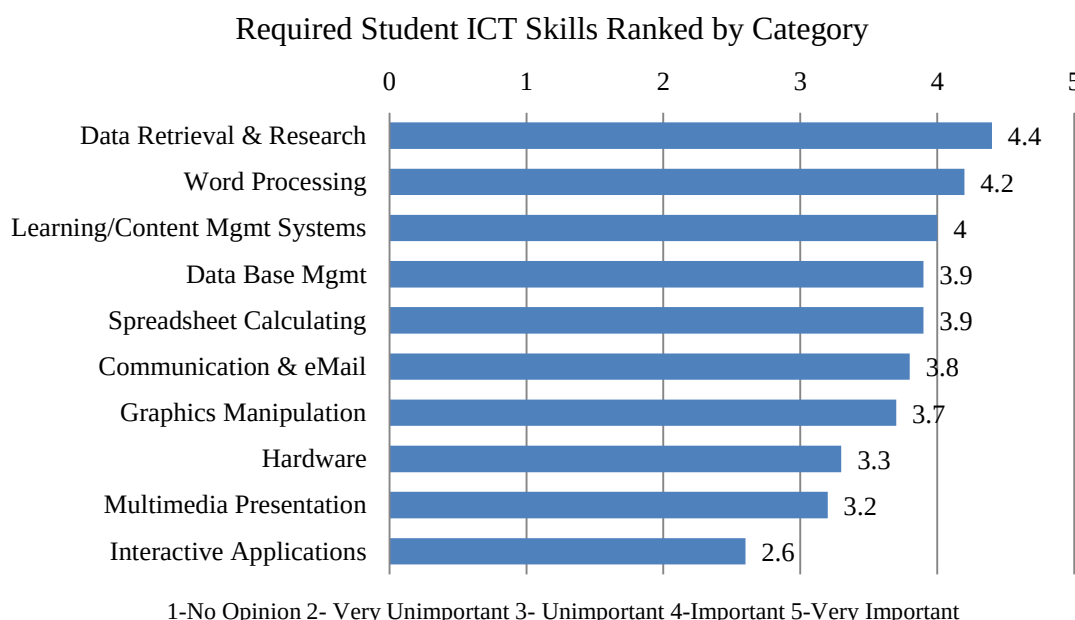


Figure 1: Ten ICT Categories Ranked by Importance

The following three tables deconstruct the ten ICT skill categories above into the operational uses of each of the ICT skills: offline skills, online skills and hardware. Skills are considered *offline* if they existed before or do not require Internet connectivity to implement. Skills are

considered *online* if they require Internet connectivity to function. These two categories include all of the skills necessary for student L/CMS interactions. These evaluations show that educator preferences were both practical in use and relevant to changes in content delivery methods. Table 2 ranks the 23 offline skills queried. Sixteen of the twenty-three ICT are ranked over 70% importance.

Table 2: Specific student offline skills required across all faculties.

Offline Skills Required Across All Faculties	Respondent Percent
Word Processing - Manipulate text	92
Word Processing - Use reference, thesaurus & language tools	87
Graphics Manipulation - Create clear, concise & logical presentations	86
Word Processing - Insert headers, footers, ToC & appendices	83
Word Processing - Work with a variety of office applications	83
Word Processing - Personalize & use spellchecker as a learning tool	82
Word Processing - Use page orientation & print layout to eliminate errors	82
Word Processing - Create boxes, borders, table, bullets & numbering	80
Spreadsheet Calculating - Understand terminology: column, row, cell	78
Graphics Manipulation - Design slide show colour, type style, transitions	78
Graphics Manipulation - Insert graphics from various sources	76
Graphics Manipulation - Select/delete/crop copy in presentation formats	75
Spreadsheet Calculating - Generate graphs, charts, bar columns, lines etc.	75
Data Base Management - Understand terminology: fields, records & files	74
Spreadsheet Calculating - Use sum, formula & basic calculations	74
Spreadsheet Calculating - Format currency, time, numerical value	73
Data Base Management - Sort data, add/delete & edit records	68
Spreadsheet Calculating - Alignment & adjust column width & row height	68
Data Base Management - Create fields & choose data types	66
Multimedia Presentations - Understand importing, navigation & hyperlinks	60
Multimedia Presentations - Transition timing, sounds & editing	57
Graphics Manipulation - Work with many graphic applications	53
Graphics Manipulation - Use freehand drawing tools & colour palettes	47

Four categories comprised the online ICT with twenty-four specific skills queried, each considered relevant for their role in mass communications and education. The nine skills included in the category *Interactivities* were ranked lowest of all 64 skills surveyed. This trend requires monitoring as these skills are often found providing support for multi-cultural and multi-lingual populations. These Twenty-six online skills were queried and the responses are ranked in Table 3 below. Twelve of these ICT are ranked over 70% import.

Table 3: Specific student online skills required across all faculties.

ICT Online Skills Required Across All Faculties	Respondent Percent
Data Retrieval & Research - Use keywords in advanced search	95
Data Retrieval & Research - Search sites with accurate information	94
Data Retrieval & Research - Record, catalogue & cite data	93
Data Retrieval & Research - Understand browser uses	87
Data Base Management - Locate information subject, keywords & author	83
L/CMS Skills - Access learning materials	81
Communication & Email - Compose appropriate emails	80
Data Base Management - Use academic & commercial data bases	80
L/CMS Skills - Upload assignments for assessment	78
L/CMS Skills - Discuss work on bulletin boards	73
Data Retrieval & Research - Work with many applications	71
Communication & Email - Format, size and send academics	70
L/CMS Skills - Access grades for units	69

L/CMS Skills - Take a quiz	66
Communication & Email - Reproduce academic formats	58
Communication & Email - Create, organise & store files	53
L/CMS Skills - Participate in a webinar	50
Interactivities - Social media, blogs & forums	49
Interactivities - Media streaming	43
Interactivities - Learning/Content Management Systems	42
Interactivities - Web development or editing tools	31
Interactivities - Mapping & location programs	28
Interactivities - Language translation programs	26
Interactivities - 3D or animation software	23
Interactivities - Games & gaming	13
Interactivities - Virtual worlds	11

The remaining ICT skills queried were those required to work with various hardware. Table 4 ranks respondents' evaluation of the importance of these twelve hardware.

Table 4: Specific student hardware skills required across all faculties.

ICT Hardware Skills Required Across All Faculties	Respondent Percent
Desktop & laptop computers	98
External storage, USB & thumb drives	90
Printers, copiers & scanners	87
Modems or routers	50
Tablets or eReaders	49
Smart phones	49
Webcams or microphones	48
Wireless, Bluetooth or tethering transmitters	44
Security digital (SD) cards or readers	43
Audio recorders or players	42
Video recorders or players	40
Interactive whiteboards	33

The top three items (identified by over 70% of respondents) were clearly the most significant, with a substantial gap before the remaining hardware items.

Recommendation of Assessment and Remediation Tools

The survey also inquired about the ICT skill discrepancies and, if identified, provides remediation. Again, across all faculties, there was general agreement that such assessment and support would be advisable. However, individual faculty responses varied. Table 5 shows the percentage of respondents who consider assessment and remediation important or very important diagnostic tools. The data is offered both across all faculties and segmented into seven faculty groupings.

Table 5: Assessment and remediation recommendations.

Assessment & remediation recommendations across all faculties	Respondent Percent
Is there a need for an assessment tool to identify student ICT skill discrepancies?	60% (Yes)
Is there a need for support and remediation to address ICT discrepancies?	60% (Yes)

Assessment & remediation recommendations per faculty	Percent recommending assessment	Percent recommending remediation
Arts	71%	67%
Business & Commerce	58%	54%
Education	67%	64%
Health Science	69%	62%
Library & Research	49%	46%
Social Science	69%	69%
STEM	58%	60%

The high assessment percentage expressed by the Arts faculty is of interest as it may reflect the use of emerging and creative applications into Arts curricula. Emerging ICT, such as 3D spatial design, virtual image projections, multimedia embedding, etc., may present additional challenges to students enrolling in these academic programs. Further study might be indicated in order to identify what emerging technologies students choose to enhance their learning with an eye on their future relevance across all curricula.

CONCLUSION

Moore's Law (1965) is the observation that, over the history of computing hardware, the number of transistors on integrated circuits doubles approximately every two years. This relationship has come to represent the rapid pace of change brought on by ICT. Keeping pace is difficult and often results in chaotic solutions. Universities strive to create students who can contribute to the knowledge society. In light of this research study, three issues that impede this goal are presented. Firstly, university decision makers do not have the timely well-supported data they require on which to base their ICT decisions. Secondly, foreign students, many from developing countries, receive limited ICT instruction and should not be expected to have the ICT skills required for rigorous university study. Thirdly, ICT usage information has not been collected from the university lecturer who is both the most influential decision maker of daily ICT use but also the person most directly affected by any inconsistencies in a student's ICT abilities as they affect classroom performance.

There are many stakeholders who might benefit from this survey data. As indicated in the introduction, academic boards of directors and chief financial officers base important technology decision on data that they indicate is increasingly hard to come by. University marketers and planners could benefit from insights that arise from this data. However, this study was intended to aid two cohorts: firstly the tertiary educator, by providing awareness of an as yet unidentified adaptation issue that as many as 50% of their students may encounter; and, secondly the student-as-academic, by alerting them to one of the more easily-remediated challenges they may find when choosing their tertiary field of study outside their home country. It is the responsibility of the accepting institution to see that the foreign student has the requisite ICT skills to engage in rigorous university studies.

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BUILDING SOCIAL CAPITAL THROUGH BLENDED LEARNING

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Abstract

Creating highly interactive and supportive blended learning environments can prove challenging. This paper reports on a Master's of Education subject in which the use of Google Hangout and a subject Ning offered students an alternative experience to the 'traditional' university LMS. Student participants report that they felt included and supported, were active, and developed strong learning bonds with the rest of the cohort.

Introduction

This paper explores the ways in which community is developed within a university blended subject. In a subject about 21st Century learning communities it is important that the subject itself becomes and embodies such a community. While it is easy to think that Communities of Practice might be the best road to follow, it is possibly not the most appropriate for this purpose. The notion of social capital features strongly in the development of a learning community that comes together briefly, is artificially created (and deliberately terminated), and yet functions in a remarkably strong way. A study by Hopkins, Thomas, Meredith and Ewing (2004) identified two kinds of social capital: bridging capital and bonding capital. These two capitals (bridging, "weak relationships between numerous people" and bonding, "strong ties within small groups" (p. 371)) are investigated in online communities by Hopkins et al who find that while it might appear at first glance that the relationships established in online communities might be of the 'bridging' kind, the reality of these communities is that even through the smallest communication media the relationships can quickly form into the 'bonding' kind. This notion of developing strong relationships through relatively small and (apparently) low level communications was demonstrated through the interactions and relationships between students and students, and students and lecturer. This strength of relationship was not only obvious amongst the face to face community but also amongst the online community with the 'face to facers'.

Using technologies that are, in a sense, cobbled together that include a Ning, Google Hangout, face to face, and anything that the students wish to use, the community is built through carefully structured academic and non-academic activities. The community comes into being through the efforts of the lecturer who can gradually let go as it develops and the community supports itself.

This paper presents the lecturer viewpoint and explores the experiences of a number of students. The paper is small scale and acts as an introduction to a longer-term study for which Ethics Clearance has been granted. In the first instance I wanted to investigate what was important to students and how that matched, or didn't match, my own priorities. Student Experience Survey responses (the University's internal student feedback device) for the group of students interviewed showed very high levels of student satisfaction with the subject and with its teaching. These surveys do not look deeply at particular aspects of a subject and provide little room for focused comment. They are also not to be used in the reporting of research about subjects.

The paper presents the lecturer's (my) story and the participants' story in response to a number of areas that were of importance to me in the design of the subject and the way it was run. These stories are presented from the lecturer point of view first and then from my analysis of the participant perspective. In the telling of these stories this paper provides an example of how contemporary social technologies can work to create a rich and rewarding educational environment and learning experience.

Blended Learning

Defining Blended Learning is somewhat of a challenge as there are possibly as many definitions as there are examples of practice. An early definition from Garrison and Hanuka (2002) stresses the importance of asynchronous interactions in the blending process. At that time text based interactions were the focus of blending, the notion of synchronous online interactions using video was in its infancy. Bonk and Graham (2012) use the word 'instruction' in their definition, as in a combination of face-to-face and computer-mediated instruction. They also posit that any blended learning definition or model will inevitably be a changing one, reflecting technological innovation and capacity. In the case of this paper and the subject on which it reports, it is defined as a learning environment in which interactions and content exist virtually and face to face both synchronously and asynchronously. Of course nothing is completely clear cut and even in this subject there were students who for reasons of geography could not take part in the 'real' face-to-face interactions. In these cases their synchronous face to face interactions were done through Google Hangout during class time.

What I wanted to achieve through the technology

First and foremost in my mind was the need to create an actual learning community within the subject. In previous years since the subject's creation in 2010, the Ning had proven to be popular with the students who appeared happy to share non-subject related materials on the Ning and to organise their own groups and discussion forums.

Although the Ning was a useful, effective and popular platform the experience for students off campus was never as strong as for those on campus. In order to address this I implemented the use of Google Hangout to provide a synchronous experience with direct involvement in class discussion and presentation. While much discussion occurred in the Ning, each week students were responsible for leading discussion on particular themes and readings.

What I thought was important

Apart from technological considerations that will be dealt with later in this section, I was keen to ensure that more than CoP literature was involved. I wanted my students to focus on 'Learning Community' in its many forms as opposed to just the notion of a Community of Practice. This was achieved through a range of topics and readings that included:

- Learning Design
- Distributed Intelligence and Learning Communities
- Online Communities
- Virtual Worlds
- Open Source Community

The thinking behind this was that what the subject was creating and what many if not all classroom settings (including those in Higher Ed and Adult Education) might actually represent in terms of community are not Communities of Practice but are in reality Learning Communities of one form or another.

Structure

A key component of the blending of this subject was the use of a subject Ning. All subject at the University are required to have a presence on its Learning Management System (LMS). This system, as with most similar systems, provides many tools for discussion, blogging, wikis, content delivery, and so on. As a lecturer trying to develop an understanding of theoretical perspectives about learning communities, I thought that by actually creating a community and attempting to grow it might provide a very useful and practical example of what these things might actually look like. Living outside the

University's LMS, the C21learning Ning provided a very different experience for students and for me. The following is a list of the ways in which the Ning provided a different level of engagement:

- **Administrator Access:** All members of the class are given administrator access of the Ning. This gives every student the power to add content, delete content, change the look of the Ning and to invite or remove members. (The provision of administrator rights was given on two conditions: 1) No one pressed the 'reset to default' button. 2) No one invited or admitted external users without my permission
- **Integrated Interface:** Unlike the LMS the Ning provides seamless integration between component pages. All content can be commented on at the point of delivery and material of just about any media can be uploaded to any page
- **Non-Branded:** The interface is clean and non-academic in appearance
- **Member page options:** Each member of the Ning automatically receives their own page. This page is linked to all posts and can be customised by the individual member

Access

I wanted full synchronous access to all students regardless of location. (I was even able to participate in a class while in the UK attending a conference.) I felt that in order to create some consistency of experience for those physically not present, this was essential.

Ownership

I believed that shared ownership of the community site was essential to the development of trust and community. It is always my practice in this subject to begin with a very high Ning presence and gradually lessen my presence. From posting every day on a range of topics I move to sending reminders and ensuring reading topics are up to date and being responded to. My role becomes far more administrative. As discussed earlier, I give all students administrator rights. One result of giving administrator rights was what I termed 'The Colour Wars'. Students frequently changed the way the Ning looked. They could customise their own page and they could customise the main Ning pages. This was an activity that was pretty well ongoing for the whole time. One never knew when one opened the Ning what it was going to look like. This was very important to me as the lecturer, it had no bearing on the content but represented a significant shift from what 'traditional' LMS experiences are.

One particular aspect of ownership was the ability to create non-subject related groups, materials and posts. In previous years I had noticed this happening and with this group it was no different. Some students uploaded personal albums of travel photos, of family events and of things of interest to them individually. Others posted links to events, lectures or videos that they thought might be of interest to other students.

Contribution

The Ning provides detailed analytics about members. This includes number of times participants visit the site and the number of posts or comments they make. At times I made mention of who was a 'top contributor' in an attempt to encourage participation. Grades in the subject include a 10% contribution mark. This mark is not based on any specific number of posts or on their quality, it exists to encourage use of the Ning. Most students received the full 10% and there were many 'top contributors' throughout the running of the subject. Given the nature of the Ning the contribution count was not restricted to subject specific material. Any and all interactions were counted.

Learning Experience

The subject is designed to develop capacity of educators to lead online learning communities and to support that learning through interactions and theory. There is no restriction on what those communities might look like, what their purposes might be or how they might be constituted. It was my intention to provide an environment that actually represented a community in development. It was essential to my educational outcomes that students felt part of the community and became active members of it. I also

wanted them to be able to reflect on their experiences and be able to apply their learning to their own professional circumstances.

Participants

Email requests were sent to all students who participated in one particular year of the subject. I selected a year in which I was the lecturer given the need for my own perspective. Students responded via email to a set of questions that asked about their experiences in the subject and about the impact it might have had on their professional lives. Nine of the twenty-three students responded with answers to the questions. Of those nine, three were classroom teachers (one based in Korea, one in Singapore), three were involved in university roles, one was a corporate trainer, one was a full time student on leave from a software development role in Chile, one was a secondary school Assistant Principal on leave who ran a national training program for a not for profit organisation. Only one of the respondents, the teacher in Korea, was wholly online. At some point in time throughout the semester most chose to attend class remotely. This was mainly due to family reasons – they couldn't physically make to class.

What they thought was important

For the purposes of this article discussion is kept to student experience in the learning environment rather than on the specific subject content.

Structure

Participants were all very positive in their responses about the structure of the subject. One participant recalls how she was introduced to the subject through an invitation to join the Ning and that she was able to “connect with my classmates at any time”. Another participant notes how “the subject was very much student-centred” and that they were “encouraged to have control” over the Ning.

It is apparent from responses that this structure was appreciated by participants. Responses refer to “flexibility while not sacrificing learning opportunities”, one notes that she “loved the structure and was very motivated to learn in this environment.” Interaction between students was something that participants agreed was of significant importance. Saying that it was “very rich and helpful”, “helpful”, “enriching and enlightening”, and that it enabled a quick affirmation of “thoughts and expectations.” From my own point of view I was surprised that the participants had very different observations about non-subject specific content.

Use of Video

In their email responses to the way the subject was structured all participants note the flexibility of the learning and the way both face-to-face students and those working remotely were able to interact during class. Mention is made of the requirement that all students were required to lead discussions on readings and that remote students could just as easily lead reading discussions as those physically in the classroom.

Ownership

Despite my firmly held belief, based on my perceptions of behaviours in previous years, participants made very little mention of the importance of being an administrator. Responses included “not really important,” “Not really important,” “It was good to have ... but I didn't use them – except to change the backgrounds/colours!” One respondent recalls how one student changed the default member image to one of the Muppets, Elmo.

Participants had different opinions about the non-subject related material. One participant couldn't remember it (admittedly the interview was some 18 months after the subject ran). Another said that he found that it facilitated “trust and understanding” by helping students to “know more about one another”.

This, he said, led “to the open sharing and exchanges.” Another participant found the non-subject related materials particularly helpful “especially the teaching resources” as they “actually complemented the learning objectives of the course.”

Contribution

As indicated earlier there was a grade attached to participation in the subject. The participants represented here were all high level contributors to the Ning and to the subject (possibly an indication as to why they responded to my request to interview them). Their responses to my question about frequency of visits and whether or not they were ‘top contributors’ surprised me. One participant noted that she went “daily – it became somewhat addictive as I developed good relationships with other students and wanted to know what people were posting.” Another said that he went “once every couple of days” but only posted about once or twice a week. This pattern of frequency was echoed by the other participants who said they went once or twice a week. One participant noted that through technological problems at the University he found it difficult to maintain enthusiasm and that most of his time was spent getting his “head around the theory of using ICT in the classroom”. This response is, I believe, a reflection more about the problems than the practice. In my analytical data of Ning content it is apparent that he made a very high number of subject related and non-subject related posts.

None of the participants said that they were top contributors. They were emphatic with short responses that include: “definitely not”, “not really”, “I doubt I was”, and “no”. One was “unsure” saying that she wasn’t interested in competitive activities and “just contributed for my own satisfaction”. One respondent indicated that others “contributed more meaningfully and were more comfortable in that space”. This was also of interest to me as she was, in my opinion, of significant importance to the learning community. The student based in Korea, therefore entirely online, indicated that he thought that he “was up there somewhere (top 5?).”

Clearly these responses from individuals who I would consider to be ‘top contributors’ indicate that this status was of such fleeting or insignificant importance that it holds little or no lasting value to their learning. In my opinion (I use that term deliberately) I believe that while it was not of any lasting value there was immediate value in the notion of ‘top contributor’ and the humour that I applied to it during the subject.

Learning Experience

Participants were asked if the experience within this subject was different to other online experiences. All responded that this was the case. One noted that she hadn’t studied in an online environment but had found that engaging with the University learning management system to be “isolating.” Another noted that her experience with the LMS it wasn’t very user friendly and was “more of an information system”. None of the respondents had anything negative to say about the structure or the experience, including the student who had some technological connection issues. Responses included that it “helped me to feel like a class member and not just an isolated online student”; that it “was possible to interact, both visually and audibly, in real time with students at remote locations and share ideas rather than having to post ideas or thoughts to a forum, blog or message board and then wait some time for a reaction.” Another reported that:

The mix of physical interaction and on-line interaction somehow allows building of trust and encourages engagement of participants with one another, whether face-to-face or online.

Importantly in terms of my desire to improve the experience for wholly online students the Korean participant responded thus:

My participation in this subject was exclusively online (out of necessity). Prior to this subject, I had only completed two other units that were ‘online based’. This unit had a significantly greater amount of social interaction, which did motivate me to get onto the Ning and leave a comment or to share some resources. It was also interesting for me to remotely lead the discussions for one of the classes. I remember thinking that this was a very ambitious

proposition and it actually worked surprisingly well. The other classes didn't have the sense of community that this class had in terms of people opening sharing and debating ideas (and teaching resources).

In terms of impact on learning and practice, something that I hold as of the utmost importance as an educator, all respondents indicated positively. Responses included the subject allowed for more interaction, and that it built confidence in students' capacity to develop online components in their own educational practice. Two participants noted that they had started instituting Nings and Hangouts as part of their practice. All participants reported direct and tangible changes in their practice as a result of the subject. This involved the development of online communities for teacher professional development, in corporate settings and in classroom settings. Respondents commented that not only had they developed confidence and understanding but they were able to look at the value of learning communities in very different ways and to seek opportunities for future development.

Conclusion

This paper has presented a very brief story of learning and experience of a small group of Masters of Education students. It provides an insight into their learning and practice, and shows, for the most part, an aligned between my goals and their perceptions. For me the ways in which they talk about the sense of belonging, the willingness to participate, the nature of the interactions, and (amongst other things) the connection between theory and practice indicate that my goal to teach about community by creating one was achieved. This is also a very clear indication of the building of social capital that Hopkins et al. (2004) see as such importance in community development. The 'weak' low-level bridging connections are evident throughout the Ning, of much greater importance is the apparent existence of the much stronger 'bonding capital' amongst the participants and between them and me, their lecturer.

There are a number of times where participants make direct mention of the blended nature of the subject and how this made a significant contribution to its success. The definitions of blended learning that I present at the beginning of this paper make mention of a blend between online and face-to-face. This blending was something that I tried to achieve and, according to the responses of the participants, I achieved. Bonk and Graham's (2012) discussion of blended learning includes the notion that this is a dynamic term dependent on technological innovation. In the case of the participants mentioned in this paper it is of significant interest to me that even the wholly online student from Korea noted that the subject was "the most 'practical' class" he had undertaken, this included face-to-face classes in Melbourne. In all his responses it is apparent that while he was aware of being remote, his learning experience was one of being blended. Here perhaps we see a move to new definitions of blended learning where the definition of face-to-face might need revision.

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ACEC2014 - PROFESSIONAL LEARNING IN 140 CHARACTERS

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Abstract

The World Wide Web has grown into a global information and communication space with more than a billion users and has entered a new, more social and participatory phase where people create and manage online content rather than just viewing it; a place where people can communicate knowledge, share resources and participate in social networks. Online social networks are being used to support professional learning where groups of people are using the Web to communicate and collaborate in order to build and share knowledge and form professional learning networks (PLNs). This paper presents the results of research into how microblogging, a form of online social networking, is being employed by educators to support their professional learning. The study examined activities and perceptions of a group of educators in order to provide an insight into how and why they engage in microblogging and the value they place on microblogging as a professional learning tool. The paper outlines the range of behaviours and activities that are undertaken to support professional learning; the advantage of microblogging as a professional learning tool; and implications for practice.

Background

My interest in the use of online social networking for professional learning emerged from my own use of microblogging. I observed through my connections with teachers and teacher educators from around the world that educators were using microblogging to share ideas and resources and to ask each other for professional help and support across a variety of topics and issues. Members of the network began referring to the group as their PLN and an online discussion ensued as to whether the “P” in PLN referred to one’s “personal” or “professional” learning network. It is to be noted that the borders between personal and professional learning networks are blurred (Ivanova, 2009) and PLN is variously used to mean personal or professional learning network in the literature. For the purposes of this study, PLN was taken to mean one’s professional learning network.

Professional Learning

Professional learning is a long-term process characterised by self-evaluation, reflective practice and continuing personal and professional development (Neil & Morgan, 2003). Professional development programs for educators were traditionally designed to change behaviour (Duncan-Howell, 2007), however, Masie (2008) contended that there has been a shift away from single-source knowledge and learners are turning to a wider set of resources for information and knowledge. The true competence for a learner of the knowledge society is the capability to stay connected and belong to digital communities in which interests are continuously shared (Pettenati & Cigognini, 2007). Learning is a social process in which interactions with the environment, both human and non-human, play an important role (Divjak, 2004) and it occurs not as a response to teaching, but as a result of a social framework that fosters learning (Brown & Duguid, 2002).

Simons and Ruijters (2001) highlighted the importance of profession-related collective learning and differentiated between collective learning, where learners consciously strive for outcomes; and learning in social interactions. The second of these, learning in social interactions, is the type of professional learning that was of interest to this study, that is, where people undertake learning together without any intended collective outcomes and which results in the learning *processes* being collective but the learning *outcomes* being individual.

Professional Learning Networks (PLNs)

Educators, like other professionals, can no longer rely on their original professional training and are required to maintain dynamically changing network connections (Hakkarainen, Palonen, Paavola, & Lehtinen, 2004). Networking is not new to educators, they have networked for many years in order to share practice; valuing contact with colleagues in similar and different settings (GTCE, 2005). What is new, is the fact that the Web can facilitate networking across greater geographical distances (Sliwka, 2003) and individuals are personalising their own social networks with the help of the Web (Wellman, Boase, & Chen, 2002). Not only are these online social networks being used for social connections, they also provide tools for personalising learning (Ala-Mutka, 2009) and have the ability to facilitate personal learning networks (PLNs) (Grosbeck & Holotescu, 2008).

The concept of learning networks was presented by Illich (1971) when he posed the question, "What kinds of things and people might learners want to be in contact with in order to learn?" (p. 78). Illich noted that information could be stored in things and in people, and that in order to learn, one needs both information and critical response to its use from somebody else. The origin of the term professional (or personal) learning network (PLN) is difficult to ascertain (Downes, 2009) and it is challenging to find a definition for the concept of PLN (Couros, 2008). The term appears to have been first used by Tobin (1998) who described a PLN as "a group of people who can guide your learning, point you to learning opportunities, answer your questions, and give you the benefit of their own knowledge and experience". More recently, professional learning networks have been variously described in the literature as: a collection of people and resources that guide learning, point one to learning opportunities, answer questions, and give one the benefit of their knowledge and experience (Nielsen, 2008); a place where one creates their own classrooms, curricula and textbooks for study of whatever one is passionate about (Richardson, 2008); a system of interpersonal connections and resources that support informal learning (Trust, 2012); and a technology-supported community of people who help each other better understand certain events and concepts in work or life (Koper, 2009).

Microblogging

Microblogging is a form of online social networking which enables people to share limited information about themselves via their profile and share their activities in short posts of up to 140 characters. Posts are made in response to the general question "What are you doing?" and the answers include messages of context, invitation, social statements, inquiries and answers, news broadcasts and announcements. Many posts are responses to other postings, pointers to online resources that the user found interesting, musings or questions (Educause, 2007). Some common contemporary microblogging services are Twitter [www.twitter.com] on which this study was based, Plurk [www.plurk.com] and Yammer [www.yammer.com].

E. M. Rogers (1995) argued that potential adopters of a technology need the ability to experiment with an innovation before they may see its application. In the case of microblogging, educators are also adopting a new learning environment, one that is open in terms of content, instruction, climate and discourse. Couros (2006) highlighted that in relation to openness, it is not just a set of new tools that need experimentation, but also a set of values and beliefs around knowledge and collaboration. Professional learning through microblogging is premised on reciprocity and harnessing collective intelligence. Lévy (1997) warned that while new communication technologies are conducive to the pooling and exchange of experience and knowledge, which is the ideal of collective intelligence, this does not happen automatically. Although microblogging provides opportunities for learning, not all individuals are equipped with the skills or knowledge to benefit from these learning opportunities (Ala-Mutka, Punie, & Ferrari, 2009). In order to participate in microblogging there is certain knowledge and understanding of conventions required that, while obvious to experienced users, might not be known to new or intending users.

THE STUDY

The aim of the study was to investigate how microblogging was being employed by a group of educators to support their self-directed professional learning. Through a qualitative research design using content analysis, an online survey and one-on-one interviews, the study examined activities and perceptions of a group of educators in order to provide an insight into how and why they engage in microblogging and the value they place on microblogging as a professional learning tool. An overview of data gathering through three instruments in three sequential phases is illustrated in Figure 1 and further described below.

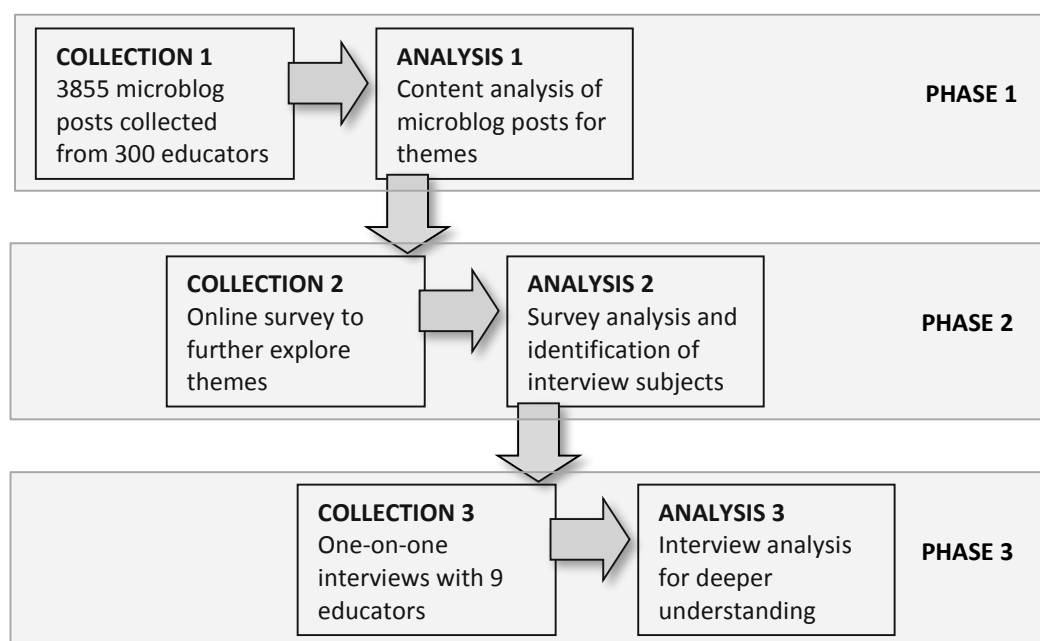


Figure 1: Sequence of data collection and analysis

Phase 1: Content Analysis: designed to discover the types of interactions that occur in microblogging. Microblog posts ($n=3855$) from a 24-hour period were collected and a sample ($n=600$) were analysed to determine the types of messages that were being posted. The *Community of Inquiry* (CoI) framework (Garrison, Anderson, & Archer, 2000) was used to analyse the posts. The CoI framework assumes that learning occurs within the community through the interaction of three core elements, that is, cognitive presence, social presence, teaching presence, which interact to influence and shape educational experiences. Analysis using the CoI framework allowed the researcher to categorise the types of interactions and identify themes, which would be further explored in Phase 2 of the study.

Phase 2: Online survey: designed to discover why educators participate in microblogging and the perceived value of their participation in microblogging. In this study the survey was used as a qualitative research tool for gathering data (Denzin & Lincoln, 2003) with the intention of describing the nature of existing conditions (Cohen, Manion, & Morrison, 2007). The survey comprised fourteen questions, which were organised around four themes: demographics, microblog usage, microblog behaviour, and PLN use. From the survey respondents ($n=121$), nine participants were purposively chosen to participate in the third phase of the data gathering, namely, one-on-one interviews.

Phase 3: One-on-one interviews: designed to further investigate how microblogging can support professional learning. The interview subjects ($n=9$) were selected from the pool of survey respondents who had indicated that their PLN was “extremely” important in their overall professional learning ($n=66$); that microblogging was “extremely” important in their PLN ($n=49$); that they considered participation in microblogging to be a meaningful form of professional learning ($n=104$) and they were willing to participate in the interview process ($n=63$). During one-on-one interviews these educators

were asked a series of six semi-structured and open-ended questions that were designed to capture their subjective experiences and attitudes towards microblogging. The interview recordings and researcher notes were analysed to determine common themes which had emerged from the content analysis of microblog posts (Phase 1) and the online survey (Phase 2), and to provide a deeper understanding of why individuals participate in microblogging and the value they perceive in their participation in microblogging.

Participants

The focus of this study was the use of microblogging for self-directed professional learning by educators who wrote their microblog posts in the English language. While individuals with a wide variety of ages and backgrounds participate in microblogging, this study explored the relationship between microblogging and professional learning by focusing on the activities of educators who currently use microblogging and would therefore be considered innovators and early adopters. Participants in the study included teachers, teacher educators, school principals, university lecturers and technology support officers. Although each of these types of “educators” work in different educational institutions with different aims, and have different concerns and practices, they have in common that they are involved in the education of others and they have individual professional learning needs.

FINDINGS

This paper presents a summary of the findings from the study in regards to the range of microblogging behaviours and activities that are undertaken to support professional learning, the perceived value of microblogging as a professional learning tool, and the advantage of microblogging as a professional learning tool. (A full report on the study can be accessed at eprints.qut.edu.au/65854/)

Microblogging Behaviours and Activities

An online survey of educators who use microblogging ($n=121$) revealed that the majority use Twitter ($n=112$, 94.1%), have been using microblogging for 1-3 years ($n=60$, 50.4%) and spend 4-6 hours per week using microblogging ($n=38$, 31.9%). The largest category of respondents ($n=54$, 45.4%) belong to 4-6 social networking communities (including microblogging), while a small number ($n=8$, 6.7%) belong to more than 10 social networking communities. The survey revealed that most educators engage in a variety of microblogging behaviours at some time with the most frequent being:

- share a resource, for example, a website, book, or video;
- on-share a resource posted by someone in your network;
- share information from a conference/workshop using a hashtag;
- save a resource posted by someone in your network;
- go back to a saved resource posted by someone in your network;
- follow a link posted by someone in your network;
- use hashtags;
- engage in a conversation with someone in your network;
- search for content;
- ask for a resource on a specific topic;
- read activity updates of others in your network; and
- act on something you have read in a microblog post.

Value of Microblogging as a Professional Learning Tool

The intent of this study was to investigate the value some educators place on microblogging as a professional learning tool, and the survey revealed that the majority of respondents ($n=104$, 92%) indicated that they considered participation in microblogging to be a meaningful form of professional learning. The majority of respondents indicated that their PLN was extremely important in their overall professional learning ($n=66$, 58.9%) and that microblogging was extremely important ($n=49$, 43.4%) or

very important ($n=38$, 33.6%) in their PLN. From comments in the survey and one-on-one interviews, eleven themes emerged regarding the value of microblogging for professional learning:

- access to timely information;
- making diverse and global connections;
- access to valuable resources;
- access to advice and support;
- ability to attend a conference “virtually” by following the hashtags posted by others;
- engaging in conversations and discussions;
- access to experts;
- keeping up with current trends;
- extending their networks beyond their local area;
- reciprocity; and
- learning.

Advantage of Microblogging as a Professional Learning Tool

The advantage of microblogging as a professional learning tool lies in its ability to link educators globally to exchange ideas from different perspectives and to share resources and teaching practices. Educators who microblog have access to relevant and timely learning that is not constrained by time or distance and can be tailored to meet their individual needs.

Although the participants in this study were enthusiastic about microblogging and believed that it contributed to their professional learning and positively impacted on their teaching practice, they described some disadvantages of microblogging. The problem common to all educators in this study was the large amount of information they received from others in their microblogging network. It was found that some educators had effective strategies for dealing with this, while others did not. Another disadvantage noted was the amount of time spent microblogging. Two educators who had been microblogging for less than three years, used the word “addictive” and said that they felt they had to constantly check their microblog streams in case they missed valuable information.

IMPLICATIONS FOR PRACTICE

This study has shown that one group of educators finds microblogging a valuable professional learning tool and that they are enthusiastic about its use in their professional learning network (PLN). The time-efficacy of writing and reading microblog posts of 140 characters makes this an ideal medium for professional learning. Therefore, the question arises as to how microblogging could be introduced to other educators as a tool to support their professional learning.

The common perception of microblogging is one of unremitting triviality about what you are making or eating for dinner (McFedries, 2007). Once an educator overcomes this perception and decides to join microblogging, they need to know how to open an account and start building their network. Effective professional learning through microblogging involves participating in the network by sharing resources and information, and engaging in dialogue with other educators. If new members do not know how to go about finding relevant educators with whom to link, their dialogue will fall short of expectations and they will not find microblogging an effective professional learning tool.

This study showed that microblogging can be a valuable tool for professional learning, therefore, it is desirable that effective ways are employed for introducing microblogging to educators in general. I advise that educators are introduced to microblogging by an experienced user who constructs a learning scenario in which they can participate. It is recommended that an effective method for introducing a group of educators to microblogging as a professional learning tool is to initiate discussion around a topic that has meaning for the group and have them participate as a closed group. Once educators experience a meaningful dialogue and gain confidence in the use of microblogging they can expand their professional learning network (PLN) beyond the original group.

Another implication for practice comes from the issue of recognition of microblogging as a legitimate form of professional learning. Several educators related that microblogging was a significant part of their informal professional learning, and despite evidencing this by documenting that learning reflectively, for example in a blog, this was not accepted by their employers as legitimate professional learning. Microblogging represents a significant shift in pedagogic approach, and should be seen as a completely new form of communication that can support informal learning beyond classrooms (Ebner, Lienhardt, Rohs, & Meyer, 2010). It is important that institutions understand that knowledge is distributed through different communities (and networks) and, central to such an understanding is placing control of learning in the hands of learners themselves and providing learners with the skills and competences to manage their own learning (Attwell, 2006). However, it may be some time before microblogging is accepted universally as a legitimate professional learning tool.

CONCLUSION

The study showed that educators who participate in microblogging consider it to be a meaningful form of professional learning and that access to information, resources, advice and support from a diverse global network was highly valued and enriched their learning experiences. The inclusion of microblogging in a PLN gives educators access to resources and information exchanges with other educators that they would not otherwise have. The ability to engage in dialogue with peers and experts outside their geographic area allowed these educators to seek advice and support from others with a wide range of experience and knowledge, and thus extend their thinking. These findings are consistent with those noted by Trust (2012), that is:

Teachers engage in PLNs to grow professionally, learn from others, and contribute to a community. Teachers are motivated to engage in PLNs because they can solicit help and support, demonstrate their knowledge by helping others, and converse with individuals about new information and feedback. (p. 37)

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PROPOSING A MODEL OF PEDAGOGICAL REASONING WITH TECHNOLOGY

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Abstract

This paper proposes a lens to view a teacher's Technological Pedagogical Reasoning through a digital portfolio. There is much evidence of pre-service teachers preparing a digital portfolio but there is limited evidence of successful programs where in-service teachers have prepared a digital portfolio. This research provides confirmation of a Queensland based program where teachers have completed a digital portfolio as part of the Smart Classrooms Professional Development Framework. This digital portfolio provides rich descriptions of a teacher's professional values, relationships, knowledge and practice. This type of portfolio encompasses sumptuous discussions and evidence of using technology in the classroom. Inherent in this digital portfolio are elements of their pedagogical reasoning with technology (PRT) or Technological Pedagogical Reasoning. This paper reports on one teacher's digital portfolio as part of the wider research project investigating the development of PRT. Findings indicate there is evidence of pedagogical reasoning within this digital portfolio, which suggest that PRT is present. Therefore, this paper proposes that it is time for a Model of Pedagogical Reasoning with Technology in order to capture the interrelationship of teaching and technology in the 21st century.

Introduction

This paper presents research from a doctoral thesis that has been designed to understand teacher's pedagogical reasoning when deciding to use technology. This acknowledges and builds upon Shulman's earlier theorising about pedagogical reasoning. The paper presents the case that while Shulman's Model of Pedagogical Reasoning and Action (PRA) is a critical model to explain effective pedagogy; it needs now to be re-examined to explain and accommodate teachers and technologies, and proposes a Model of Pedagogical Reasoning with Technology (PRT). To begin, the *SMART Classrooms Professional Development Framework* is described to provide the context in which teachers, participating in this research project, have prepared digital portfolios. To understand the process, the digital portfolio is explained with the example from one teacher 'C1' or Carmelina (not her real name).

The Smart Classrooms Professional Development Framework (SCPDF)

The *Framework*, launched in Queensland 2005, adopted tri-level accreditation for teachers to provide evidence of the use of technology in their teaching practices. The three levels were: *ICT Certificate*, the *Digital Pedagogical License*, and the *Digital Pedagogical License Advanced* (Department of Education Training and Employment, 2012a; 2012b). It is important to note that these were conceptualised to reflect pedagogy and digital technologies, as reflected in their naming.

For the *ICT Certificate* level teachers were expected to show understandings of using technology purposefully. The *Digital Pedagogical License* was used to demonstrate and reflect on using technology. Finally, the highest level - *Digital Pedagogical License Advanced*, was designed to show evidence of teachers who lead the transformation of learning through technology (Department of Education Training and Employment, 2012c). Embedded in their digital portfolios, teachers provided evidence of their values, relationships, knowledge and practice.

This SCPDF was successful, as shown in Table 1 by 2010 over 13,500 teachers had completed and

submitted a digital portfolio (O'Hagan, 2010). Within two years, over 25000 teachers had completed and submitted a digital portfolio (Department of Education Training and Employment, 2012a). With a teaching workforce of more than 40000 teachers in Queensland's state schooling system, this represents a significant growth in their capability with over half of the teaching population providing evidence that they were using technology in their teaching.

Table 1 - Smart Classrooms Professional Development Framework Growth in Capability

Smart Classrooms Professional Development Framework	2006	2010	2012
ICT Certificate	549	11714	22000
Digital Pedagogy License	525	2021	3800
Digital Pedagogy License Advanced	0	54	54

For this research project the Digital Pedagogical License was used as a lens to view how these teachers pedagogically reasoned with technology.

The Digital Pedagogical License (DPL)

The format of the evidence required for the DPL was published as part of the framework. The DPL required the development of a digital portfolio consisting of a variety of items including:

- context statement;
- belief statement;
- evidence (items including unit overviews, assessment tasks, virtual classrooms screen shots, webquest evidence, links to learning objects, lesson plans, photographs, blogs details, student work, recorded lessons, audio recordings, national testing data, resources and grading examples); and
- a support statement from their principal or delegate.

The objective of the DPL was to acknowledge teachers who demonstrated and reflected on how learners use technology purposefully (Department of Education Training and Employment, 2012c) as a collection of “carefully selected or composed professional experience, thoughts and goals that are threaded with reflection, evidence and self assessment” (Department of Education Training and Employment, 2012b). Each candidate for the DPL was required to discuss and present two or three items of evidence depending on the coverage of the indicators.

There were thirteen indicators covering: values; relationships; knowledge; and practice. Teachers were required to map their evidence against these indicators and show that mapping in their evidence. The indicators were embedded to ensure that they were all addressed in order for the certification to be issued. After completion of the DPL, an ‘Accredited Facilitator’ was assigned to access the portfolio before a certificate was awarded. In compiling their digital portfolio, teachers could use various tools including webpages, virtual classrooms (BlackBoard) and wikis.

A Model of Pedagogical Reasoning and Action

This section presents a brief discussion of Shulman's Model of Pedagogical Reasoning and Action, referred to as PRA (Shulman, 1987b). It is briefly discussed because it provides the framework upon which to consider the need for renewal linked to pedagogical reasoning with technology.

Shulman's seminal work (1987b) was his conceptualisation of knowledge base of teaching proposed the Model of Pedagogical Reasoning and Action (PRA). His “view of pedagogical reasoning is from the point of view of the teacher, who is presented with the challenge of taking what he or she already understands and making it ready for effective instruction” (Shulman, 1987, p.14). This thinking is developed “through the process of planning, teaching, adapting the instruction, and reflecting on the

classroom experiences, (teachers) acquire new types of knowledge” (Shulman, 1987, p. 17). The PRA is described in six processes: Comprehension; Transformation; Instruction; Evaluation; Reflection; and New Comprehension. As previously reported in Smart, Sim, and Finger (2013a):

Comprehension is achieved when teachers understand what they are going to teach. Transformation is about transforming the content into a format that will motivate the learner. Shulman suggests the following processes for Transformation: Preparation; Representation; Selection; and Adaptation. Instruction is the act of teaching including the many aspects of pedagogy including “organizing and managing the classroom; presenting clear explanations and vivid descriptions; assigning and checking work; and interacting effectively with students through questions and probes, answers and reactions, praise and criticism” (Shulman, 1987a, p. 117). Evaluation is completed as teachers check for student understanding. Reflection is what teachers do when they “look back at the teaching and learning that has occurred, and reconstructs, re-enacts, and/or recaptures the events, the emotions, and the accomplishments” (Shulman, 1987a, p. 117). New comprehension are gained when the teacher identifies improvements in the teaching and learning processes, that is their new understanding of what works and what doesn’t. (p. 2)

For this study, we emphasise that Shulman’s PRA was developed well before the emergence of the digital technologies, including the Internet enabled connectivity and its associated possibilities for learning and teaching. Therefore, while PRA is used as a basis for understanding teacher pedagogical reasoning in making decisions about using technology in the complex process of teaching, we also draw upon the work by the authors (Smart, Sim, & Finger, 2012; Smart et al., 2013a; Smart, Sim, & Finger, 2013b) and Finger and Finger (2013) in suggesting that PRA is no longer sufficient, and that teachers engage in pedagogical reasoning with technology.

Summary of the research design of this study

This research presented in this paper is part of a wider doctoral research project that has been designed to answer the following research questions:

- *how do teachers pedagogical reason with technology? and*
- *what influences their development of technological pedagogical reasoning?*

The teachers selected for this study were considered to be technology-using teachers who had developed a digital portfolio. They reflected diverse teaching contexts, and were at differing points in their teaching careers. Project data have been collected from video-stimulated recall interviews, think-aloud interviews and concept maps. In accordance with university policy, prior to the study commencing, ethical clearance (EDN/89/11/HREC) was obtained.

Findings from the wider study will be presented as a multiple case study design whereby each teacher will represent one case. Each case will include the teacher’s digital portfolio. Case studies “are strong in reality...because case studies are down to earth and attention holding, in harmony with the reader’s own experience, and thus provide a natural basis for generalisation” (Cohen, Manion, & Morrison, 2011, p. 292). While conclusions drawn from this small qualitative study may lack statistical significance, the insights gained from the number of case studies will add to the growing body of literature on teachers’ pedagogical reasoning with technology.

The digital portfolios were analysed using Shulman’s PRA as a theoretical frame and has been reported by the authors (Smart et al., 2013a, 2013b). This paper provides a detailed description of the mapping of one individual teacher’s digital portfolio. As previously published in an International Society for Technology in Education (ISTE) conference paper (Smart et al., 2013a), Table 2 contains a revised example of the mapping of Shulman’s PRA to the DPL headings for a new teacher - Carmelina. A portion of the table has been reproduced below to show an example of this mapping.

Table 2 – Revised Example of the mapping of Shulman’s Model of Pedagogical Reasoning and Action to the DPL Evidence Item Headings

Shulman's Model of Pedagogical Reasoning and Action (PRA)	DPL Evidence Item Headings
Comprehension – Understand what is to be taught <i>Of purpose, subject matter structures, ideas within and outside the discipline</i>	1. Title 4. Year level and student context 5. Item Overview 6. Reason for inclusion 7. Development and planning 8. Curriculum links 9. Central focus of the student learning (curriculum intent) 11. Teaching and learning approach

Evidence from one teacher - Carmelina

Carmelina has been selected for review and discussion in this paper. Carmelina has been teaching for over 20 years in a primary school setting. She would be described as a highly accomplished teacher and is recognised in her school as such. She has previously held technology leadership responsibilities in her school, and she is informally responsible for mentoring teachers to use technology. She had first prepared her digital portfolio in 2009 and significantly updated it, when renewing it in 2011. Carmelina has provided two pieces of evidence in her digital portfolio, and this has been mapped to the PRA as shown in Table 3. The text in italics is taken directly from her digital portfolio.

As shown in Table 3, there is evidence across all aspects of the PRA. This supports and extends what has been previously reported by the authors (Smart et al., 2013b) and provides evidence that the PRA is valid. However, as Shulman's original work was published over twenty-five years ago and before technology becoming so prevalent, the evidence shown incorporates digital technologies and pedagogy. Consequently, the key question is whether or not PRA is still valid. We suggest that PRA is now insufficient, and along with the expanding TPACK (Mishra & Koehler, 2006) literature research which builds upon Shulman's Pedagogical Content Knowledge, we agree here with Finger and Finger (2013), and to build upon the work of Starkey (2010) outlined in her paper *Teachers' pedagogical reasoning and action in the digital age*, and Smart et al. (2013) in proposing a Model of Pedagogical Reasoning with Technology.

For teachers, the use of technology can be add on to existing practices, or it can transform existing practices (Finger, Russell, Jamieson-Proctor, & Russell, 2007). The evidence shown in Carmelina's digital portfolio highlights this teacher's transformational use of technology by incorporating Learning Contract (Item 1) and Science Unit (Item 2). Carmelina's key argument for this approach is to provide differentiation for her mixed ability students plus the class being a 1:1 laptop class where all students used their own school defined but individually purchased laptop. Both items of evidence show a redesign of the teaching approach from instruction through to evaluation with the use of technology. This is supported by Teacher-Carmelina's discussion of her beliefs of using technology in her teaching.

Transformational learning occurs when there is a fundamental shift in learner's worldview, which leads to profound changes in the learner themselves, not just their thinking. ... I advocate purposeful digital pedagogy to teachers and students and support others in this endeavour. (Carmelina – Digital Portfolio - Belief Statement)

Conclusion

Proposing a Model of Pedagogical Reasoning with Technology (PRT)?

This paper has presented a sample of evidence to show support for Shulman's PRA as found in this teacher's digital portfolio. The digital portfolio was created to show the knowledge, values, relationships and practices of using technology and, in particular, the opportunities this teacher has taken to transform her teaching with technology. However, it is clearly evident that digital technologies have

implications for the way in which teachers undertake their pedagogical reasoning, which builds upon PCK /TPACK and PRA/PRT. Therefore, is the PRA still appropriate or do we need a new model incorporating technology as Pedagogical Reasoning with Technology? The contribution that this paper makes is to raise this question and to propose that further research needs to be undertaken to explore the proposal here for a Model of Pedagogical Reasoning with Technology.

Digital portfolios

This research upon which this paper is based has demonstrated how practising teachers are using digital portfolios for provide evidence for professional purposes, such as the SCPDF accreditation and career development. These digital portfolios were not based on professional standards but a consistent framework based on items of evidence to enable them to be peer reviewed. In examining the nature of the evidence included and the ways in which teachers explain the purpose of the evidence, the study is identifying specific factors that align with a model for pedagogical reasoning but include of course, a focus on the use of digital technologies.

It is suggested that digital portfolios should be viewed as a career-long and lifelong investment from graduation, registration, and career promotional advancement in developmental and leadership career stages, and not as separate digital portfolios, but conceptualised and supported as a continuous process of reflection and renewal. While the technology platform might change, such as the use of social media such as LinkedIn, the teacher has a sense of agency to update, review and improve their digital presence and portfolio.

The format for this type of digital portfolio has no linkage to the professional standards. We suggest that in Australia, the format and approach for preparing any digital portfolio could also be conceptualised according to the *Australian Professional Standards for Teachers* (AITSL, 2011). This would facilitate a digital portfolio development that not only responds to a nationally recognised representation of the work of those teachers, but can develop evidence to contribute to a clearer understanding of what constitutes the career stages of the 21st century teaching profession. In this way, the digital portfolios that include reference to the professional standards would provide comprehensive evidence of what is important to become a quality teacher. Teachers could map the standards to their digital portfolio responses. This would also provide them with a means to identify opportunities to expand their knowledge and experiences and for others to easily see that they have addressed all focus areas.

In Queensland, the system established to support the *Smart Classrooms PD Framework* was effective in promoting teacher engagement with many teachers across the state preparing a digital portfolio and a network of people to mentor and assess those digital portfolios. Disappointingly, due to a change in Government and subsequent budget cost cutting, this program was no longer funded to continue in the established format. Though some schools and regions have decided to encourage teachers to continue, in general, in 2014, it has lost momentum across the system and the references to the DPL on the SCPD website have been removed. There is now the assumption is that technology is embedded in their teaching, because of the new Australian Curriculum (which is now also being reviewed). This assumption is problematic, and considerable work is suggesting that TPACK capabilities require significant development in an era where PCK and PRA are insufficient. As this paper concludes, it is proposed that TPACK might be enhanced through the development of Pedagogical Reasoning with Technology.

Table 3 – Teacher-Carmelina mapping of evidence to Model of Pedagogical Reasoning and Action (MPRA)

	DPL Evidence Item	Teacher – Carmelina Item 1	Teacher – Carmelina Item 2	PRA
1	Title	Integrated learning contract using Microsoft OneNote	Its electrifying - A science unit	Comprehension
2	Date of implementation	2011	2011	Instruction
3	Evidence	OneNote/Photo/Screen shots/Work samples/Curriculum documents	Unit Plan/Photostory/Childs work sample Virtual classroom/Class blog	Instruction Evaluation
4	Year level and student context	Y5 -eLearning class/Gifted and talented focus school where differentiation is school policy	Y5 -eLearning class/Gifted and talented focus school where differentiation is school policy	Comprehension Adaptation
5	Item overview	Learning contract covering learning for one month	Science unit – concept of electricity and simple circuits.	Comprehension
6	Reason for inclusion	• Use of digital technology allows for differentiation very effectively with the use of open ended software. • Students were able to work independently. • Assist with support staff as task was set up with clear instructions.	Example of work that has used online community for collaboration and sharing.	Comprehension Preparation Representation Instructional Selection Adaptation Tailoring
7	Development and planning	• Having a master of the work proved invaluable as I could spend the majority of my teaching time supporting the children and not on sending, saving distributing or creating resources for the class.	• Used agreed learning materials for year level. • as a 1-1 eLearning class we had the ability to provide a wider range of resources and response tools.	Comprehension Preparation Representation Instructional Selection Adaptation Tailoring Evaluation
8	Curriculum links	• School is a gifted and talented focus, school differentiation and productive pedagogy is a planning consideration	• State based essential learning for Science and ICT.	Comprehension Preparation

9	Central focus of the student learning (curriculum intent)	Differentiation	- Science - ICT tools for collaboration and learning	Comprehension Preparation Representation Instructional selection Preparation Representation Instructional Selection Instruction Comprehension Preparation Representation Instructional Selection Adaptation Tailoring New Comprehensions Reflection New Comprehensions
10	Sequence of learning	Detailed lesson sequence	Embedded in learning	
11	Teaching and learning approach	- The learning contract is a purposeful way to scaffold differentiated learning. - This item clearly shows my belief in teaching and learning for a purpose and that digital devices are to be used as tools to drive and support learning.	- Whole class instruction - Group work - The virtual classroom community became a place where learning could occur at school and at home. The class could use the learning objects and blog entries to contribute to their homework log and even involve family in the learning experiences.	
12	My learnings	...effective tool to structure the content and learning experiences. - Children requiring support found the flexibility a challenge at the start of the contract as they tried to complete activities they considered “fun” to the exclusion of learning they found challenging. - OneNote itself proved to be a very successful tool to differentiate the learning tasks, however on reflection I would have introduced the OneNote contract as a smaller learning experience initially as a maths investigation. - OneNote has been so successful...I have already planned next terms maths investigation...	- The unit was very successful as it engaged the children and allowed them to collaborate in a safe environment. - Some student literacy issues when contributing to a blog ...I would buddy them with another learner for support - Overall the unit is interactive, interesting and the students rate it as one of their favourites in the year.	
13	Further reflections and information	I have been asked to share my experience with OneNote in a web conference to eLearning Facilitators on transformational learning in term 3 this year.	- Looking forward to using new ICT learning tools. - The unit could be negotiated with higher-level learners ...They could have a journal of their learning possibly in OneNote and contribute to a blog as proof of their learning.	Reflection New Comprehensions

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DEADLY REMOTE TEACHER EDUCATION BY MOBILE DEVICES

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Abstract

This paper reports preliminary findings from ongoing PhD research which is investigating how Aboriginal and Torres Strait Islander pre-service teachers view the use of mobile devices for their studies while living in remote communities.

Participants come from two community-based Initial Teacher Education (ITE) programs in Queensland and South Australia. Qualitative data from individual interviews and focus groups indicates many of these pre-service teachers see the use of mobile devices as an innovative approach to learning which personalises their study by enabling them to participate at times and in places they find most convenient. Engaging features of mobile devices appear to contribute to students' spontaneous participation in elements of their course. Pre-service teachers indicate use of mobile devices gives freedom from pursuing their course only in a designated study centre. Life events sometimes prevent them attending study centres, yet mobile devices are seen to grant pre-service teachers flexibility to continue their study.

This research is important as it aims to generate new knowledge about reasons for and hindrances to the uptake of mobile devices in community-based ITE programs for Aboriginal and Torres Strait Islander people in remote communities.

In Aboriginal and Torres Strait Islander slang if someone is 'deadly', it means that person is highly skilled, and to be admired – such a person is very good at what he or she does. An expression of this were 'The Deadlys', which, until 2014, were Australia's National Aboriginal & Torres Strait Islander Music, Sport, Entertainment & Community Awards, and recognised the elite in their fields. The research presented in this paper investigates how the use of mobile devices for Initial Teacher Education (ITE) for Aboriginal and Torres Strait Islander people in Community-Based Programs in remote communities could enhance teacher training, so that in the eyes of the pre-service teachers, it is 'very good' or 'deadly'.

Higher Education Institutions which offer Community-Based Programs work in partnership with the Education Department and / or TAFE in their jurisdictions to provide designated classrooms as study centres in remote communities. The study centre holds an array of resources specific to the Community-Based Programs as well as general study facilities such as desk top computers with Internet access. Only pre-service teachers enrolled in a Community-Based Programs may use the study centre. A supervisory teacher is dedicated to assist the pre-service teachers with their study, and coordinates the use of the study centre on a daily basis. This person lives in the community for the duration of the academic year. Two Community-Based Programs have operated for twenty five years; one in South Australia the other in Queensland. Most of the pre-service teachers in these two Community-Based Programs live in the yellow area of the map in Figure 1 on the following page.

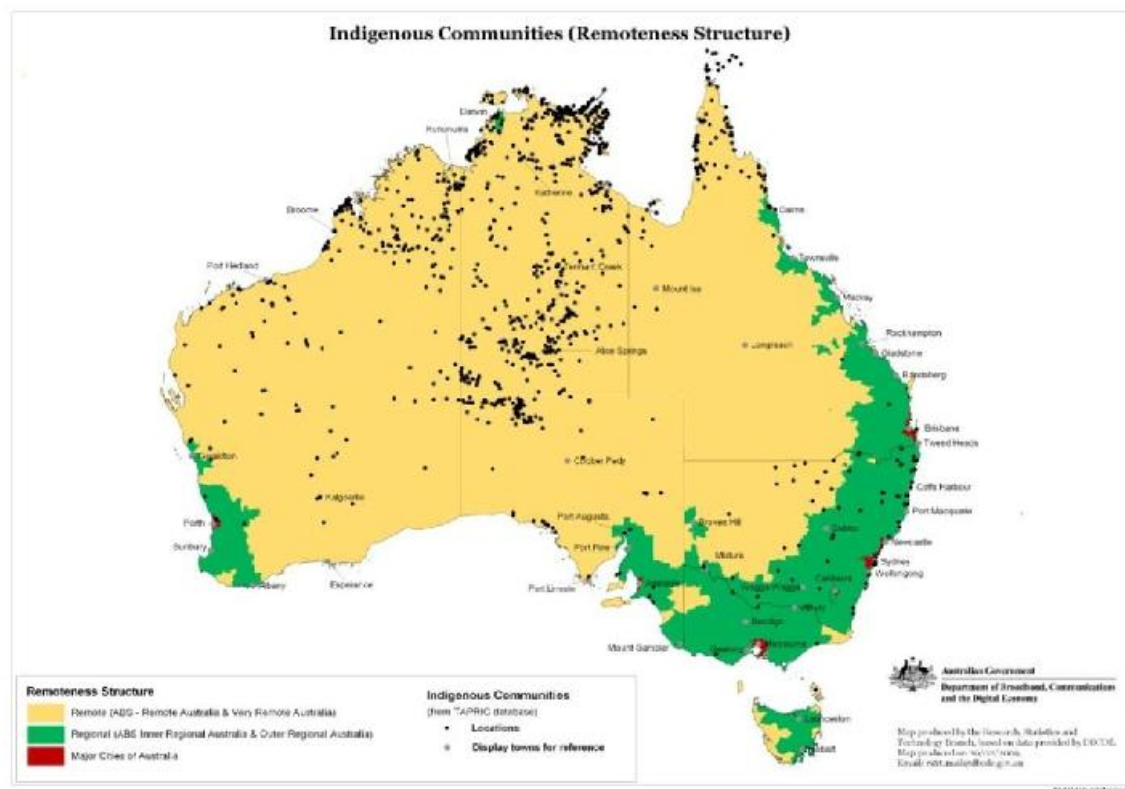


Figure 12: Map of Indigenous Communities (Remoteness Structure), Source: (DBCDE, 2009)

A range of international agencies and organisations advocate the use of Information and Communication Technologies and endorse the potential of mobile technologies for education generally, for remote situations specifically, and for ITE and Continuing Professional Development of teachers. The issue of mobility and access to ITE training in remote contexts occurs globally, and some of these pre-service teachers participate in online segments of their courses by mobile devices. Vosloo argues “There is a significant opportunity to more fully explore how mobile technology can support teachers and contribute to their training, motivation and retention within the teaching profession” (Vosloo, 2012, p. 35). The research for this paper fits with these international trends in teacher education. Moreover, at a national level, government policies foster the use of Information and Communication Technologies across the education sector – for ITE trainees, teachers and school pupils. Hence, current Aboriginal and Torres Strait Islander pre-service teachers in remote communities are required to utilise Information and Communication Technologies in their professional study. This research investigates the views of such pre-service teachers regarding the integration of mobile devices within their courses.

As mobile network coverage has increased across Australia, Aboriginal and Torres Strait Islander young people in remote communities are using *Facebook*, *YouTube*, making online purchases, doing Internet banking, and using a range of other services, and “are skilled and clever participants in both the local and global world, enacting an expertise that is recognised both in their remote home communities and increasingly in the outside world” (Kral & Schwab, 2012, p. 51). Such expertise means that many of the pre-service teachers are themselves already ‘deadly’ users of mobile devices. These pre-service teachers may be called Global Digital Nomads – people who connect to the Internet through a variety of mobile devices anywhere, anytime. Do these pre-service teachers want to use mobile devices in their professional study? If the course providers facilitated the use of mobile devices in the ITE courses, would that mean the pre-service teachers would see the course as ‘deadly’?

The context of Aboriginal and Torres Strait Islander remote communities

The research focusses on Aboriginal and Torres Strait Islander pre-service teachers living and studying in remote communities. It would be an essentialist caricature to suggest that all Aboriginal and Torres Strait Islander groups were identical in their historic cultures or contemporary lifestyles. Nevertheless, a number of commonalities exist among remote communities which provide the unique context and interplay of factors affecting the uptake of mobile devices.

Nakata points out

For many Indigenous students and lecturers, regardless of their distance from what we understand as “the traditional context”, the Indigenous epistemological basis of knowledge construction and the ways of “doing” knowledge are not completely unfamiliar. These are embedded, not in detailed knowledge of the land and place for all of us perhaps, not perhaps in environmental or ecological knowledge, but in ways of story-telling, of memory-making, in narrative, art and performance; in cultural and social practices, of relating to kin, of socialising children; in ways of thinking, of transmitting knowledge, even in creolised languages; and in that all encompassing popular, though loosely used term, “worldview”, and so on. (Nakata, 2007, p. 10)

In addition, mobility within and between remote communities and other population centres is an enduring aspect of contemporary lifestyles (Dockery, 2014). The uptake of jobs in remote communities for some industries by Aboriginal and Torres Strait Islander people living in remote communities is relatively low. Similarly, Year 12 completion rates among Aboriginal and Torres Strait Islander school children in remote communities is below the national average (Guenther, 2013).

Australia’s 3G network was launched in April 2003. Since then 4G has been added and a National Broadband Network and associated satellite services has commenced (though the final shape of this remains unclear). As mobile network coverage increased, Aboriginal and Torres Strait Islander people in numerous remote communities spontaneously engaged with mobile devices and now enthusiastically use them for social purposes. As Kral states, “...communication via mobile phones and social networking has rapidly become the norm for Indigenous youth who have access to the new telecommunications infrastructure at home or in school” (Kral, 2014, p. 1). Many Aboriginal and Torres Strait Islander pre-service teachers in remote communities own and skilfully use mobile devices for personal reasons. It is anticipated that mobile services in remote communities will improve in coming years through a variety of emerging technologies. So too, it is expected that Higher Education Institutions will increasingly utilise mobile devices for teaching and learning (Johnson et al., 2013; Johnson, Adams Becker, Estrada, & Freeman, 2014).

Background about ITE

National reports on Aboriginal and Torres Strait Islander peoples’ participation in higher education generally (Behrendt, Larkin, Griew, & Kelly, 2012), and ITE specifically (Patton, Hong, Lampert, Burnett, & Anderson, 2012) note Aboriginal and Torres Strait Islander peoples’ access, retention, success and completion rates in higher education are generally below those of the rest of the Australian population. ITE is the third highest field of participation for Aboriginal and Torres Strait Islander university students (DIISRTE, 2013). Two national undertakings have been shaping issues regarding Aboriginal and Torres Strait Islander education and affecting ITE. The first is the ‘Aboriginal and Torres Strait Islander Education Action Plan 2010-2014’; the second is the ‘More Aboriginal and Torres Strait Islander Teachers Initiative’ (MATSITI).

This paper reports on qualitative interviews and focus groups with students in two Community-Based Programs. AnTEP (Anangu Tertiary Education Program) began in 1984 in order to train local teachers for communities in the Anangu Pitjantjatjara Yankunytjatjara Lands of north-west South Australia (Edwards & Underwood, 2006). RATEP (Remote Area Teacher Education Program) commenced in 1990. Initially designed to train Torres Strait Islanders as teachers, students from a variety of remote,

regional and rural locations in Queensland now participate (Osborne, 2003). Both courses provide the ultimate end point of a university degree. However, not all students who begin these courses are aiming to progress that far. Each course has recognised exit points along the way. Data from RATEP covering the period 2007-2011 indicates a completion rate of about 15% (Mitchell & Linkson, 2012). AnTEP completion rates are anecdotally reported as very low.

This raises a question: Might the use of mobile devices in these Community-Based Programs, endorsed and facilitated by Higher Education Institutions, contribute to enhanced retention and completion rates and thereby increase the number of registered Aboriginal and Torres Strait Islander teachers who could be employed in remote community schools? The research addresses the perceptions of Aboriginal and Torres Strait Islander pre-service teachers from remote communities about the use of mobile devices in their professional learning.

Methodology

This investigation uses a Mixed Methods Research approach which integrates both qualitative and quantitative data (Tashakkori & Teddlie, 2010). Aboriginal and Torres Strait Islander pre-service teacher volunteers from the two Community-Based Programs and some Aboriginal and Islander Education Workers not enrolled in an ITE course participated in semi-structured face-to-face interviews as individuals or in focus groups. Interviews were conducted in English with audio recording from which transcripts were made. Details are shown in Table 1 below. Quantitative data collection has not yet commenced.

Table 1
Sites and Nature Of Qualitative Data Collected

Site	1	2	3	4	5	6	7	8	9	1	1	1	1	1	1	N
										0	1	2	3	4	5	
Individual interview	1	2	4	3	5		1	1	1	4	2	1	1		1	27
Joint interview	2					1				1	1	2	3	6	2	18
Focus Group			1									1	1	1		4
Total participants	5	2	4	3	5	2	1	1	1	6	5	6	1	7	6	64
													0			

Data was obtained from fifteen sites: five in South Australia and ten in Queensland. Joint interviews comprised of two or three people. Focus groups had four or more participants. Overall there were 64 informants. A set of thirteen questions were used in the interviews. Participants could choose not to answer all questions and withdraw at any time. The researcher sometimes elected not to discuss a question if the content area had already been covered under a previous question, or if there was a time limit on the interview. The focus of this paper is on participants' perceptions of personalisation of their learning through the use of mobile devices.

Results – Initial findings

The main early finding arising from the data is that many of these Aboriginal and Torres Strait Islander pre-service teachers in remote communities want to use mobile devices in their study. In the case of Community-Based Programs students in Queensland, most of them are already doing so. The reason is that they see the devices as facilitating the personalisation of their learning. They indicate this happens through the features of mobile devices and the affordances they provide, such as freedom and flexibility. These perceptions are summarised in the following quote from a respondent: "Mobile is flexible: anytime, anywhere." These aspects of learning through mobile devices will be presented with a selection of quotes.

Features of mobile devices are engaging and personal

The portability of mobile devices means they are constantly with the pre-service teachers – in their hand, pocket, or bag. This lessens the distinction of the device as an object ‘over there’ to almost becoming a part of the person, as articulated in the following quote: “[A] desk-top feels more professional ... sort of like an object, but this is like a personal thing.” One pre-service teacher stated that mobile devices are easier to use than desk-top computers: “Mobile devices are just easier. [They have] more comfortable settings.” In particular, touch screens are perceived as intuitive and appealing, as suggested by another research volunteer: “That’s why Smartphones are so popular, because [of the] touch screen. So [a] touch screen ... it’s personal to you.” Another student teacher expressed the idea that a relaxed posture can facilitate learning: “When I am on a desk top computer trying to look up, say, Maths homework ... I can’t do it, but if I sit out here on the iPad, it’s easy for me, and it’s also interactive.” These quotes indicate that portability, tactile functionality, multiple postures in use and interactive software are features of mobile devices which make them engaging and personal to pre-service teachers in community-based ITE programs in remote communities.

Mobile devices enable freedom from being bound to the study centre

The usual mode of delivery of courses via Community-Based Programs has been through a study centre. These rooms contain resources including desk top computers, which are used for accessing online materials, live-streaming of sessions with lecturers and writing and uploading of assignments. Participants believe use of mobile devices gives them freedom to pursue their learning away from the study centre. One pre-service teacher said: “If you have that motivation, you can do it anytime, anywhere.” Another respondent remarked: “I wouldn’t be so tied in physically to [the study centre].” Some pre-service teachers work full time, and are able to get to the study centres only for limited periods. Using mobile devices bypasses the issue of business hours access, as mentioned by one participant: “I have a laptop that I use at home for when I can’t make it in.” Family commitments may mean time away from the study centre, yet study can continue with a mobile device: “When I take my son to football training he’ll be out on the field and I can be sitting there doing my study.” Other pre-service teachers prefer to be outdoors and feel that their learning is enhanced in relaxing settings:

If I had a laptop I could choose anywhere I’d like to study. I could be on a beach. If you can put yourself in a place that’s very very tranquil where you can allow your mind to free associate, you’ll find that you’ll get more clarity.

The comments cited suggest pre-service teachers like the freedom and agency to choose a variety of places where they study. They now are not restricted to only one site – the designated study centre.

Mobile devices facilitate flexibility when facing barriers to learning

Participants indicated a range of situations in which they could continue their study when not at the study centre, as expressed in the following scenarios. Employment limits access to the study centre and so study has to be done at night after other family members have gone to bed. When asked when she did her study, one pre-service teacher reported: “Every night until about three o’clock in the morning.” Health issues (including sickness or injury to self or relatives, pregnancy, and funerals) may mean a pre-service teacher is unable to attend a study centre and could be absent from the community. Use of a mobile device allows study to continue. One person indicated “When the children are sick I use the laptop at home.” Participation in cultural activities (such as religious ceremonies) may mean the pre-service teacher is away. Similarly, involvement in meetings with various agencies (relating to health, law and order, art, tourism, land rights, and mining developments) can interrupt study. Use of mobile devices gives pre-service teachers autonomy over the time they choose to study – it is not restricted to business hours / ‘clock times’.

The data discussed above suggest three factors that foster the personalisation of learning through the

use of mobile devices, as perceived by Aboriginal and Torres Strait Islander pre-service teachers in remote communities. The following section explores possible responses from the Higher Education Institutions that offer the Community-Based Programs.

Discussion

This research found that many Aboriginal and Torres Strait Islander pre-service teachers in remote communities are already using mobile devices in their ITE study. They took the initiative to do so. Course providers had not made the use of mobile devices mandatory, yet students in these courses experimented with ways of integrating them into their study. Given the desire of Aboriginal and Torres Strait Islander pre-service teachers in remote communities to use mobile devices in their study, four possible implications for Higher Education Institutions will be discussed briefly. These include access to and ownership of mobile devices, cost of Internet services and mobile telephone usage, observation of classroom Professional Experience, and use of social media to foster formation of digital Communities of Learning, and personal encouragement.

Access to and ownership of mobile devices

Many Aboriginal and Torres Strait Islander pre-service teachers in remote communities use their own money to buy mobile devices. These student teachers believe they have an advantage over other students in the course. Many of those who do not currently have mobile devices would like to have them to assist in their study. RATEP has provided a tablet to each site to be shared by course students, specifically to complete a module about the use of tablets. It is meant to be used only on-site. RATEP has occasionally provided a laptop on loan to some isolated students who are not based at a study centre. AnTEP has issued one or more laptops to each site for use in the learning centre. Research participants know that in recent years every secondary school student in Years 9-12 was issued with a laptop as part of the national government's Digital Education Revolution, and some schools are continuing this policy. Some universities in Australia provide free tablets to all enrolling undergraduate students or to specific cohorts. However, neither AnTEP nor RATEP has issued mobile devices free to all Community-Based Programs students. Issues of equity and access between students in these Community-Based Programs courses, and also between Community-Based Programs students and students in other courses are relevant. During the research pre-service teachers raised several questions for course providers about mobile devices, such as: Could the Higher Education Institution (HEI) issue a common device free or on hire to all students in Community-Based Programs? Could the HEI offer cash subsidies to Community-Based Programs students towards purchase of either a prescribed device or one from a designated list of devices? Could the HEI encourage the Community-Based Programs students to Bring Your Own Device (BYOD)?

Cost of Internet services and mobile telephone usage

Presently, pre-service teachers themselves pay for Internet services and mobile telephone usage on their mobile devices. If however, they use the desk-top computers in the study centre, they do not have to pay, as the fees for such services are covered by the Community-Based Programs provider. Most study centres have Wi-Fi capability and it is technically possible for students' personal mobile devices to be connected to this. However, in practice, this appears not to have happened in a consistent fashion. Hence, even if pre-service teachers bring their own devices to the study centre and use them there, they are still incurring a cost personally. RATEP has provided Internet dongles with laptops to some off-site students. Browsing the Internet for resources, participating in Collaborate or Elluminate sessions, and listening to podcasts are data intensive activities which quickly expend a student's Internet credit. Thus if pre-service teachers make use of mobile devices for study purposes they are financially disadvantaged. While interviews were being conducted pre-service teachers identified several questions that could be considered by course providers, such as the following: Is the cost of using mobile devices solely the students' responsibility? Could the Higher Education Institution (HEI) issue pre-paid dongles to pre-service teachers? Could the HEI offer cash subsidies to students

towards such costs? Could the HEI arrange special provisions with one or more telecommunication providers?

Observation of classroom Professional Experience

An increasing trend internationally is for pre-service teachers participating in Professional Experience internships in schools to video their classroom lessons with pupils (West, 2012). Mobile devices can be used to make videos. These videos may subsequently be perused by the pre-service teacher and supervisory teacher. When isolated pre-service teachers are at distance from the Higher Education Institution and the lecturer is unable to visit that site, these videos may be posted online for the lecturer to view. This provides the pre-service teacher with feedback from not only the supervisory teacher but also the assessing lecturer. The use of videos and online posts in this manner provides significant economic efficiencies for the course provider by saving in travel costs for lecturers to visit remote locations.

Use social media to foster Communities of Learning and Personal Encouragement

Universities use learning management systems, most of which provide a variety of ways to facilitate online Communities of Learning involving lecturers, tutors, and pre-service teachers. Furthermore, there is now a range of social media which can also be used to foster such professional learning among groups. Participants in the research reported the use of telephone calls, SMS, emails and the use of Facebook between pre-service teachers to solicit and provide academic support. Course providers could integrate the use social media within the delivery of the Community-Based Programs, as social media are a favoured mode of communication by many pre-service teachers.

Along with many indigenous cultures globally, Aboriginal and Torres Strait Islander societies are relationship based. Mainstream Western society in Australia may more readily be identified for its emphasis on individualism rather than group orientation. One of the major strengths of the delivery of ITE through Community-Based Programs in remote communities has been the positive relationship between fellow students at that site and their local supervisory teacher. The use of mobile devices for both planned and informal communication between fellow course students and between pre-service teachers and supervisory teachers and lecturers and administrators is likely to strengthen such personal relationships, thereby providing encouragement for pre-service teachers to persevere with their studies. This itself is not unique to a cohort of Aboriginal and Torres Strait Islander pre-service teachers, but does appear to resonate with the importance of relationships to these people in remote communities. Moreover, the use of mobile devices and social media between cohort members from different communities may also heighten a student's perception of self as a member of a group, thereby diminishing feelings of isolation.

Conclusion

This paper has presented perceptions about the personalisation of learning through mobile devices, as described by current Aboriginal and Torres Strait Islander pre-service teachers pursuing ITE through Community-Based Programs in remote communities. Many of them are already skilled, 'deadly' users of mobile devices. The major finding was that many of the pre-service teachers want to use mobile devices for their professional learning. They do so because they see mobile devices have engaging features which bring the learning close to them; they welcome the opportunity mobile devices provide for learning to occur not only at the designated study centre; and they are enthusiastic about the flexibility that mobile devices provide to circumvent potential barriers.

Implications for course providers arising from the strong desire of pre-service teachers to use mobile devices were discussed. In order to improve the delivery of Community-Based Programs and student participation in such courses, the following recommendations to Higher Education Institutions are made: provide mobile devices to pre-service teachers under schemes similar to those for secondary students; provide pre-paid Internet; use mobile devices to video classroom Professional Experience;

and foster social media use to develop digital Communities of Learning and personal encouragement. If these recommendations are followed, then it is likely course providers of ITE through Community-Based Programs for Aboriginal and Torres Strait Islander pre-service teachers in remote communities could enjoy a reputation of providing 'deadly' remote teacher education by mobile devices.

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REDEFINING EDUCATION: 1:1 COMPUTING STRATEGIES IN ENGLISH SCHOOLS

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Abstract

Since 2010 Schools in England have been faced with far-reaching changes in policy, support and funding for digital technology. At the same time there has been an explosion in the penetration of mobile devices into students' homes and 'pockets'. Many English schools have responded to these developments by implementing 1:1 computing strategies. Whilst there is a body of relevant research literature, there is a lack of research evidence about the implementation of tablets in schools and a need to provide robust up to date guidance to inform schools' digital technology strategies. This paper provides a brief overview of the existing literature, including early research on tablets in schools and approaches such as Bring Your Own Device (BYOD). It then focuses on 22 case studies that were carried out towards the end of 2012 to examine a range of digital technology strategies in English schools. These studies, which spanned primary and secondary education, and included two special schools, all utilised the same methodology. A meta-analysis of data across these 22 studies resulted in a set of 'emerging trends' that provide a useful framework for thinking about digital technology strategies, and key 'lessons learnt' which provide practical guidance for schools.

Context

In 2010, there was a change of government in England, which was rapidly followed by substantial changes to education policy and support for ICT in schools. Thus, for example, funding for Becta, the agency that provided support to schools to enhance their use of digital technology, ceased, and the Harnessing Technology Grant, which provided dedicated funding for digital technology in schools was terminated. Over the following years the Minister of Education was highly critical of the teaching of ICT in schools, which he stated was a mess (Gove, 2012), and the National Curriculum and associated assessment criteria for ICT were disapplied. Other changes to how schools were funded resulted in confusion for head teachers about how much money they had available to devote to digital technology and an overall reduction in practical terms. Based on BESA's annual surveys of ICT in schools (BESA, 2009, 2012) there was a reduction in UK state school ICT budgets between 2009/10 and 2012/13 of £44.8million.

Over the same timeframe the technology available rapidly changed, with the emergence of the iPad in 2010, and substantial growth in the penetration of mobile devices in society. Thus, for example, based on major surveys and interviews that were repeated annually from 2009 to 2013 with thousands of parents and children. Ofcom (2013) estimated that there were considerable increases in ownership of smartphones and access to tablets over this time period, as illustrated in Table 1.

Table 1 Percentage of children who own a smartphone and/or use a tablet
(adapted from Ofcom, 2013, pp. 26, 28 & 35)

		Aged 3-4	Aged 5-7	Aged 8-11	Aged 12-15
Smartphone ownership	2011		3%	12%	41%
	2013	0%	1%	18%	62%
	Change		- 2%	+ 6%	+ 21%
Tablet use	2011		2%	6%	6%
	2013	28%	39%	44%	42%
	Change	Up to 28%	+ 37%	+ 38%	+ 36%

In reaction to the changing context, many schools started thinking about mobile technology strategies, and, in particular, the use of tablets. Based on 632 responses to an online questionnaire from members of a stratified sample population of 1,400 schools carried out in April 2013, BESA (2013) estimated that, by the end of 2013, there would be around 260,000 tablets in UK state schools for use by pupils, and that this figure would increase by 170,000 tablets per year over the next two years. Roughly 60% of school staff responding to the survey identified that funding was a major barrier, and whilst 31% of secondary and 63% of primary respondents would prefer for the school to buy and own the devices, 24% of secondary and 7% of primary respondents preferred for parents to pay for the devices.

The use of mobile devices in English schools was not new, and there was a body of relevant research literature, for example, looking at the use of portable computers (including laptops and PDAs) in schools (e.g. Fairfax County Public Schools, 2003; NCET, 1993; Chris Robson, Wagstaff, & Watson, 1990; Stradling, Sims, & Jamison, 1994), Tablet PCs (e.g. Twining et al., 2005), and to a lesser extent, mobile phones (e.g. Naismith, Lonsdale, Vavoula, & Sharples, 2004). There was also a small but growing body of research about the use of tablets (e.g. Burden, Hopkins, Male, Martin, & Trala, 2012; Clark & Luckin, 2013; Heinrich, 2012). However, schools identified the need for further evidence about the impact of tablets to inform their strategic thinking about mobile devices (BESA, 2013). Vital, who were funded by the English Department for Education to support schools in making better use of ICT, commissioned 22 case studies (the Vital Studies) to help address this need. This paper provides an introduction to those Vital Studies and the emerging trends (or dimensions of practice) that developed from them.

Methodology

The methodology for these 22 Vital Studies was based on one used in previous research on the use of Tablet PCs in schools (Twining et al., 2005). For the Vital Studies, this involved up to four days in school, over a period of at least three weeks, between October and December 2012. Table 2 provides a summary of the data sources and methods. For fuller details of the data collection, including copies of the data collection instruments see http://edfutures.net/Research_Strategy.

Table 2 Summary of basic data sources and collection methods
(adapted from http://edfutures.net/Research_Strategy)

Who	Why	How
SLT member	To provide a senior leadership team perspective	Staff questionnaire Follow up interview
ICT Coordinator / Network Manager	To provide information about the digital technology infrastructure within the school and provide a technical/support perspective	ICT Coordinator Questionnaire (including Staff questionnaire) Follow up interview
2 adult key users (usually teachers)	To provide a teacher perspective and enable the researcher to collect data on teaching/learning	Staff questionnaire Observation Debriefing interview Diary Follow up interview
4 pupil key users	To provide a pupil perspective and enable the researcher to collect data on teaching/learning	Portfolio Observation Focus group

Inevitably, due to the pragmatics of the particular contexts, there were minor variations in the data collection across the 22 Vital Studies.

Ethical approval for the research was obtained from the university's Human Research Ethics Committee, and the research conformed with the British Educational Research Association's ethical guidelines for educational research (BERA, 2011).

Data analysis – the emerging trends

The data from the 22 studies were analysed using an emergent themes analysis approach (based on Wong & Blandford, 2002). This resulted in a number of ‘emerging trends’, which were further refined through triangulation with information from the literature. These ‘emerging trends’ are described below.

Provision

Across the Vital Studies, there was a mix of different models of technology provision, which appeared to form a dimension from Labs through to Bring Your Own (BYO) strategies. The main models were:

Lab	Dedicated room with desktop machines. Generally a timetabled or bookable resource for a whole class.
Group sets	Clusters of desktop machines in a class, shared area or department, or sets of mobile devices on trolleys, which are timetabled or bookable.
Class sets	Sets of mobile devices on trolleys, sufficient for every child in a class to have a device, but which are shared with other classes.
1:1 loan	There is a mobile device for each student, which is not shared with anyone else. However, access is restricted in some way (e.g. students can only use them during lessons; students cannot install apps or upload personal music).
1:1 owned	There is a mobile device for each student, which is not shared with anyone else. Every student in a class/year group will have the same specification of device. Students can take the devices home and can customize them to some degree (e.g. install games, upload personal music).
BYOD	Students are allowed to bring their own devices from home to use in school. Students have to register their devices (e.g. provide the MAC address) so that the school can manage access to, and use of the school network.
BYOT	Students are allowed to bring in their own devices from home to use in school. They do not have to register their devices and can use the school network to access the Internet (usually using their individual username and password).

In most cases, more than one model was evident in each of the Vital Studies. For example, Vital Study 16 had a range of provision, including: labs; group sets of PCs, laptops and iPads; class sets of laptops; and BYOD. In a smaller number of cases, only one model was evident, such as Vital Study 7, a primary school in which the computer lab had been replaced by two class sets of Chromebooks on trolleys.

Network

It was clear from all of the Vital Studies that having a robust wireless infrastructure was critical in order to take full advantage of mobile devices. In most cases, this had necessitated upgrades to the existing networking, sometimes adding wireless provision or significantly enhancing the existing wireless network(s). This led to the Network dimension, which consisted of the following categories:

Wired	A hard-wired network, which provides access to the Internet and school servers and services (e.g. shared folders).
Closed wireless	A wireless network, which provides access to the Internet and school servers and services. Only school devices can access the wireless network.
Controlled wireless	A wireless network, which provides access to the Internet and may provide access to school servers and services. Only devices that have been registered with the school can access the wireless network.
Open wireless	A wireless network, which provides access to the Internet. Any device can connect, login may be required using a Username and Password.

Most of the Vital Study schools had a mixture of wired and wireless networks, often having a Closed

wireless network for staff use and a Controlled or Open wireless network for student use. In one case, referred to as Vital Study 17, the school had a separate Controlled wireless network for staff and an Open wireless network for student BYO use. However, the BYO network had been disabled, which meant that students who had brought in their own devices were using their own 3G connections that the school couldn't monitor or filter.

Hosting

Associated with changes along the Network dimension were changes in terms of the services that schools provided and how these were hosted. Four different models of hosting were identified:

Local servers	The school had its own physical servers, which provided shared folders and other services (e.g. MIS)
VLE	The school had a learning platform, which could be accessed by staff, students and sometimes parents. Logging on to the network provided access to the VLE.
Cloud	The school used a learning platform that was hosted 'in the cloud' (i.e. by some other provider) and which required a separate login from the school's network(s).
Cloud +	The school used a range of services hosted 'in the cloud', which required separate logins from the school network and allowed staff and students to mix and match the services they used to meet their needs (i.e. not constrained to one learning platform)

It was not uncommon for schools to have different models for staff and students, for example with staff being able to access local servers for management/admin purposes whilst students and staff used a VLE or Cloud option for 'teaching and learning'. As with the other dimensions, schools often spanned more than one category. Vital Study 12 for example had a VLE (Frog) and used a wide range of other cloud based services (Cloud +), including: Google Drive (document sharing), RealSmart (learning environment including portfolio and self-assessment tools), Vimeo and YouTube (video sharing), Flickr (photo sharing), SoundCloud (audio sharing – used for podcasts), Issuu (publishing prospectus and newsletters), CoverItLive (sharing live events), Wordpress (school website), and Weebly (web site building tool).

Access

This dimension overlaps with the Network and Hosting dimensions, and relates to who can login to access school systems and information (e.g. curriculum resources, students' work) and where they can login from.

Internal	Access is only available from within the school.
External – staff	Staff can login via the Internet. Other people (e.g. students) can only access school systems and information from within the school.
External - registered	Anyone (e.g. staff, students, parents) who has a username and password can login over the Internet.
Public	Anyone can access non-confidential school information, for example curriculum materials or students work, over the Internet.

All the Vital Study schools had public websites, as they are required to do in England. However, some of them went much further than the basic requirement of telling people about the school provision, and provided access to curriculum materials and/or student work over the Internet. In most cases, such material was only accessible to registered users such as parents (e.g. Vital Study 7). Several schools had open student blogs (e.g. Vital Study 4, 7, 13). Whilst a small number published teaching materials, for example, Vital Study 3 shared 'courses' on iTunesU.

Funding

As already noted, funding is a major issue, and this was equally true for the Vital Study schools. A range of models were in evidence, including:

School funded	The school pays for all the digital technology used in the school. This funding might come from specific project funding or commercial sponsorship, but not from parents.
Subsidised	Parents make a (voluntary) contribution towards the cost of digital technology that is used in the school, often in the form of monthly payments over several years.
Hybrid	Parents make a (voluntary) contribution towards the cost of a mobile device for their child, or if they already have a suitable device at home then their child uses that.
Home	Parents buy a mobile device that their child uses in school.

In all cases the school provides the networking infrastructure and some computers. These might be for specialist purposes, for general use, and/or for students' whose parents hadn't paid towards digital technology provision. For example, Vital Study 18 offered a hybrid model in which parents could either pay a monthly donation towards the cost of an iPad provided by the school, or could provide their own iPad for their child to use. Support was provided for parents who couldn't afford either option. In Vital Study 18 all parents agreed to 'on-site management of the device', even if they owned it outright. This leads into the next dimension, Technology model.

Technology model

Whilst many of the other dimensions could have been anticipated from existing literature the Technology model appeared to be 'novel', and emerged explicitly in Vital Study 3 where the head teacher was very clear that he wanted to move from School to Consumer technology.

School technology	All the digital technology and associated services are controlled and managed by the school. E.g. There is a standard 'desktop image' for each mobile device that the school configures.
Consumer technology	Mobile devices (and related services) are managed by the users. E.g. The user controls the installation of apps and configuration of the device.

Most of the Vital Study schools retained a 'School technology' approach, even in some cases where the parents actually owned their children's mobile devices outright, as in Vital Study 18.

Tech Support

It was clear in some of the Vital Studies that changes were taking place in who was responsible for managing and providing technical support for digital technology.

ICT teachers	The ICT teacher/coordinator is responsible for managing and supporting use of digital technology throughout the school, often with the assistance of a (part time) technician, teaching assistant, or external consultant.
Dedicated team	The school employs a dedicated digital technology team (e.g. network manager and technicians).
Digital leaders	The school 'appoints' some students as Digital Leaders, who have roles in supporting the use of digital technology. This may include helping to manage equipment, supporting staff and students in using digital technology in lessons, providing input to professional development for staff, or a range of other roles.
Manage YOT	Staff and students become responsible for managing their own mobile devices. This might range from making sure that devices are charged

overnight to having full responsibility for installing software and getting devices repaired (outside school).

Moving towards a BYO model on the Provision dimension usually involved a shift towards Manage YOT (e.g. Vital Study 2). However, it was also evident in schools that had not moved to a 1:1 or BYO approach. For example, in Vital Study 8, the Digital Leaders were responsible for managing 42 iPads that could be booked out by staff. They ensured that the iPads were returned to their standard configuration after use, delivered devices to classes, and helped their peers use the iPads (and in particular how to share files via WebDav) during lessons.

Pupil role

Being a Digital Leader clearly changed the role of those students. However, there was also evidence of changing student roles in many of the Vital Studies where Digital Leaders were not present.

Consumer	A traditional model of the student as the recipient of knowledge (from the 'expert' teacher).
Independent learner	Students work at their own pace through structured curriculum materials and/or carry out personal or team projects (under the supervision of a teacher).
Co-learner	Students are involved in peer support, which may include explicitly teaching other students. At times they learn alongside and/or teach their teachers.

In almost all the schools where iPads were being used there was evidence of students supporting their teachers with the technology. Often this involved the students in suggesting suitable apps to use for particular tasks, or showing their teachers how to use apps or share files. In several cases, the school was trying to develop their students' independence. For example, in Vital Study 9, where a 1:1 loan laptop scheme was in operation, the students worked independently in some subjects, utilizing self-study materials prepared by the staff, and signing up to attend 'teacher led lessons' when they felt that they needed to. This was accompanied by changes in the role of the teachers.

Teacher role

Whilst many of the Vital Study schools were only a few months into the implementation of their mobile technology strategies, there was evidence of changes in the role of teachers, moving away from traditional practice to teachers becoming learners alongside their students. This was most evident in relation to students teaching staff about apps and how to use them.

Sage on the stage	A traditional model of the teacher as ‘the expert’ who imparts information, directs activity and assesses students’ learning.
Collaborative resource designer & Guide on the side	The teacher prepares independent study materials and acts as a facilitator to students as they work through those materials.
Co-learner	The teacher no longer sees herself as ‘the expert’ and expects to learn alongside the students, and sometimes to learn from the students.

In Vital Study 9, the role of the teachers had changed significantly in some subjects. Staff worked in teams, supporting a whole year-group. Roles included curriculum and resource design, monitoring students’ activity (using PC ‘spy’ software), facilitating independent work, traditional teaching with groups of students, and providing feedback (both face to face, online and via email). Staff in Vital Study 3 talked about learning alongside and from students, though there was little evidence of this in any of the Vital Study schools, except in relation to the use of digital technology.

CPD

A range of approaches to CPD were evident in the Vital Study schools, fitting with the following broad categories of CPD:

Formal CPD	Traditional face-to-face workshops and courses, often run by ‘external experts’ and linked to school or national priorities.
Informal CPD	Generally linked to teachers’ personal concerns and interests and involving approaches such as TeachMeets and the use of Personal Learning Networks.
Learning organisations	Schools where professional development is embedded within the school culture and systems. Involves approaches such as practitioner research.

Nearly all the schools used traditional models of CPD such as hands-on workshops after school. Several of the schools explicitly talked about TeachMeets, for example the ICT Coordinator in Vital Study 4 said that he learnt about Digital Leaders at a TeachMeet, which led him to set up a Digital Leaders Programme in his school. In some cases the implementation of their mobile technology strategy explicitly involved desk research, followed by a pilot roll out to a small cohort of staff and students, prior to the full implementation (e.g. Vital Study 16). A couple of the schools talked explicitly about practitioner research (e.g. Vital Study 17), though it was clear that a cyclical process of trying out an idea, evaluating it, and sharing the outcomes with colleagues was common to many of the schools. Often this involved providing staff with mobile devices to try out and experiment with, before feeding back to colleagues (e.g. Vital Study 20).

Conceptualisation of trends

Figure 1 provides a diagrammatic summary of the emerging trends.

Figure 1. Conceptualisation of Trends

Provision	Lab	Group sets	Class sets	1:1 loan	1:1 owned	BYOD	BYOT
Network	Wired		Closed wireless			Controlled wireless	Open wireless
Hosting	'Local' Servers		VLE			Cloud	Cloud +
Access	Internal	External (staff)			External (registered)		Public
Funding	'School'			Subsidised	Hybrid		Home
Tech model	School technology				Consumer technology		
Tech support	ICT teachers		Dedicated technology infrastructure team			Digital Leaders	Manage YOT
Pupil role	Consumer		Independent learner				Co-learner
Teacher role	Sage on the stage		Collaborative resource designer & Guide on the side				Co-learner
CPD	Formal CPD		Informal CPD			Learning organisation	

This diagrammatic conceptualization of the emerging trends hints at the fact that, as a school changes its position in relation to one of the trends, then it often also changes in relation to the others. However, it is important to note that there is no simple relationship between most of the trends, and, indeed, that the same school may locate itself in more than one position on any one of the trends at any point in time. Similarly, the trends do not say anything about quality of provision, in the sense of suggesting where a school should be aiming to position itself on any of the dimensions. The optimal configuration for any particular school will depend upon the school's educational vision and their particular circumstances.

Conclusions

The emerging trends highlight potential directions of travel that schools might take, based on evidence from 22 case studies in English schools. There is evidence from these Vital Studies about 'what works' and what doesn't when trying to implement changes along these dimensions, which are associated with different possible trajectories. This conceptualisation of the emerging trends, along with the associated guidance (see http://edfutures.net/Digital_technology_strategies), is intended to be used as a tool to support discussion about digital technology strategies in schools. It can be used to guide professional learning, stimulate discussion about resource provision, and enhance school decision-making.

Inevitably, as further research is carried out on digital technology strategies these emerging trends and their associated guidance will change. So they should be treated as starting points for discussion about strategically planning your digital technology strategy rather than blueprints or definitive strategic advice.

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PROJECT 600: INSPIRE, CONNECT AND TRANSFORM

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Abstract

This paper provides an overview of the highly successful Education Queensland Project 600 literacy and numeracy strategic initiative, with more than 19000 students from Years 3-9 being involved since its inception as Project 300 in 2011. Project 600, which aims to inspire, connect and transform student learning through deep engagement, involves Education Queensland's regions choosing a specific area to focus on within their improvement agenda. The Project 600 team then works with the regions to design and implement the initiative, enabled through online learning, guided by the IMPACT model which enables personalised learning. This paper suggests that the IMPACT model makes a contribution to proposing a Model of Technological Pedagogical Reasoning and Action (MTPRA) (see Smart et al., 2013; Finger & Finger, 2013), which builds upon Shulman's (1986; 1987) Model of Pedagogical Reasoning and Action (MPRA). Features of Project 600 are summarised, including the recruitment of high performing teachers who form an expert team, their training and ongoing coaching and mentoring, engagement for school leaders and parents, and strategies for disseminating Project 600 within schools. Subsequently, this paper presents a summary of some key findings, which reflect Education Queensland's Performance Monitoring and Reporting Branch (PMRB) reporting "Our findings were that participation in Project 600 – Year 5 Numeracy 2013 significantly increased student results in the Year 5 NAPLAN Numeracy Test in 2013". In addition, PMRB reports that "Project 600 has also been successful in terms of NAPLAN data in other regions." Importantly, this paper provides insights from students which collectively portray Project 600 as 'awesome'.

Introduction

As outlined in the *Horizon Report K-12 2103 Edition* (Johnson et al., 2013), schools are situated within contexts in which education paradigms are shifting to include online learning, hybrid learning, and collaborative models, and the abundance of resources and relationships are made easily accessible via the Internet is challenging us to revisit our roles as educators.

These trends are occurring in an increasingly networked world, where "having the ability to network with others, share original thoughts and creations, and work together will only become more important in the future, as will tools to leverage the power of community members, students, and others to contribute within schools" (Illinois Institute of Design, 2007, pp. 24-25).

However, Davidson and Goldberg (2009) argue that "our institutions of learning have changed far more slowly than the modes of inventive, collaborative, participatory learning offered by the Internet and an array of contemporary mobile technologies" (p. 9). Selwyn (2013) goes further in suggesting

that “the primary significance of the information age and network society is one of globally networked power” (p. 4) and that, “This new world economic order is seen to be founded upon globally networked processes that are fast-changing, flexible and based around ephemeral rather than material ‘content’” (p. 4).

This paper, focusing on the Project 600 initiative, is positioned within those trends and takes into account the importance of proposing models of schooling in a networked world (Illinois Institute of Design, 2007; Davidson & Goldberg, 2009; Lee & Finger, 2010; Johnson et al., 2013; Selwyn, 2013). An overview and description of Project 600, which is a technology enabled literacy and numeracy strategic initiative, is presented.

Subsequently, the IMPACT conceptualisation which guides Project 600 is discussed through aligning IMPACT with relevant TPACK literature (Mishra & Koehler, 2006; 2008; Starkey, 2010) to inform a proposed Model of Technological Pedagogical Reasoning and Action (MTPRA) (Smart, 2013; Finger & Finger, 2013). The paper concludes with a discussion of future directions for Project 600, and the case is made for Education Queensland to build capacity through formalising this model at a systems level.

Project 600 - Background and project features

Project 600 was designed on the assumption that students in almost any location across Queensland could benefit from the strategies and skills taught by an expert teacher. Consequently, the first project called Project 300, as it involved 300 students, was conducted in 2011. It was conceptualised to capitalise upon networked technologies, whereby an expert teacher could design and deliver targeted and highly interactive lessons to students online.

Due to its success, there was a scaling up of that project and the next project was called Project 600, as it involved 600 students. Due to the collegiality of those involved, the ‘brand’ Project 600 seems to have taken hold, even though subsequent projects have included more than 600 students. Metropolitan Region and North Coast Region have re-named their version of Project 600 as Project U2B, referring to the Upper 2 Bands of NAPLAN results.

To participate in Project 600, Education Queensland Regions choose a specific area to focus on according to their improvement agenda, such as Year 5 Reading for average students, or Year 9 Numeracy for above average students. Project 600 focuses on literacy and numeracy for average to above average students. These students are regarded as being at risk of plateauing and Project 600 provides them with an opportunity to deeply engage in learning and boost their achievement.

The Project 600 team then works with the region to:

- recruit high performing teachers from the region who form an expert teaching team;
- train this expert teaching team in project content and online pedagogies and lesson delivery;
- provide ongoing coaching and mentoring including feedback on lesson design and delivery;
- support teachers, teacher aides and school leaders to implement the project at their school;
- engage parents in supporting their child’s participation and progress; and
- coordinate training sessions for schools; e.g. *Project 600 Reading Strategies* or *Online Learning in Your Classroom*.

As shown in Table 1, since 2011, approximately 19000 Year 3-9 students and over 180 expert online teachers from all 7 Education Queensland regions have been involved, with approximately 4700 Year 4-8 students from South East Region involved.

Table 1 Summary of Project 600 Participation 2011-2014

Title	Target	Date	No. of Students	No. of Schools	No. of Expert Online Teachers	Regions***
Project 300	Year 7 Writing and Year 7 Numeracy	March -May 2011	300	19	4	South East Metropolitan North Qld Central Qld
Project 600	Year 7 Writing	Oct 2011-May 2012	600	28	8	South East Metropolitan North Qld Central Qld Darling Downs South West North Coast Far North Qld
Project 600	Year 5 Numeracy	Feb-May 2012	1200	88	8	Metropolitan
Project 600	Year 5 Reading	Feb-May 2012	675	71	9	Central Qld
Project 600	Year 4 Number	Apr-Jun 2012	600	37	6	South East
Project 600	Year 7-8 Reading (Boys)	Apr-Sept 2012	250	20	6	South East
Project 600	Year 6 Reading	July-Dec 2012	600	45	10	South East
Project 600	Year 7-8 Reading	July-Dec 2012	250	19	4	South East
Project 600	Year 5 Numeracy	Feb-Jun 2013	1200	76	8	South East
Project U2B	Year 5 Numeracy	Feb-May 2013	2000	102	12	Metropolitan
Project U2B	Year 9 Numeracy	Apr-May 2013	360	18	2	Metropolitan
Year 7 Flying Start Schools	Year 7 Numeracy	Apr-May 2013	190	3	1	Metropolitan
Project 600	Year 5 Numeracy	Feb-May 2013	550	28	7	Central Qld
Project 600	Year 5 Reading	Feb-May 2013	650	47	9	Central Qld
Project 600	Year 9 Numeracy	Feb-May 2013	100	10	2	Central Qld
Project 600	Year 5 Reading	Feb-May 2013	450	38	6	Darling Downs South West
Project 600	Year 4 Reading	July-Dec 2013	350	27	6	Darling Downs South West
Project 600	Year 4 Maths	July-Dec 2013	700	67	7	South East
Project 600	Year 8 Maths	July-Dec 2013	300	18	3	South East
Project 600	Year 7 Numeracy	Feb-Jun 2014	680	47	8	South East
Project 600	Year 5 Reading	Feb-Jun 2014	1090	97	12	Central Qld
Project 600	Year 9 Reading	Feb-May 2014	750	27	10	Central Qld
Project 600	Year 3 Reading	Feb-May 2014	150	25	2	Darling Downs South West
Project 600	Year 5 Reading	Feb-May 2014	270	41	3	Darling Downs South West
Project U2B	Year 5 Numeracy	Feb-May 2014	900	64	6	North Coast
Project U2B	Year 5 Numeracy	Feb-May 2014	1935	113	12	Metropolitan
Project U2B	Year 7 Numeracy	Feb-May 2014	61	2	1	Metropolitan
Project U2B	Year 9 Numeracy	Feb-May 2014	447	27	3	Metropolitan
Project U2B	Year 4-5 Numeracy	May-Aug 2014	860	59	6	North Coast
Project 600	Year 4 Numeracy	May-Aug 2014	390	49	3	Darling Downs South West
Project 600	Year 8 Numeracy	May-Aug 2014	150	6	2	Darling Downs South West
TOTAL			*19000	**500	*186	-

*Note: A small number of students and project teachers have been involved in more than one project

** Note: Many schools have participated in multiple projects, so the total of 500 is a close estimate if the number of schools

Further projects are being designed for delivery towards the end of 2014 by South East, North Coast and Darling Downs South West Regions. By the end of 2014, more than 21000 students will have participated in Project 600 or Project U2B since 2011.

The project which is the focus of this paper is Project 600 - Year 5 Numeracy – South East Region, conducted from February until June in Semester 1, 2013. This was a joint initiative between Education Queensland's South East Region and the BSDE Regional Projects and Training Team. This project aimed to deeply engage students in learning and boost achievement of students into the NAPLAN Upper 2 Bands in numeracy, according to their Year 3 NAPLAN results in 2011 (Bands 4-5).

Approximately 1200 Year 5 students from 75 schools across South East Region participated in the project. The project's curriculum focus was problem-solving, informed by Polya's problem-solving process of See, Plan, Do, Check and students applied this to various mathematical problems. This mirrored the successful use of Polya's work in Metropolitan Region's Project 600 – Year 5 Numeracy project in 2012. Acknowledgement goes to Metropolitan Region's Teaching and Learning Team for introducing Polya's work to Project 600.

Students participate in one Web Conferencing group session per week at school for the duration of the project using Elluminate in 2011-2013 and Blackboard Collaborate in 2014. Students also access independent consolidation and extension activities via the Virtual Classroom at any time, using Blackboard's Learning Management System. The Project 600 networked, online model enabled the expert teachers and the Project 600 students to have both synchronous and asynchronous access.

The pedagogical conceptualisation guiding Project 600 is referred to IMPACT, which is an acronym for Inspire, Model, Practise, Apply, Connect and Transform. This conceptualisation was developed by Glen Watt, a BSDE Project 600 Team leader, and he recommends the IMPACT model for all subjects across all year levels.

The IMPACT model has also been used as an example of best practice by the Learning Mentors facilitating DEEWR's Integrating ICT Pedagogy in School Communities Workshop in 20 regional and remote locations across Australia.

IMPACT is also used as a learning design by a number of mainstream primary and high schools in Education Queensland's South East Region.

...I think teachers like the model because it provides a simple, yet comprehensive structure. ...importantly, it provides the teacher with flexibility. The amount of time devoted to each step and the sequence of activities is influenced by the subject matter being taught and the nature of the students in the class. (Watt, cited in Microsoft Partners in Learning, 2010, p. 20)

Review of Relevant Literature – TPACK and IMPACT

Shulman's (1986; 1987) theorising of Pedagogical Content Knowledge (PCK) has informed the design of most initial teacher education programs in Australia. Integral to PCK is his Model of Pedagogical Reasoning and Action (MPRA), which comprises:

...actions that a teacher undergoes during the teaching process including: comprehension of subject knowledge, transformation of subject knowledge into teachable representations, instruction, evaluation of students' learning and teacher's performance, reflection and new comprehension. Thus it was an attempt to illustrate reflective practice during the teaching process..." (Starkey, 2010, p. 234)

Shulman's thinking in this area was conceptualised well before the emergence of the networked society in which schooling is now located and enabled by the Internet. Subsequently, Starkey (2010) explored how MPRA might occur in this digital, networked world. A key finding from Starkey's research was that MPRA "remains relevant" (p. 233), but "was based on an assumption that teaching involves knowledge being passed from a teacher to their students, which was found to restrict

innovation by digitally able teachers” (p. 233).

Building upon Shulman’s PCK has been the conceptualisation of Technological Pedagogical Content Knowledge (TPCK), and now known as TPACK (Koehler & Mishra, 2005; Mishra & Koehler, 2006; 2008). TPACK more adequately understands how technological knowledge (TK) might intersect with content knowledge (CK) and pedagogical knowledge (PK).

Recent attempts to explore teachers’ Technological Pedagogical Reasoning (TPR) (Smart et al., 2013) have added to proposals by some writers for a Model of Technological Pedagogical Reasoning and Action (MTPRA) (Finger & Finger, 2013). Smart et al. (2013), for example, in examining the digital portfolios of four experienced teachers, suggested that these teachers might develop technological pedagogical reasoning (TPR) through their careers, and her research explores the influences on their TPR development.

Drawing upon Smart et al. (2013) and the concept of TPR, Finger and Finger (2013), in examining an early career teacher’s story of technology and teaching, also drew upon ‘praxis’ (Freire, 1970), which involves “highly developed educational practice that consciously articulates the theory on which it is based, and, in turn, generates new theory” (O’Toole & Beckett, 2013). This enables teacher voice to portray experience and reflection which might differ from those around them, through ‘limit situations’ (Freire, 1970).

Consistent with ‘limit situations’, TPACK accommodates different understandings of the context and complexities of teaching with technologies. In examining an early career teacher’s story, TPACK was found to be inherent in the *Australian Professional Standards for Teachers* in relation to Graduate Teachers (Finger & Finger, 2013). They highlighted that this was evident in the *ICT Elaborations for Graduate Teachers* (AITSL, 2011) developed through the *Teaching Teachers for the Future (TTF) Project* (see AITSL, 2013; Finger et al., 2013) which used TPACK as the guiding conceptualisation.

By drawing upon the recent work by Smart et al. (2013), and reflecting upon the teacher’s story presented, Finger and Finger (2013) suggested that TPACK, which builds upon Shulman’s PCK and MPRA, might be assisted by the conceptualisation of a Model of Technological Pedagogical Reasoning and Action (MTPRA) to accommodate the importance and influence of the technological changes since Shulman theorised PCK and MPRA.

Figure 1 below attempts to conceptualise Project 600 contexts, and MPRA and MTPRA, by drawing upon the work of Shulman (1986:1987), Starkey (2010), Smart et al. (2013), Finger and Finger (2013), and IMPACT. It is evident that, in Project 600, the expert teachers, when employing IMPACT, require TPACK capabilities. This also reflects alignment with MPRA. However, we suggest that MPRA is insufficient, and have proposed that IMPACT requires TPACK capabilities, and that the Project 600 teachers adopt a Model of Technological Pedagogical Reasoning and Action (MTPRA).

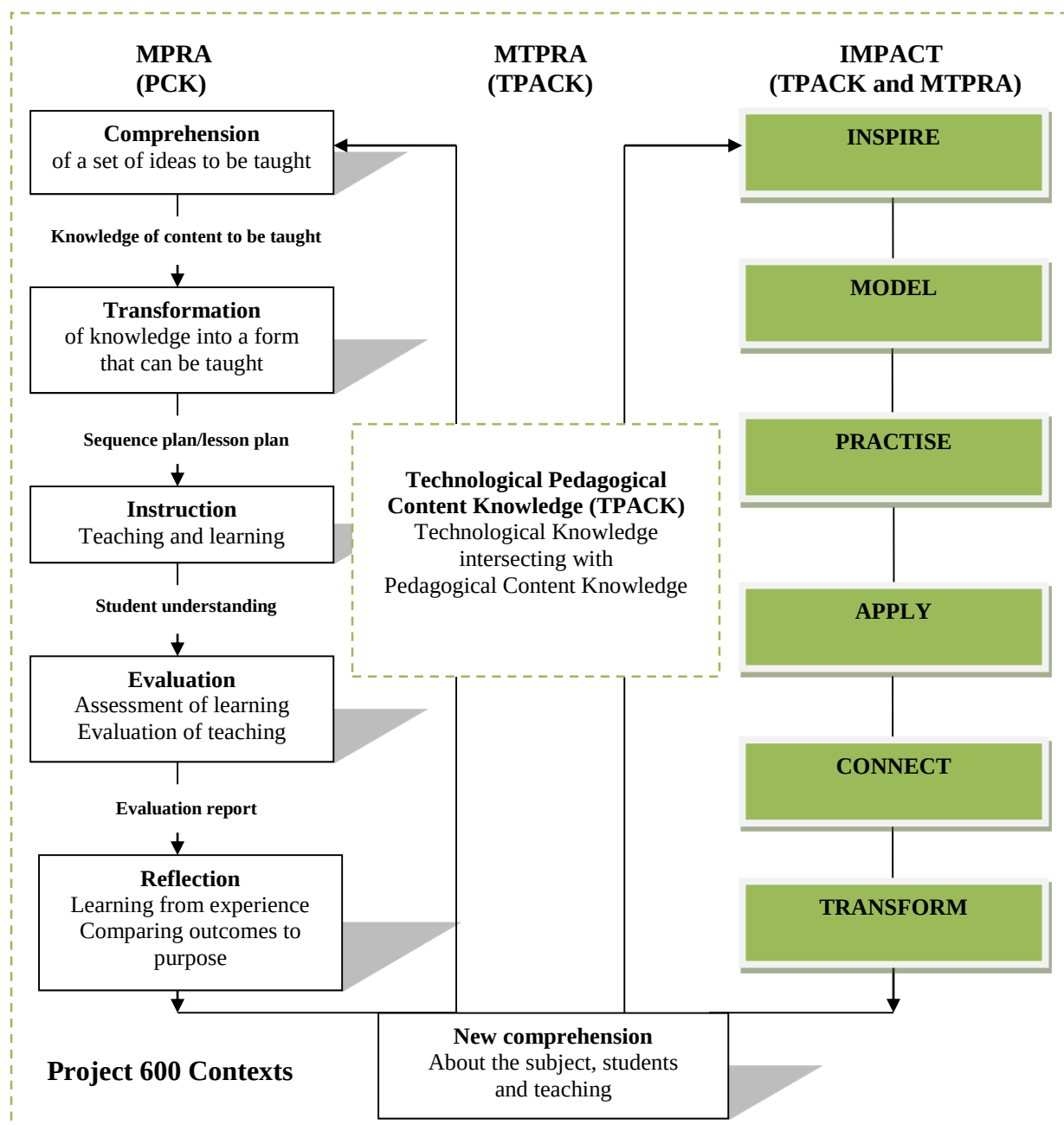


Figure 1: Project 600 Contexts - Conceptualising TPACK, MPRA, MTPRA and IMPACT

Research Design

Participants

The student participants in this study were 1200 students from 75 South East Region schools who had participated in the Project 600 Year 5 Numeracy Project. Schools which participated had nominated, and the 1200 student places were rapidly filled, with the demand for places in the project exceeding places available. The project parameters included a negotiated cap of 24 students in 2 groups per school so that all schools that nominated could participate. To select the students, the schools analysed data sources to identify students who might have the potential to reach the Upper 2 Bands in numeracy with targeted support. Most of these students had achieved Band 4-5 in Year 3

NAPLAN numeracy in 2011.

The participating Project 600 teachers were eight high performing teachers from schools recruited to deliver the program. These teachers were specially trained and mentored by the Regional Projects and Training Team at BSDE. Schools also organised one or more teachers to coordinate and support their students' involvement. Teachers, teacher aides and school leaders accessed professional development via after-school web conferences and lesson observations.

Data were collected by the BSDE Project Team for research and evaluation purposes, as well as for accountability purposes. For example, for accountability purposes, data were collected to record the number of students, schools, expert online teachers, and Regions participating in these projects. Research and evaluation data were collected through surveys of students, school leaders and parents. Furthermore, the Year 5 NAPLAN results for numeracy were obtained and analysed in collaboration with Education Queensland's Performance Monitoring and Reporting Branch (PMRB).

Summary of Findings

Given the length limitations of this paper, this section provides some key outcomes in terms of NAPLAN Results, and the perceptions of teachers, students and parents.

Student Learning Outcomes - NAPLAN Results

As outlined earlier, the target group for the project was students who achieved Band 4-5 in Year 3 Numeracy in 2011. Students from this target group were compared in relation to 2 groups; namely, Project 600 vs Non-Project 600 (Control Group). There were 819 students in the Project 600 target group and could be matched in relation to their Year 3 NAPLAN Numeracy result of Band 4-5 in 2011 and their Year 5 NAPLAN Numeracy result in 2013. Similarly, 1935 students were in the Control Group and could be matched in relation to their Year 3 NAPLAN Numeracy result of Band 4-5 in 2011 and a Year 5 NAPLAN Numeracy result in 2013. While comparisons need some caution, as displayed in Figure 2, Project 600 students overall showed that more Project 600 students reached the Upper 2 Bands than did their Control Group peers in the Year 5 Numeracy NAPLAN 2013 Test.

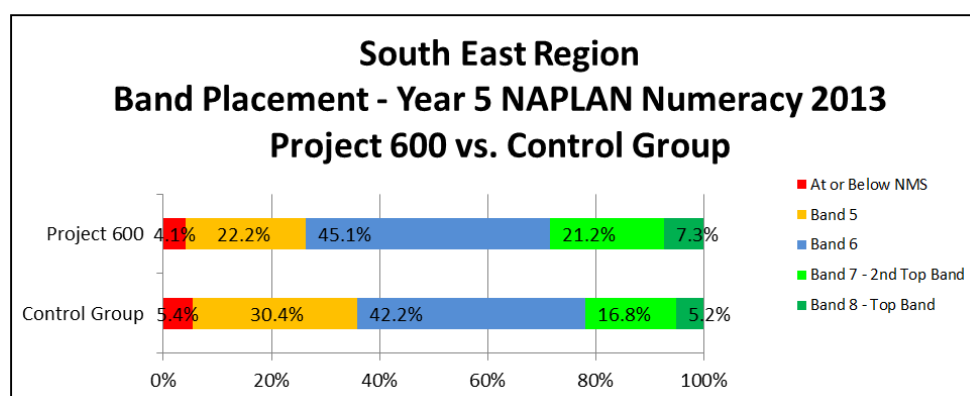


Figure 2: Project 600 and Control Group – Year 5 NAPLAN Numeracy 2013 Results

In general, students in the Control Group received 2 years of classroom lessons from Year 3 to Year 5, Project 600 students participated in up to an additional 12 project lessons from February and completed prior to the NAPLAN test in May 2013 in this planned high impact, high yield strategy.

Education Queensland's Performance Monitoring and Reporting Branch (PMRB) reviewed the data and concluded that, *“Our findings were that participation in South East Region’s Project 600 – Year 5 Numeracy 2013 significantly increased student results in the Year 5 NAPLAN Numeracy Test in 2013”*.

Perceptions of Students

A total of 814 students completed the online survey during one of their final project lessons. As shown in Figure 3, the students were enormously positive about their involvement in this learning experience.

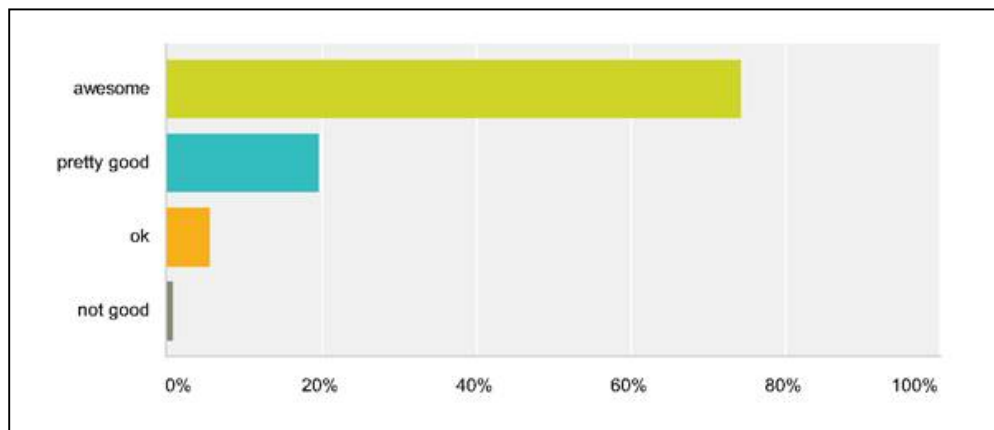


Figure 3: Project 600 student responses to “I would say Project 600 is...” (N=813)

Complementing these data shown in Figure 3, students’ responses highlighted that Project 600 was awesome, it inspires, connects and transforms through improving thinking skills and ability to collaborate and use technology, as conveyed in the following examples of student responses.

The web activities are absolutely awesome. The activities to work out are fun, they really get your brain working and that is what I love about Project 600. During Project 600 I have really improved.

Computer skills are great because I didn't know much about computers and Project 600 helped me.

In my opinion, I think Project 600 is an awesome way to learn other than working on paper all day! It helps us learn beyond what people are learning in class, it is fun, and you can interact with teachers in different areas!

Perceptions of Teachers and School Leaders

Feedback from the teachers and school leaders during the project was tremendous. Strong relationships between the project team and school coordinators were developed. 14 schools responded to an optional online survey and this survey was completed by the Principal or key project coordinator at the school. As indicated in Figure 4 below, Project 600 was seen as being a very worthwhile experience.

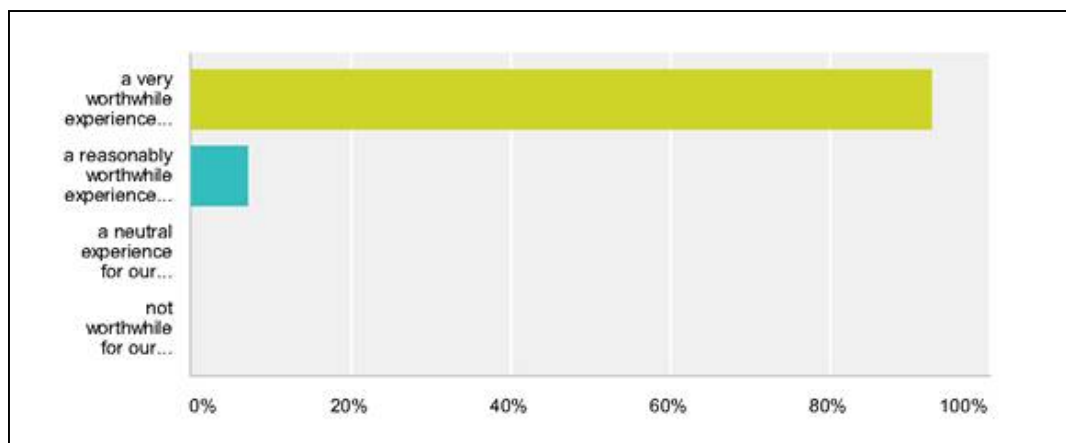


Figure 4: Project 600 School Leaders responses to “I would say Project 600 – Year 5 Numeracy Project is...” (N=14)

Teacher responses were extremely positive, and, in particular, highlighted improved engagement, learning outcomes and motivation by students. Their comments, such as the following example, also reflected the development of their own capabilities in an innovative project.

Students (and staff) at my school were exposed to an innovative, engaging and interactive approach to teaching. The students were so motivated throughout the entire project, which is evident in the way they have engaged, progressed and also in the fact that they are devastated it is coming to an end.

As conveyed in the following comment, teachers received positive feedback from parents, such as the following example.

One parent said they had never seen their child so enthusiastic to do homework, the child loves project and is eager to do extra work to succeed. Very rewarding and insightful. Can't wait to be involved again. Thank you for your time and effort and expertise.

Perceptions of Parents

Parents of the participating students were included in this project from the beginning. They received a letter via the school introducing them to the project. They also received a Parent DVD which outlined the benefits of the program and showed them how Web Conferencing and Virtual Classrooms work. The online teachers communicated with many parents via email and the virtual classroom. Students brought home a certificate at the end of the project.

Schools also contributed to parent engagement by including project updates in their newsletter, coordinating parent information sessions and inviting parents to attend project lessons at the school to check it out for themselves. The parent response to the program was very positive and parents indicated that their children were talking to their parents about their learning and the parents, reflected in the following parent comments from the Project 600 Online Parent Survey sent via email at the conclusion of the project.

Confidence and attitude to maths has increased 200%. Before the program his self-talk was “I hate maths” and “I’m no good at maths” and it was becoming a struggle to get him to attempt it. Now he does his maths homework first ☺

Our daughter has thoroughly enjoyed her time participating in this program and has expressed interest in being able to do it again next year if it is offered to Year 6 students. It has been a great confidence building activity for her and has helped to improve her problem-solving ability not only in maths but other parts of her schooling also.

Conclusion and Future Directions

To conclude, the case is made for Education Queensland to build capacity through formalising this model at a systems level. This paper has provided evidence through achievement data and positive student, parent, school and teacher feedback that this project capitalises upon online, networked design possibilities.

Importantly, this project is agile, scalable and enables agency by Schools and Regions in Queensland to engage in high priority areas of study, such as improving NAPLAN literacy and numeracy in this high impact online project. While the target group has been average to above average students, there is the potential for project design to include students with lower achievement levels to participate in a longer project timeframe to enable success. There is the potential for the target group of students could be anyone, anywhere, anytime as this project has proven that connecting like-minded students across the state can be hugely successful.

Furthermore, future directions could continue to investigate and build upon innovations that have already occurred within and across Regions in Queensland, such as Project 600 in Central Queensland Region, Project 600 in Darling Downs South West Region, Project U2B in Metropolitan Region and North Coast Region.

Further innovations, dissemination and impact in schools are occurring as a direct result of the projects and the training programs delivered by Project 600 leaders at Brisbane School of Distance Education, including:

- Brisbane School of Distance Education has delivered UNIFY – University For You online projects to more than 8000 gifted or high achieving students from over 500 Queensland state schools since 2012 – topics include Critical Thinking, Science, Design and Technology and Creative Writing
- Helensvale State High School and Southport State High School have delivered online projects to their feeder primary schools
- Queensland Academy Science Mathematics and Technology now deliver online projects to over 500 high achieving students in Brisbane and the Gold Coast
- Metropolitan Region's Teaching and Learning Team now deliver the majority of their regional Professional Development programs via web conferencing and edStudios improving access and outcomes for teachers and school leaders. They have also developed online projects for indigenous students (Solid Pathways Project) and high schools maths students (Metro 10 Project)

Project leadership has been integral to the success of Project 600 in South East Region and the other online projects listed above. Investment is required in the leadership team of the BSDE Regional Projects and Training Centre which enables this innovative, approach to teaching and learning guided by the IMPACT conceptualisation to become embedded and formalised through a systems level approach. This will require investment for 2015 and beyond to ensure that existing outcomes are sustained and further possibilities explored.

Moreover, this paper has attempted to make a contribution to the literature (Smart et al., 2013; Finger and Finger, 2013) which is emerging to suggest that TPACK might require an accompanying Model of Technological Pedagogical Reasoning and Action (MTPRA). The IMPACT model which guides Project 600 teachers shows alignment with Shulman's MPRA. However, we suggest that MPRA is insufficient, and have proposed that, as IMPACT requires TPACK capabilities, the Project 600 teachers adopt a Model of Technological Pedagogical Reasoning and Action (MTPRA) in their design, implementation and evaluation of their Project 600 initiatives.

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EVALUATING A 1-TO-1 IPAD PROJECT: BEYOND ROSE COLOURED GLASSES

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Abstract

Today's digital world calls for contemporary pedagogical practice and curriculum that aligns with the relevance of today's youth. Educators frequently use contemporary digital tools and innovative teaching and learning approaches to engage their students. A regional single sex high school implemented a 1-to-1 iPad program for the Year 8 -10 students with the aim of creating a technology rich learning environment with personalised access which would facilitate innovative teaching and learning opportunities and to promote personal learning with additional outcomes of independence, lifelong and life-wide learning for their students.

In particular, this project investigates the use of the iPad at school and home for academic purposes and also examines the parental perceptions of the use of the device for learning. Survey data indicated that the implementation of the 1-to-1 iPad project had positive outcomes including enhanced learning opportunities and motivation for learning. However, during the initial phase of implementation, both parents and students had concerns regarding possible off-task behaviours of students when using the iPads.

Internationally education systems have invested significant financial and human resources to equip classrooms with computer technologies to enhance productivity and efficiencies, improve learning and teaching, and develop digital skills in students (Bebell & Kay, 2010). Critics of this investment commented that technologies in schools have had less than wide ranging and consistent positive impacts on learning and have been "oversold and underused" (Cuban, 2001). Since the late 1980s schools have been investing in hardware to reduce the student to computer ratio (Bebell & Kay, 2010; Fleischer, 2012). While they have achieved some success in this goal, "student-to-computer ratios have not yet reached a stage at which the technology is ubiquitous" (Bebell & Kay, 2010, p. 5). The concept of ubiquitous computing was first introduced by Weiser (1991) and he commented that "the most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it" (p. 94). Papert (1996) and others have suggested that "the full effects of computers in school cannot be fully realized until the technology is no longer a shared resource" (Bebell & Kay, 2010, p. 6). With the introduction of mobile devices and 1-to-1 projects, schools are trying to resolve the issue of having personal devices rather than shared computing resources while still considering equity of access.

1-1 Computing

As access to computing devices became more widespread, it was "possible for students and teachers in schools to transition from occasional, supplementally use of computers for instruction to more frequent, integral use of technology" (Penuel, 2006, p. 332). Many schools have implemented 1-to-1 projects which enabled 24/7 access to digital devices and the Internet (Fleischer, 2012; Penuel, 2006) at school and home making the access personal rather than shared. "Ubiquitous, 24/7 access to computers makes it possible for students to access a wider array of resources to support their learning, to communicate with peers and their teachers, to become fluent in their use of technology tools of the 21st century workplace" (Penuel, 2006, p. 332).

1-to-1 projects provide "increased access and resources when technology is no longer shared" (Bebell & Kay, 2010, p. 46) and facilitates more time on task for student learning. There are four key features

of 1-to-1 computing: Students are provided with (1) a portable device with software; (2) wireless Internet access; (3) used to complete academic tasks; and (4) the student has 24/7 access to the same device (Fleischer, 2012; Penuel, 2006).

There are a number of positive outcomes reported previously in 1-to-1 computing studies (Bebell & Kay, 2010; Fleischer, 2012; Lowther, Inan, Ross, & Strahl, 2012; Penuel, 2006; Schmidt & Ho, 2013) including:

1. Improved academic achievement;
2. Increased equity of access to digital resources;
3. Increased student-centred learning and enhanced student autonomy;
4. Increased student engagement;
5. Enhanced student motivation;
6. Higher motivation; and
7. Decreased disciplinary problems.

Teachers in Bebell and Kay's (2010) study reported "widespread adoption of new and novel approaches across their traditional curriculum, which were then subsequently reported by teachers and administration to increase student motivation and engagement" (p. 16). Teachers use of technology for 'behind the scenes' increased and most teachers found they 'fundamentally changed' their teaching practices. Having said that, teachers also reported that "even after a couple of years we still fell like were just getting accustomed to teaching in a 1-to-1 setting" (Bebell & Kay, 2010, p. 21). In addition to new approaches, the access to 1-to-1 devices also increased the just-in-time teaching and enhanced the responses to teachable moments (Fleischer, 2012). Students were willing and interested to experience a 'radical shift' in their approaches to learning, however, not all teachers changed their pedagogical approach to embed the devices into the teaching and learning opportunities in their classrooms (Bebell & Kay, 2010).

Challenges for 1-to-1 Projects

Research provides little discussion about the problems associated with 1-to-1 projects (Fleischer, 2012). In their study of mass deployment of iPads, Schmidt and Ho (2013) suggested that the success of any technology integration for the improvement of learning and teaching has had a "hit-and-miss track record" and that it is "fraught with challenges"(p. 2).

When discussing mass deployment of digital devices, challenges identified by Schmidt and Ho (2013) were of a management nature and included activities such as the time involved in setting up the devices, installation, configuration, deployment of apps, making backups, and overall care and maintenance of the devices. The identification of suitable applications can be difficult given the large range available. Unlike other computing devices such as desktop and laptop computers where teachers can use monitoring software, "[t]o date, there is an inability to control activities performed on the iPad" (Henderson & Yeow, 2012, p. 81). Monitoring activity makes it possible for teachers to check what students are doing and redirect them to productive learning activities when necessary.

The limited research available reveals varied and frequent off-task behaviours with students on 1-to-1 devices during class time and finding research on off-task behaviour during homework time is even more problematic. A study completed by Donovan et al., (2010) discloses that "[s]tudent disengagement in learning, or off-task behaviour, is less researched and less documented, perhaps because the range of student off-task behaviours is extensive" (p. 426). Examples of off-task activities related to ICT use include cognitive disengagement from the current teaching and learning activities, completing non-related activities, and using the device for "purposes other than intended or specified for the learning activity" (Donovan et al., 2010, p. 426). They go on to indicate that the result of their study of 1-to-1 computing in the middle school does "not support the notion that increased access to technology leads to increased engagement in the K – 12 setting" (p. 437).

Context

This study was set in a regional Catholic community for the education of students from years 5-12. The participants of this study were students and their parents from Years 8 – 10. The school provides each child from Years 8 – 10 with an iPad as a learning tool, and the current Years 11 and 12 students were provided with a laptop. The current Year 10 cohort was part of a laptop 1-to-1 program when in Year 9. The key educational role of the iPad was to provide access to digital information and communication tools any place, anytime.

A number of apps were recommended by the school, e.g. Keynote, iMovie, Pages, PDF Expert, and Explain Everything. Students were expected to set up their own iTunes account and install the apps from the App Store at school or at home. After the first two weeks, the students were only able to download from the App Store at school before and after school.

All teachers were provided with a laptop and an iPad, and each classroom had wireless Internet, a tethered and wireless projection device, and speakers. Teachers had training for the iPad initially looking at how to use the device and then exploring the use of the iPad for learning and teaching purposes. Students and parents were involved in information sessions addressing functionality of the iPad, safety, care, consequences if iPad was misused or lost, and cybersafety.

Methodology

An online survey was made available to all Year 8 – 10 students and their parents. The purpose of the survey was to explore the perspectives of parents and students in terms of the educational use of the iPad and also to gain data for the enhancement and ongoing development of the project. The survey was conducted within the first 15 weeks of initial iPad implementation.

The student survey included 29 closed questions about the student use of the iPad and an open ended question at the end of the survey. The closed questions included items about problems with the technology, length of time using the tool, purpose for using the tool, and Apps used on the tool.

The parent survey included 10 closed questions and a section for additional parent comments. The questions included items about how their child was using the iPad and the impact it had on home and school. The comment section was widely used by the parent participants.

Results and Discussion

The self-reported results from parents and students indicated promising educational outcomes, particularly in terms of the students' use of the iPads as a learning tool and the belief of parents and students in the positive impact it had on student attitudes and motivation. This aligns with Koh et al., (2011) 1-to-1 study that found overwhelming positive reactions from students and Warschauer (2007) established that the students enjoyed the fact that 1-to-1 access allowed them to control their own learning.

In the students' response to the question: Do you use your iPad primarily as an educational tool? Only 2% of students indicated that the iPad was NOT primarily used as an educational tool; 37% answered yes; and 61% indicated mostly. One survey question asked how much of your time on the iPad at home is spent on homework, 3% of the student respondents reported that 100% of the time was for homework tasks, 41% said that 75% of their iPad time was for homework tasks, 39% said 50% of their time on the iPad was spent completing homework or assessment and 17% suggested that 25% of their time on the iPad was for homework purposes. Given this was a self-report survey, it is possible that students provided the answer they believed that their school and parents wanted to hear.

Home use of the iPad was largely to complete homework or assessment related activities. Grimes and Tawchauer (2008) research on 1-to-1 laptops also found that 75% of laptop use at home was to write and revise school assignments. Students reported that the use of the device both at school and at home was largely for educational purposes. However, from a parent perspective, 59% of parents noted

no real change in their child's study habits, 23% perceived their child had an increase in time spent on homework, 14% felt it had decreased and 4% were unsure.

The survey also indicated that because students have an iPad they have engaged in collaborative eLearning and peer teaching with students they would not normally have worked with previously. A number of students made specific comments about enhanced email access. When asked if they used their school email more having an iPad, 70% responded yes, 14% indicated no, and 16% felt they used it the same as before.

The majority of the students felt that they could achieve more with the iPad. Students also responded positively about the use of the iPad to be more organised for school with 79% of the students indicating that the iPad assisted with their organisation, 7% indicated it did not assist and 14% indicated no change to their organisation.

When asked how the students used the iPads, most of the usage was for Internet access and eBook reading, see Figure 1 below. Warschauer (2007) and Oliver and Corn (Oliver & Corn, 2008) also found high use of Internet search and increase in research skills as a result of the implementation of 1-to-1 devices.

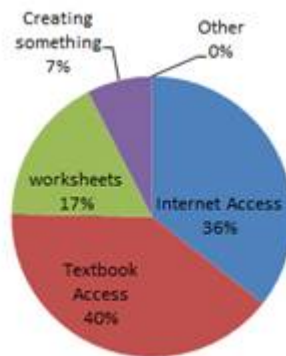


Figure 1: The major use of the iPad at school

When inquiring about which subject the students mostly used the iPad (excluding IT subjects) English had the highest level of use, closely followed by Maths. Figure 2 shows the breakdown of disciplines. Other subject areas did not have high levels of iPad usage. In contrast, Beball and Kay's (2010) study found that students were less likely to use a 1-to-1 device in Math and Science when compared to Social Science and English. They also found that "there was no single subject area or grade level where technology uses were found to be universally more widespread or universally unused" (p. 49). Although, Fleischer (2012) suggested that the use of laptops in curriculum areas varied across disciplines. He also recommended that "it would also be fruitful to investigate the connection between leisure-time based learning and academic interest" (p. 199).

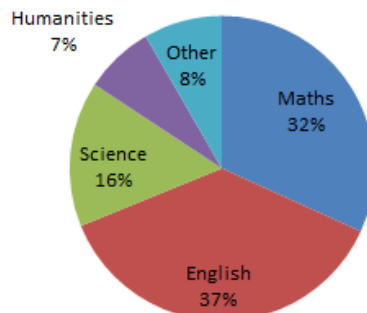


Figure 2: Use of the iPad across disciplines

Within the open ended comment section students had a very positive perception on the use of iPads for learning. This is demonstrated by comments such as: “Lets me do more at home”; and “I believe that it has helped me concentrate in class because it is something I enjoy doing (technology) and I believe I have more of an opportunity of doing stuff”. Other comments indicated that the students believed that the iPads were easy to use and the portability was a significant benefit when compared to carrying around heavy text books. This aligns with Lowther, Inan, Ross and Strahl’s (2012) 1-to-1 laptop study, which reported “that the use of laptops improved their learning and study skills and made them more interested in learning” (p. 25).

The majority of the parent comments were of a positive nature including the perspective that access to the iPad was responsible for increased positive attitudes towards school. It appeared that parents who set ground rules (e.g. no use at bedtime, use for social/gaming activities after homework); and those that have some IT knowledge appeared to have made more positive comments. The following is a sample of the types of positive responses made by parents: “I think having an iPad has provided more opportunity for my son to learn, especially when completing assessment and some teachers are using it for innovative learning...Overall, though I believe the positives outweigh the negatives”; “It has been a very positive impact and has made homework much more engaging”; and “There is a very noticeable improvement in his attitude towards school work and organisation of work”.

Three disadvantages were presented within the student comments. Firstly, the ease with which students could get distracted by games and social activities. Illustrated by comments such as “It is a distraction in class with a very high temptation to play games”; and students “are playing too many games and are getting me distracted and I am not doing as well as I used to be”. Secondly, the preference was to use handwriting or a laptop/computer to create text based items when compared to the iPad. Thirdly, they were disappointed that the school had locked the App Store during class time.

Parents, however, were concerned about the teachers directed use of the iPad with one parent commenting, “Some teachers are using the iPad extensively and some not at all”. Interestingly, a number of parents were concerned about traditional reading and writing skills, preferring to purchase text books rather than use the iPad as an e-reader.

The parents’ key issue centred on the non-educational use of the iPad, especially for social networking and games, which were also identified by the students as a disadvantage of the device. Many parents would have liked control over what occurs on the iPad and to remove games, Facebook, or include filtering or monitoring software. Since the initial survey, the school has found that additional parental education, in the form of tips sent out to parents, reduced this concern for parents.

There is very little research discussing the disadvantages of 1-to-1 devices and student off-task behaviours. The parent and student comments in this study align with the findings of Donovan, Green and Hartley (2010). Off-task behaviour during class and homework time is not a recent occurrence, students have often been distracted or disengaged in class in the past. The 1-to-1 devices provide an alternative to passing notes, staring out the window, doodling, and other non-engaged behaviours that students have demonstrated previously. Donovan et al’s (2010) study suggests that student off-task behaviour “may be interpreted as being contradictory to existing beliefs on the relationship between computer access and student motivation and engagement” (p. 439).

Like the parents, Banister, Miller and Herman (2010) commented that it would be useful to have the ability to track and manage content and activity on mobile devices. In their research with pre-service teachers, Schmidt and Ho (2013) suggested that the ability to gather analytics to track device usability would assist in identifying if and when students are distracted and using the device for off-task activities. Analytic data on student usage may also enable educators to support their students in a more informed way.

83% of the parents provided rules or guidelines for the iPad use at home use. 64% felt the iPad had a positive effect on their son’s education, 8% perceived a negative effect and 29% responded no real

change in their child's educational outcomes. The following quotes are representative of the parents comments: "I realise now I need to set some rules at home"; and "I would have preferred parental control mechanism or an ability to monitor what the iPad is being used for so I could better guide".

Implications

The use of mobile 1-to-1 devices enable learners to interact with content, learning resources, peers and their teachers in different ways than was traditionally available. This paper reports on a 1-to-1 project during phase one of the project implementation. When schools deliberately implement a 1-to-1 project, a number of implications need to be considered:

Firstly, the data indicated from both a student and parent viewpoint that they have positive perceptions about the use of the iPad as an educational device. This aligns with the research of Lowther et al., (2012) who also found positive attitudes and increased motivation with the use of a 1-to-1 device. Bebell and Kay (2010) also reported that the "consensus of the participants was overwhelmingly positive towards these educational opportunities afforded through increased educational technology" (p.47). These outcomes and positivity may be attributed to the training and Internet access provided by the school, affordability, light weight, immediacy of response and the low cost of applications for the device.

Secondly, this project affirmed the importance of parental involvement. Fleischer (2012) also reported on the importance of parents when implementing 1-to-1 projects. In this case there were benefits in having parental training in the use of the device, in exploring ground rules for suitable use of the device at home, and to support parents in their involvement in their son's education. Interestingly, for some families, especially where ground rules were not explored, parents felt they had less control over what the students do with the device.

Thirdly, parents and students both reported concerns about off-task behaviours or the increased opportunity for distraction, particularly in the areas of gaming or social networking. This was of concern both at home and in class. Off-task behaviours at home or in class not new however something to consider is whether the off-task behaviours of students while on iPads may have limited negative impact on the learning of other students when compared to non-iPad off-task behaviours. Henderson and Yeow's (2012) study also found "that distraction is an issue with the iPad" (p. 85) as it is with other technologies used in classrooms. The school in this study and the one in Henderson and Yeow's (2012) study indicated that it is important that "expectations are clearly laid out in terms of behaviour around the iPad and school work" (p. 85) for use at home and at school. In this study many parents recognised that at home they need to implement an acceptable behaviour or acceptable use policy.

Conclusion

This study revealed that the implementation of a 1-to-1 project resulted in a positive experience and enhanced educational opportunities. The size, portability, connectivity, and intuitive nature of the device enhanced the experience for the students. A key learning from this study is that it is necessary to set guidelines both at school and home to reduce the risk of distraction.

A limitation of this study was that the data was limited to one school in one regional centre in Australia. This limits the ability to generalise beyond the initial context. A second limitation is that the data was collected through a single self-report survey. Data collected through self-rating is subjective and may not be reliable with the participants providing the answers they believe the school would like to hear rather than the actual impact of the device. Another disadvantage is that there is no data from the teachers and it may have been useful to gain their perspective on this important matter. Future research may include some observation in classrooms to explore the range of off-task behaviours, in addition to collecting teacher perspectives.

This study indicated positive educational outcomes from the 1-to-1 iPad project. Although there are some obstacles to overcome before it reaches the potential to transform learning and teaching. The

challenge for educators is to meet the educational needs of our digital students in an environment where the tools themselves change quickly and the IT skills of students develop faster than that of the teachers. The 1-to-1 project provide students with access to a personal device for use at home and school rather than access to a shared device.

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COWPADS: FINDINGS FROM A PROJECT USING iPADS AS SHARED DEVICES IN A SECONDARY SCHOOL

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Abstract

During 2013, a group of three teachers (French, mathematics, music), undertook a pilot project to find out how iPads could be used cross-curricularly as a class set. This presentation outlines some of the challenges the school faced in changing a personal device to shared one across three subjects, and housed in a COW (Computers on Wheels storage and charging device). It also outlines their solutions, the effect on the project when the school received an upgrade to their computer network infrastructure halfway through the year, and where this has led the school since conclusion of the small project. The project was a collaboration between the school and the university researcher, who became the 'critical friend', allowing the participants to review their experiments, their pedagogical thinking and design, and the technological hurdles they needed to jump. In essence, this critical friend role links to an action inquiry framework by suggesting potential benefits arising from the issues and challenges the school faced in doing something communal with a personal device (the iPad) and meeting the unexpected. The research supported the examination of pedagogical practices alongside observable impacts on learning (for both teachers and students) when the iPads were used. This presentation is companion to one that a key teacher involved in the project will present.

Introduction

A programme funded and driven via the Ministry of Education in New Zealand, is the roll out of ultrafast broadband (UFB) to schools. This accompanies a programme of SNUP - The School Network Upgrade Project. This latter project manages the upgrades of data and electrical cabling for state and state-integrated schools (see <http://goo.gl/9HjVjY> for more details) through the country, so that schools can reliably operate their Internet provision. This is important to accompany a rollout of ultrafast broadband. Overall, this programme of upgrade sits alongside a long-term, bipartisan focus on the provision of an education that is increasingly digitally proficient.

However, this also exists within a self-managing policy framework for schools. This means that no two schools are the same regarding how 'on' they are. To take one example of secondary schools in the Waikato region, each secondary school has an individual cultural ethos that may or may not embrace things digital, and may or may not have leaders who understand or embrace its potential. While one school may enforce a ban on students' mobile digital devices at school, another may actively encourage students to bring them and use them, while another may mandate the use of particular devices. As well, some schools may have a well-resourced and current network provision with robust wifi for students and staff without too many firewalls restricting access to educationally useful sites. Another may operate a very low-trust policy akin to siege mentality of fear and insularity, rather than openness and inclusivity. The trend, however, is for schools to embrace the potential of mobile digital devices and explore what this means for students, staff and education.

It is in this latter context that this small project was undertaken in one secondary school. It was partially funded by the Wilf Malcolm Institute of Educational Research at the University of Waikato, and emerged after showcasing to the school's staff how teachers might focus on evaluating their pedagogical designs using action enquiry methods. This also demonstrated simple ways of gathering student feedback to develop an evidence-led reflective model of teacher practice. It also indicated how teachers could robustly monitor the value of their own innovations and experiments with learning, without the process becoming onerous or too unwieldy.

At the same time, the school embarked on a process of developing their digital capability across the campus. This led to appointing an e-learning director from within the staff, and gathering a group of three teachers prepared to experiment with a class set of iPads during 2013. The essential question for this project focused on examining the value of using a Teaching as Inquiry research process to understand how iPads can be used for learning in these three subjects.

Structure and issues of the project

Over a number of meetings, the teachers and I worked out a project plan to test our question. This linked to the frequency of experimentation, the design of lessons and opportunities for gathering student feedback as well as researcher visits. Essentially, the intention was for regular fortnightly classroom observations and monthly meetings to discuss progress and evidence.

A plan is a beautiful thing. Reality, however, is another story.

The first issue related to the late arrival and formatting of the class set of iPads. The technical issues of how to share a device designed to be a personal one, were prodigious and meant that teachers could not begin experimenting until about two months after the first term started. This put the project plan into disarray very quickly, which meant some rethinking and redesign. While the teachers became anxious about this, I was able to reassure them by pointing out that if everything went according to plan, then it wouldn't be research, and we wouldn't discover what we didn't yet know.

Their next impediment was an issue with the configuration of the iPad docking station, or COW (Computers on Wheels), an adaptation of the kind of trolley designed to house a set of laptops for sharing across classes. The COW that the school was provided was not compatible (they found after considerable delay) with the iPad software, but the provider took a very long time to address this. It was vitally important to address, because it was the mechanism whereby Apps could be loaded and updated for each class. Teachers could not rely on the iPads having available the Apps they needed from day to day. As a result, the teachers became increasingly reluctant to plan lessons around using specific Apps, and frustrated by not being able to properly experiment with using them to test their learning use.

A third issue was the wifi connectivity. For two of the three teachers, the wifi signal was relatively strong and reliable. This was important when they needed students to email their work before leaving class. For the third teacher however, her classroom was on the outskirts of the teaching building complex, and the wifi signal was weak. This meant that when students needed to be 'on' together, the signal would drop. Sometimes it failed. For this teacher, who was also the least confident in using digital technologies, it was difficult for her to work out where the issue lay. She often thought 'it was me' but in fact it was a technical issue that had nothing to do with either her or her students' skills in using the devices or the Apps.

The school year began in February. The teachers could use the iPads by April. The COW issue was resolved in July. We therefore had from August until early November to properly trial the iPads across Music, French and Mathematics in Year 10 (that is, students being between about 13-15 years old) classes. We abandoned our initial plan. Instead, we negotiated two or three occasions when I could visit each class between August and November, while all three of us met regularly each month. During the meetings, each teacher talked about what they had experimented with, learned, were frustrated with, or got excited by. This, plus feedback from students they gathered and my classroom observation data, became the data sources. We learned a great deal.

Action inquiry

Action inquiry was the chosen framework best suited to teachers examining their own practices as they insert new resources or tools into their pedagogical designs with specific classes. These new resources were the iPads and Apps, plus the Google suite of tools. While there was an overarching

question to examine regarding the iPads and action inquiry, each teacher designed a question targeted at the class they linked the iPad experiment to.

The action inquiry method used here is a modified version of the Teaching as Inquiry model in the New Zealand Curriculum (Ministry of Education, 2007) and summarised by Wright (2013) for teachers. This modification was designed to make it easier for teachers to focus an inquiry on a single lesson or set of lessons as a starting point for examining the effects on their learners of their pedagogical design and the tools and interventions they incorporated into them. Cresswell (2005) encapsulated the intention of the design, saying:

Action research designs are systematic procedures done by teachers...to gather information about, and subsequently improve... their teaching and their students' learning. Teacher researchers reflect on issues or problems they face, or select an area of focus, collect and analyse data, and implement changes based on their findings. (p. 550)

Ethics protocols were important. Once the ethics clearance was gained from the Faculty of Education's Ethics Committee, the expectations and requirements inherent in that approval were addressed. Each teacher provided written consent to the protocols for engagement, while they in turn undertook to gather consent from students and their parents once they had explained the purpose and context. In one class, one set of parents were reluctant to provide approval for their son's participation, feeling that he would not learn from it. Their child was mildly autistic and had learning difficulties. Most other parents and students 'jumped at the chance' to be involved, as one of the teachers put it.

The project was more than just a researcher-led study. Teachers themselves are in charge of what they were studying, and what they wanted to know. Our collective discussions were intended to discover if their own projects informed the bigger question centred on their use of action inquiry, the iPads and their pedagogical practices. The teachers had mostly not undertaken a research project before, and so we workshoped how to refine their questions enough to be able to properly explore. I was concerned that unless the questions were specific, they would find it difficult to make sense of their experiences. This caution was well founded, because at the end of the year review day for the project, each teacher was able to outline what they did, what they learned and what it meant for themselves by focusing on only the parameters of the question. This was also a feature they commented on - that this refinement made it very easy for them to focus and stay committed to answering their question.

Findings

While each teacher's experience was tempered by their existing confidence and familiarity with digital technologies, it was also tempered by the purposes for which they designed lessons integrating the iPads. These teachers described their iPad class with characteristics such as: relatively noisy, lacking in concentration, students with behaviour or learning issues, or a disinterest in the subject. They were, however, keen to try out the iPads to see what might happen.

The observations of classes were revealing. In one case, the students could see that the teacher was learning too - she freely admitted her lack of confidence and skill. This proved to be highly productive because the students realised they could not rely on the teacher to solve the problems they faced. Instead they became adaptive help seekers (Steed & Poskitt, 2010), searching out how best to address whatever arose. Students within the class could then share their prior knowledge and expertise with their classmates and the teacher. This change in the classroom dynamic was a positive one, for students were unafraid to ask questions, learned off each other, and saw the teacher as a learner too, who also made mistakes and 'didn't know stuff'. This alteration made it much easier to encourage students to experiment with their mathematical learning. Before using the iPads, the class had been relatively lacklustre in their willingness to learn mathematics, despite the teacher's best efforts at mixing up the learning and making it as student-centred as possible.

Once the iPads were a regular feature of the learning, the enthusiasm increased, as well as the collaborative learning and help seeking. This class also contained the boy whose parents had initial misgivings. This boy became, within a short period of time, one of the go-to people for help. This boosted his confidence and spilled over into his mathematics learning.

In another case, the French teacher commented that her pedagogical practices changed the more she used the devices and built her lessons around their use. She found that by designing tasks that students could tailor their own interests to, using the iPad to use online sources and complete tasks, she was able to spend less time at the front of the class and more time one-to-one with students. Another unexpected effect was that students' French vocabulary was increased, as they searched for words that helped explain or provide French names for aspects of their area of interest. She also found that because students could use online sources to listen to French being spoken, they heard authentic French speakers, rather than only the teacher. A third important point was that she could develop students' critical thinking and French language by expecting them to check any Google Translate examples with how a specific App would translate information.

In the case of the music class, where students were learning about specific notation, the teacher found an App which provided a mastery process for developing the skill of recognising sounds and notes on a staff. On the face of it, the lesson was drill and repetition. Normally, students become quickly restless in such lessons, getting 'bored' with the repetition. However, for over thirty minutes, students were each concentrating on their own, practising the skill of note recognition by sound and notation. There was very little chatter or sound other than the notes in the App. When students reached the end of each level, they took a screenshot and emailed that to their teacher. This meant he had a record of each level achieved by each student in each lesson. Near the end of the class, he would ask students to open up a site which gave them access to online blank staves. They could then practise putting notes on the bass line, and practise writing the bass clef.

This was a very interesting exercise. Normally, the teacher would have handed out printed copies of the bass clef and asked students to complete the same task. Usually, students would try the task once or twice, then give up after messing up their page, even after getting a new one. On the iPad however, they could easily rub out their attempts and start again. Over and over. Students only became frustrated using their fingers to make the symbols, complaining that the lines their fingertips made were too fat. At that point, the teacher shared out a few stylus pens that worked.

The degree of concentration, repetition and desire to improve was remarkable to see. This was consistent across all students in this class. Somehow, the iPad made such tasks much more meaningful. Students wanted their work to look good, and so they strived for this. The level of attention and care was not as noticeable when paper was the tool of choice.

For the teachers themselves, they were supported by the researcher, who helped provide the space to talk about their efforts, work through issues with them, and suggest the positive outcomes from their trials and issues. This researcher role as critical friend was significant as a mechanism for keeping going, and not being disheartened when their ideas were frustrated by the technology (particularly initially), their lack of skill or confidence, or just grappling with undertaking learning with unfamiliar tools.

As far as the whole school was concerned, the iPad trial has generated quite a bit of interest. Both students and staff are interested to learn from the experiences. In 2014, the following year of the project, the teachers involved now want to focus much more on experimenting with specific Apps to see how well they work across subjects, as well as develop their own skills and knowledge about using both iPads and now Chromebooks as learning tools.

Conclusion

While the findings are still provisional - after all, the project was truncated somewhat by the circumstances arising from the newness and focus of the trial - the trends across the classes point to the iPads supporting students to care about their work, repeat efforts, access information online, and share expertise and knowledge. For the teachers, they noticed changes to their pedagogical planning and practices. They spent more time designing the learning than dominating lessons once they got underway. They noticed students concentrating and on-task much more, they felt that their relationship with students altered positively, and students were keen to try anything new on the iPad. Teachers also noticed that students were more likely to cooperate, collaborate and develop adaptive help seeking behaviours than when the iPads were absent.

Overall, this points to a positive beginning for what will most likely become a whole school BYOD programme. The trial was essentially about examining how this could be enacted and what issues might arise to account for. The first year of this trial certainly raised a number of issues and led to creative solutions but highlighted how important it was for the IT supplier to be as responsive as possible so that students' learning was as enhanced as possible and that the tools available were as reliable as possible.

Lastly, the project highlighted the value of using a flexible teaching as inquiry process, and that linking a university researcher with classroom teachers was beneficial to both. Teachers could talk freely about their experiences, while the researcher was able to reflect the significance of the data, pointing out that apparent failure was actually a learning opportunity and provided data that might otherwise have never been collected.

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