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Contents

Editorial	1
Information and Communication Technologies and Educational Change	
Systems Thinking and Technology Integration as Catalysts for School Change in High Need Schools: IMPACT V and the Alignment of Organisational Ends and Means.....	7
Anthony Chow, Kimberley Hewitt, and Holly Downs	
Mobile Instant Messaging (MIM) Applications to Assist Learning in South Africa	30
Jean Greyling, Melisa Koorsse, Tawanda Ngundu and Michael Kyazze	
Pre-service Primary Teachers' Use of iPads to Support Teaching: Implications for Teacher Education.....	48
Damian Maher	
The Influencers of Scholars' ICT Career Choices	64
André Calitz, Jean Greyling and Margaret Cullen	
Pedagogic Strategies to Support Learning Design Thinking in a Masters Course	82
Cheryl Hodgkinson-Williams and Andrew Deacon	
Exploring Flexible e-Learning Options in a Postgraduate Project Management Course.....	98
Claire Donald and Garry Miller	
How Physics Teaching is Presented on YouTube Videos.....	117
Peter Gustafsson	
REPORT	130
Annual ASCILITE Conference, 2012	
BOOK REVIEW	133
Your guide to case study research	

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Educational Research for Social Change, April 2013, 2 (1)

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Editorial

Information and Communication Technologies and Educational Change

The Information and Communications Technology (ICT) landscape and ownership have changed considerably since the 1943 statement allegedly made by Thomas J. Watson, president of IBM, that "I think there is a world market for maybe five computers" (Watson, n.d.), and the 1977 declaration by Ken Olsen, founder of Digital Equipment Corporation that "there is no reason anyone would want a computer in their home" (Frater, 2007). In 2013, it is evident that these statements were not well thought through or, the possibilities that computers could offer, had not been visualised. From computers—the big desktops and huge box-like amber monitors of the early 1980s—we have moved to the laptop, cellular phone, notebook, tablet and phablet arena and virtually all new appliances are starting to be developed with networking capabilities and internet connectivity in mind.

In the education sector in the 1990s, it was postulated that ICTs could be a critical catalyst for educational change (Fullan & Smith, 1999; Hawkrigge, Jaworski, & McMahon, 1990). Although a great deal of ICT infusion is visible in educational settings, technology implementation and integration still seem to be the exception rather than the rule in most classrooms and lecture halls (Elliot, 2009). It appears that Web 2.0 technologies (Cochrane & Bateman, 2010; Gray, Thompson, Sheard, Clerehan, & Hamilton, 2010; Li, Kai Wah Chu, Wah Ki, & Woo, 2012; McLoughlin & Lee, 2010; Scutter, Stupans, Sawyer, & King, 2010) and even strategies that make use of the Internet and office suites (Du Plessis & Webb, 2011, 2012a, 2012e) offer several possibilities that could assist in bringing about change in the education sector. Although the digital divide argument still exists in many parts of the world including South Africa, youth are increasingly engaging in social media and web technologies through their cell phones. This offers interesting opportunities for harnessing in the school and university contexts, both in teaching, research, and engagement. A study in progress by Subramanien (work in progress) with multi-grade teachers in the rural area of the Eastern Cape in South Africa, suggests that ICT has enabled participating teachers to transcend the digital divide in their classroom and rural contexts and, consequently, it has become the catalyst of change within their school context. Although this is only one study on a small scale, it suggests that ICT has the potential to address issues in education and as a result could assist with changing the social dynamics and the ways in which things are being done in communities that have not been exposed to ICT related technologies such as laptops and Internet connectivity.

Within the ICT field, some of the recent discussions have been related to theory, learning contexts, leadership for change and innovative approaches or strategies related to learning and teacher professional development. Schifter and Stewart (2012) and Selverian and Stewart (2012) suggest that technology is starting to afford opportunities to move beyond constructivism when using ICTs with reference to virtual worlds. Siemens (2005, 2006a, 2006b) has argued for moving to a connectivist approach; Luckin (2010) made a case for the importance of re-designing learning contexts. Papa (2011) stated in the preface of *Technology Leadership for School Improvement* that technology leadership is required for school improvement and change, and Nussbaum-Beach and Ritter Hall (2012) made a plea that educators become more "connected" for learning and leading in a digital age. Ertmer (1999), Kirkland and Sutch (2009), Law,

Educational Research for Social Change, April 2013, 2 (1)

Faculty of Education: Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

Pelgrum and Plomp (2008), Du Plessis and Webb (2012b, 2012c, 2012d), and Tsai and Chai (2012) have argued that there are several first-, second-, and third-order barriers that seem to be impeding ICT implementation and integration within educational contexts. Tsai and Chai's (2012) third-order barrier, namely, design thinking, could actually represent a fourth order because a third-order barrier has already been shown by Kirkland and Sutch (2009) and Du Plessis and Webb (2012d) as being on a systems level. Subramanien (work in progress) has found that these barriers are also experienced within a multi-grade context in rural communities, but that some categories of the barriers are different in the multi-grade context—suggesting that there is no one-size-fits-all panacea when looking at challenges pertaining to ICT implementation within the school context.

Another aspect that requires attention is that it seems that ICTs have not yet been fully harnessed within the higher institutional sector. It appears that the reason why ICTs are not being harnessed may be because of a scarcity of information and real context practice in the form of clear guidelines of *how* to integrate ICTs into curricula (Hodgkinson-Williams, 2005; Leach & Moon, 2000); hence, the “how to” aspect, and the sharing of the how to, seem not to be filtering through.

A number of ICT-focused conferences, world wide, have engaged with various aspects of how to. The 2012 Tech4Dev International Conference in Switzerland focused on “Technologies for Sustainable Development: A Way to Reduce Poverty?” and aimed to promote social transformation and change. The annual Australasian Society for Computers in Learning in Tertiary Education (ASCILITE) conference in Australia is a proponent of the use of ICTs in teaching and learning. The International Federation for Information Processing (IFIP) hosted the 12th International Conference on Social Implications of Computers in Developing Countries in May 2013. The above three examples represent only a drop in the ICT conference ocean, but what becomes evident is that the education sector is becoming more and more aware of the potential, and the pitfalls, of technology. It seems that the educational community is not viewing ICTs as the medicine that will cure all the educational issues at hand, but that they do accept that it offers many possibilities to not only think about teaching and learning differently, but also to experiment with its possibilities.

All of the above has implications for innovative thinking towards the use of ICTs in education. It challenges us to ask questions such as:

- What are current experiences of using ICTs in educational settings?
- What pedagogical innovation could ICTs bring?
- What methodological innovation could ICTs bring?
- How can ICTs be used in creative and novel ways in research and engagement?
- What is the link between ICT and educational change?

Many questions pertaining to ICTs are raised, but do we have the answers? In this issue we definitely do not profess to provide answers to all the above questions; rather, we provide a glimpse of the possibilities that ICTs offer in education—possibilities that could assist with social change.

The articles in this issue

This issue offers some ideas towards harnessing ICT to assist with changing the thinking in the educational landscape and towards highlighting the potential it has for social change.

In “Systems Thinking and Technology Integration as Catalysts for School Change in High Need Schools: IMPACT V and the Alignment of Organizational Ends and Means”, **Anthony Chow, Kimberley Hewitt, and Holly Downs** of the University of North Carolina describe the infusion of technology into middle and high schools across the state of North Carolina in the USA. This was to assist participating schools with an ICT integration process by means of a systems thinking approach, based upon a ‘Three-Prong Curricula Design’. The participating schools seem to have had a large teacher turnover rate, large achievement gaps among learners, and be located within impoverished areas. The logic model of the W. K. Kellogg Foundation was used because it provided a framework for the ICT implementation process that assisted schools with the identification of clear goals, activities, outputs, and outcomes. The results suggest that the principals found the process difficult at the start but that, through the on-going support and as a result of the systems thinking approach, this changed to confident and satisfied principals. The authors claim that this project has had an impact on social change within the participating schools’ contexts and also provide useful guidelines and implications that could be taken into consideration and even be adapted within similar contexts, worldwide.

Jean Greyling, Melisa Koorsse, Twanda Ngundu and Michael Kyazze from the Nelson Mandela Metropolitan University (NMMU) in Port Elizabeth in South Africa provide, in the second article, “Mobile Instant Messaging (MIM) Applications to Assist Learning in South Africa”, a glimpse of the possibilities that MIM applications offer pertaining to cellular (mobile) based learning. Their focus was to assist learners from public schools (township schools, in the South African context) in poverty-stricken contexts in Computer Application Technology (CAT) and Mathematics learning areas. They therefore developed applications to assist learners with the terminology related to computers and technology and mathematics. Many learners from these schools did not have access to textbooks during class time or after school and, in addition, these learners had limited access to computers at school and at home. The authors report on the popularity and effectiveness of MIM applications as tools to assist learners from impoverished contexts and they suggest that the mobile platform has great potential as alternative to assist with learning in contexts where ICT resources such as computer desktops and laptops are not available.

Damian Maher from the University of Technology, Sydney, Australia reports in the third article, “Pre-service primary teachers’ use of iPads to support teaching: Implications for Teacher Education”, on the use of iPads (tablets) by pre-service primary school teachers (students) to support learning, using a qualitative approach. The author explores the Technological Knowledge, Pedagogical Knowledge, and Content Knowledge (TPACK) framework as the three types of knowledge that should be embedded within a teaching programme. He reports on the teaching related and non-teaching related usage of iPad apps and found that the participating teachers were using the iPad in innovative ways.

In “The Influencers of Scholars’ ICT Career Choices”, **André Calitz, Jean Greyling and Margaret Cullen** from the NMMU draws on his unpublished second doctorate which argues that there is an ICT skills shortage that compromises the business and education domains. He further states that there seems to be uncertainty, from the learners’ side, of what ICT is about and the career paths that ICT offers. He also laments the fact that the vast majority of schools within the South African context are without ICT resources. The foci of his research are the roles that parents and teachers play in career counselling and how learners obtain career information pertaining to ICT. In addition, he indicates strategies that the ICT department at the university has implemented to assist learners regarding raising their ICT awareness.

Then, in “Pedagogic Strategies to Support Learning Design Thinking in a Masters Course”, **Cheryl Hodgkinson-Williams and Andrew Deacon** of the University of Cape Town in South Africa describe the pedagogic strategies that they have adopted in order to model and support design thinking within a module called Online Learning Design, which forms part of a Masters programme. They explain how they have used the framework and ideas of Dabbagh and Bannan-Ritland’s (2005) classification of pedagogic

strategies to assist students with fostering learning design thinking, and draw on activity theory to describe the learning context and pedagogical change. They come to the conclusion that one has to embed what one wants to teach in one's practice.

Claire Donald and Garry Miller of the University of Auckland in New Zealand, in their article titled, "Exploring flexible e-learning options in a postgraduate project management course", provide an overview of their project. Their three aims were: to increase flexibility for part-time and distance students by integrating ICTs into the teaching and course materials; to use the project as a trial for further ICT and e-learning integration in other postgraduate engineering and business courses; and to adopt a research-based approach using peer review and formative evaluation of specific features of the course in collaboration with colleagues (teachers, engineers, and learning designers) at each stage of development. Their thinking was based on "teaching presence" (Garrison, Anderson & Archer, 2000), a key element of the Community of Inquiry (CoI) framework. Teaching presence can be divided into design as teaching presence, facilitation as teaching presence, and direction as teaching presence. The findings of this, their first iteration, suggest that the blended approach seems to increase student satisfaction, improves productivity during delivery, and increases flexibility in learning. They also provide the procedure for their second iteration.

The seventh and final article explores the social media domain, YouTube. **Peter Gustafsson** from Mälardalen University, Västerås, Sweden, presents a snapshot of physics teaching in "How physics teaching is presented on YouTube videos". This article is based on a conference paper that he delivered at the International Organisation of Science and Technology (IOSTE) in Tunisia in 2012. Gustafsson selected 120 video clips related to physics and science teaching published on YouTube and tried to ascertain how science concepts were taught in these videos. His findings suggest that the videos can be categorised into three modes of practice, namely, a traditional lecturing mode, students presenting their projects, and teachers who promote science material for teaching needs. He argues that the majority of explanation and teaching is still situated within traditional practice.

This issue concludes with a report by André du Plessis (Nelson Mandela Metropolitan University) on the ASCILITE 2012 ICT conference held in Wellington, New Zealand, as well as a review of Peter Rule and Vaughn John's book, *Your guide to case study research*, prepared by Inbanathan Naicker (University of KwaZulu-Natal).

This issue of ERSC hopes to further open up the debate and research for ICT and social change world wide, and particularly in South Africa.

References

- Cochrane, T., & Bateman, R. (2010). Smartphones give you wings: Pedagogical affordances of mobile Web 2.0. *Australasian Journal of Educational Technology*, 26(1), 1–14. Retrieved from <http://www.ascilite.org.au/ajet/ajet26/cochrane.html>
- Dabbagh, N., & Bannan-Ritland, B. (2005). *Online learning: Concepts, strategies and application*. Upper Saddle River, New Jersey: Pearson.
- Du Plessis, A., & Webb, P. (2011). An extended Cyberhunts strategy: Learner centred learning-by-design. *Australasian Journal of Educational Technology*, 27(7), 1190–1207.
- Du Plessis, A., & Webb, P. (2012a). Digital immigrant teacher perceptions of an extended Cyberhunt strategy. *Australasian Journal of Educational Technology*, 28(2), 341–363.

- Du Plessis, A., & Webb, P. (2012b). A teacher proposed heuristic for ICT professional teacher development and implementation in the South African context. *Turkish Online Journal of Educational Technology*, 11(3), 312–325.
- Du Plessis, A., & Webb, P. (2012c). Teachers' perceptions about their own and their schools' readiness for computer implementation: A South African case study. *Turkish Online Journal of Educational Technology*, 11(4), 46–55.
- Du Plessis, A. & Webb, P. (2012d, October/November). *A proposed ICT implementation heuristic for schools in disadvantaged contexts: An African perspective from South Africa*. Paper presented at the Science & Technology Education for Development, Citizenship and Social Justice, IOSTE 15 Symposium, Hammamet, Tunisia.
- Du Plessis, A. & Webb, P. (2012e, November). A heuristic for higher level student cognitive thinking and questioning through collaborative student designed wiki-based Cyberhunts. Paper presented at the Seventh International Conference on Science, Mathematics and Technology Education in Muscat, Oman.
- Elliot, B. (2009). E-Pedagogy: Does e-learning require a new approach to teaching and learning? Retrieved from <http://www.scribd.com/doc/932164/E-Pedagogy>
- Ertmer, P.A. (1999). Addressing first- and second order barriers to change: Strategies for technology integration. *Educational Technology Research and Development*, 47(4), 47–61.
- Frater, J. (2007). Top 30 Failed Technology Predictions Retrieved from <http://listverse.com/2007/10/28/top-30-failed-technology-predictions/>
- Fullan, M., & Smith, G. (1999). Technology and the problem of change. Retrieved from <http://www.michaelfullan.ca/media/13396041050.pdf>
- Garrison, D., Anderson, T. and Archer, W. (2010). The first decade of the community of inquiry framework: A retrospective. *The Internet and Higher Education*, 13, 5–9.
- Gray, K., Thompson, C., Sheard, J., Clerehan, R., and Hamilton, M. (2010). Students as Web 2.0 authors: Implications for assessment design and conduct. *Australasian Journal of Educational Technology*, 26(1), 105–122. Retrieved from <http://www.ascilite.org.au/ajet/ajet26/gray.html>
- Hawkrige, D., Jaworski, J., & McMahon, H. (1990). *Computers in Third-World Schools*. London: MacMillan.
- Hodgkinson-Williams, C. (2005, July). Dust on the Keyboards: Policy Gaps in the Integration of ICT into the South African Curriculum. *Proceedings of the 8th IFIP World Conference on Computers in Education*, Stellenbosch, RSA: University of Stellenbosch.
- Kirkland, K., & Sutch, D. (2009). Overcoming the barriers to educational innovation: A literature review. Retrieved from http://archive.futurelab.org.uk/resources/documents/lit_reviews/Barriers_to_Innovation_review.pdf
- Law, N., Pelgrum, W.J., & Plomp, T. (2008). *Pedagogy and ICT use in schools around the world: Findings from the IEA SITES 2006 study*. Hong Kong: Springer, Comparative Education Research Centre.
- Leach, J., & Moon, B. (2000). Pedagogy, information and communications technology and teachers' professional knowledge. *Curriculum Journal*, 11(3), 385–404.
- Li, X., Chu, K. W., Ki, W. W., & Woo, M. M. (2012). Using a wiki-based collaborative process writing pedagogy to facilitate collaborative writing among Chinese primary school students. *Australasian Journal of Educational Technology*, 28(1), 159–181. Retrieved from <http://www.ascilite.org.au/ajet/ajet28/li.html>
- Luckin, R. (2010). *Re-designing learning contexts: Technology-rich, learner-centred ecologies*. London: Routledge.

- McLoughlin, C. & Lee, M. J. W. (2010). Personalised and self regulated learning in the Web 2.0 era: International exemplars of innovative pedagogy using social software. *Australasian Journal of Educational Technology*, 26(1), 28–43. Retrieved from <http://www.ascilite.org.au/ajet/ajet26/mcloughlin.html>
- Nussbaun-Beach, S. and Hall, L.R. (2012). *The connected educator: Learning and leading in a digital age*. Bloomington, IN: Solution Tree Press.
- Papa, R. (Ed.). (2011). *Technology Leadership for School Improvement*. California, Thousand Oaks: SAGE.
- Schifter, C.C., & Stewart, C. (2012). Technologies and the classroom come to age. In C.M. Stewart, C.C. Schifter, & M.E.M. Selverian (Eds.), *Teaching and learning with technology: Beyond constructivism* (pp. 3–26). New York: Routledge.
- Scutter, S., Stupans, I., Sawyer, T., & King, S. (2010). How do students use podcasts to support learning? *Australasian Journal of Educational Technology*, 26(2), 180–191. Retrieved from <http://www.ascilite.org.au/ajet/ajet26/scutter.html>
- Selverian, M.E.M., & Stewart, C. (2012). 'Real' learning in virtual worlds: An integration of media, curricula and pedagogy through telepresence. In C.M. Stewart, C.C. Schifter, & M.E.M. Selverian (Eds.), *Teaching and learning with technology: Beyond constructivism* (pp. 261–285). New York: Routledge.
- Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology and Distance Learning*, 2(1). Retrieved from <http://www.webcitation.org/5Xuh37vbA>
- Siemens, G. (2006a). *Connectivism: Learning theory or pastime for the self-amused?* Retrieved from http://www.elearnspace.org/Articles/connectivism_self-amused.htm
- Siemens, G. (2006b). *Knowing Knowledge*. Retrieved from <http://www.scribd.com/doc/5156367/Knowing-Knowledge>
- Subramanien, B. (work in progress). Multi-grade teachers' perceptions of the Intel Teach programme as a strategy to assist with their challenges within the multi-grade context. (MEd in progress). Nelson Mandela Metropolitan University, Port Elizabeth, South Africa.
- Tsai, C.-C., & Chai, C. S. (2012). The "third"-order barrier for technology-integration instruction: Implications for teacher education. In C. P. Lim & C. S. Chai (Eds.), *Building the ICT capacity of the next generation of teachers in Asia*. *Australasian Journal of Educational Technology*, 28(6), 1057–1060. Retrieved from <http://www.ascilite.org.au/ajet/ajet28/tsai-cc.html>
- Watson, T. J. (n.d.). In *Wikipedia*. Retrieved from http://en.wikipedia.org/wiki/Thomas_J._Watson

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Systems Thinking and Technology Integration as Catalysts for School Change in High Need Schools: IMPACT V and the Alignment of Organisational Ends and Means

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Abstract

As part of a grant project in the state of North Carolina in the United States, eleven schools participated in the IMPACT V project, designed to help infuse technology into middle and high schools across the state. Involvement in the program required the preparation of a detailed action plan identifying how each school would use grant funding, coaching, and graduate-level courses to integrate technology effectively. Faculty assigned to mentor and provide direct instruction to the principals of the participating schools soon determined that there was a high degree of variability in terms of how well prepared principals were to plan, develop, and implement their respective action plans in a systematic fashion. Each school was asked to prepare a logic model designed to help both their planning and implementation of IMPACT V funds through identification of clear goals, activities, outputs, and outcomes. Preliminary results of our study indicate that principals were initially disoriented and confused when introduced to the project, and their preliminary action plans were not grounded in a clear understanding and plan for technology integration. The cohort model provided a lot of necessary support, and the action plans changed over time with statistically significant differences found between pre and post action plans. In terms of participant attitudes, principals have moved from excited and frustrated at the beginning of the project to confident and satisfied as their technology integration action plans have evolved into living documents that have helped them utilize systems thinking in planning and implementing technology into their schools.

Keywords: Systems Thinking; Technology Integration; Logic Model; Artefact Analysis; IMPACT V.

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Introduction

An interdisciplinary research team collaborated to study the impact that using systems thinking and logic models had on the refinement and implementation of IMPACT V action plans by participating school level stakeholders who had received extensive funding for technology integration in their respective schools. The team comprised of three university faculty members representing three different departments within the School of Education at the University of North Carolina at Greensboro (UNCG) —information science, educational leadership, and educational measurement—two of whom are course instructors.

The IMPACT V Grant

The IMPACT V grant entitled, “Building 21st Century School Leadership” positions technology integration as a catalyst for school improvement through leadership and technology access to principals, teachers, and students (North Carolina Department of Public Instruction, 2005). The primary goal for IMPACT V is:

Based on valid research and reflecting the recommendations of the revised North Carolina Educational Technology Plan (2005–2009), the IMPACT model . . . assures that the media and technology resources and conditions necessary to support the teaching and learning process are present. (Hewitt, Lashley, Mullen, & Davis, 2012)

The project originally included 13 administrators from 12 high-need schools across a southeastern state in the United States that participated in an online [Specialist in Education \(EdS\) in Educational Leadership](#) program as part of the project. The instructional framework involved:

A three-pronged curricular perspective on curriculum that underscores this online leadership preparation initiative in order to reach our desired target of building 21st-Century leadership. Three overarching concepts or “target arrows” of this program innovation are (1) to engage in leadership development through coursework, institutes, and enrichment activities within a social justice framework (Normore, 2008); (2) to promote through the internship experience practice-based leadership coaching to increase school team/democratic decision making and empowerment in schools (Papa & Papa, 2010), and (3) to anchor these two major goals through school improvement specifically aimed at technology leadership at multiple levels. (Schrum & Levin, 2009, as cited in Hewitt, Lashley, Mullen, & Davis, 2012, p. 8)

Figure 1

IMPACT V Three-Prong Targeted Curricula Design (Hewitt et al., 2012)



- 1) *Leadership Development within a Social Justice Framework*
- 2) *Practice-based Leadership Coaching for Empowerment*
- 3) *Technology Leadership: School and Classroom Levels*

Participating schools were selected for the project based on two core factors—they served a high needs student population based on socioeconomic criteria and they did not have a technology facilitator.

Potential participants completed an extensive visioning and planning process over a four-month period. The IMPACT V model involves:

School teams comprised of the principal or assistant principal, four teacher leaders representing core curricular areas, and one media specialist. The district level media/technology director also constitutes the team. The core curricular teachers are currently participating in a fully online Masters of Instructional Technology program at another university in North Carolina while the practicing administrators are earning the EdS degree through our new online program, which functions informally as a cohort. These school teams are figuring out how to work collaboratively to develop a school improvement action plan and provide professional development for their schools while seeking support and resources from their district office. (Hewitt, Lashley, Mullen, & Davis, 2012, p. 8)

The IMPACT V grant provides participating schools with substantive funds for technology equipment/infrastructure, professional development, the school team's graduate school programs, and leadership coaching.

The problem among schools, however, was the absence of a guiding framework in which to implement technology integration in a systematic fashion that was both well aligned with the schools' existing goals and also within the existing capabilities of their teachers and respective school climates. School principals became frustrated when dissonance arose between what was being asked of them by the grant, and what they were learning in their coursework, and what they were experiencing in application—especially as it related to technology integration, assessment, and systems thinking. Two of their primary instructors are authors of this article, which reflects the action research involved in addressing this unexpected problem by introducing systems thinking and how it positively impacted these projects.

Literature Review

Systems Thinking

A system can be defined as a “set of elements that function as a whole to achieve a common purpose” (Betts, 1992, p. 38), and systems thinking emphasises the need to take into account how smaller parts interact and interconnect with one another to form an entire system. Senge (2012) uses the family as an example of how to understand systems thinking, and refers to individuality and the interaction effect it has on a family unit as navigating a “web of interdependence.” Each member's individual behaviour has an impact on the others and also influences others' behaviour and, ultimately, the entire system. Senge also believes there are three primary components of systems thinking: 1) A commitment to learning, 2) Being prepared to accept when you are wrong, and 3) The need to triangulate. In Video 1, Senge (2012) describes systems thinking as a web of interdependence.

Video 1

What is Systems Thinking? (Peter Senge, 2012)



One of the first examples of systems thinking and education was developed as part of the United States' preparation for WWII (Chow & Whitlock, 2010; Instructional Design Central Website, 2009; Reiser & Dempsey, 2002). Faced with the need to mobilize millions of troops in a very short period of time, President Roosevelt called on the nation's top psychologists to help develop a training system based on contemporary human performance and learning. Based largely on BF Skinner's work, the field of instructional systems design (ISD) was born. After the war, other businesses and governmental organisations began using this methodology to provide training to impact their employees' overall skills and performance. A primary issue, however, that was soon discovered was that there are many aspects of an organisational system, outside of a worker's knowledge, skills, and abilities, that influence human performance. In Video 2, Joe Harless (2009) describes his definition of what performance technology means.

Video 2

What is performance technology? (Joe Harless, 2009)



The discipline that then emerged was called human performance technology (HPT) and emphasised the application of systems thinking to human and organisational performance. The foundational process for both instructional systems and human performance technology is the ADDIE process, which calls for a systematic process involving Analysis, Design, Development, Implementation, and Evaluation (Chow & Whitlock, 2010). It represents a systematic process of discovery, identification of clear goals, and continuous evaluation and improvement. Joe Harless, considered one of the forefathers of HPT, ultimately added assessment to the ADDIE model. Because data and existing information about the organisation and

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its stakeholders must first be collected before the analysis stage can begin, the revised model is A-ADDIE (Chow, 2008).

Systems thinking is characterised by the concept of synergy where “the whole (system) is greater than the sum of its parts (elements)” (Betts, 1992, p. 38) and it can be differentiated into hard systems thinking and soft systems thinking (Checkland, 1981; Dawidowicz, 2012). Hard systems thinking is most often applied as systems or operational analysis to environments where both problems and solutions are well defined and controlled; soft systems thinking, better known as “holistic” or “reflective” thinking is applied to systems that are less precise and where the variables are less controlled (Dawidowicz, 2012). A recent study of 172 people in the United States found that systems thinking was important to approximately 79.7% of all decisions made yet the majority of respondents demonstrated limited or no understanding of what exactly systems thinking was or how to apply it (Dawidowicz, 2012).

Another way to view systems thinking is through open (complex) and closed (simple) systems (Bates, 2013). An open system is complex because there are many variables that are uncontrolled, dynamic, and unpredictable; such systems must be adaptable and collect feedback continuously because change is constant. Closed systems are controllable, with linear thinking and feedback loops in which cause and effect are well determined and understood (Bates, 2013; Betts, 1992).

According to Alhadeff-Jones (2008) two opposing views of systems thinking have emerged over the past 50 years—first order and second order systems thinking. First order systems thinking attempts to reduce and breakdown the inherent complexity of any system into its individual parts; this type of thinking emphasises a reductionistic, autonomous perspective where a sum can be understood and controlled through its individual parts, which promotes “command and control” type thinking and leadership. Second order systems thinking adds a constructivist layer to first order thinking but accepts that many of the parts of a system are unique, independent, and will develop their own meaning and perspectives, which therefore requires participatory management and communication approaches (Alhadeff-Jones, 2008; Bates, 2013).

Ends and Means Thinking

According to Kaufman (1988), “all individual accomplishments within an organization must combine to provide a useful organizational contribution; some results are ‘building blocks’ for larger, overall ones” (p. 80). The means, resources committed to attaining a goal, and ends, the goal to be accomplished, can be described by five organisational elements (see Figure 2).

Kaufman’s (1988) model recognizes the need for clearly established ends or outcomes, and the alignment of means necessary to attain them, and illustrates how interrelated the organisational elements are.

Figure 2**Organizational Elements Model (Kaufman, 1988)**

	Inputs	Processes	Products	Outputs	Outcomes
	(New Material)	(how-to-do-its)	(en-route results)	(the aggregated products of the system that are delivered or deliverable to society)	(the effects of outputs in and for society and the community)
Examples	Existing human resources; existing needs, goals, objectives, policies, regulations, laws, money, values, societal and community characteristics; current quality of life.	Means, methods, procedures; searching for "excellence," teaching; learning; human resource development, training, managing.	Course completed; competency test passed; competency acquired; learner accomplishments; instructor accomplishments; production quota met; the performance "building blocks."	Delivered automobiles, sold computer systems; program completed; job placements; certified licenses, etc.	Safety of outputs; profit; dividends declared; continued funding of agency; self-sufficient, self-reliant, productive individual; socially competent and effective, contributing to self and to others or to substances; financial independence.
Scope	Internal (Organization)				External (Societal)
Cluster	Organizational Efforts		Organizational Results		Societal Results/Impacts

When applied to educational environments, systems thinking is often referred to as systemic change, which reflects the need for holistic solutions to the complex problems associated with public education. Reigeluth (1992) noted that there are two types of change: piecemeal, and systemic—which is often referred to as paradigm shift. Piecemeal involves singular changes that do not take into account other aspects of the system that also need to be addressed for any effective or long-term change to occur. Systemic change involves looking at all aspects of the system to ensure that the change that takes place is aligned with, and resonates throughout and around, the organisation (Reigeluth, 1992). According to Banathy:

In education, it must pervade all levels of the system: classroom, building, district, community, state government, and federal government. And it must include the nature of the learning experiences, the instructional system that implements those learning experiences, the administrative system that supports the instructional system, and the governance system that governs the whole educational system. (Banathy, 1991 as cited in Reigeluth, 1992, p. 2)

The application of systems thinking to public education is a natural fit because educational systems represent complex organisations with a large variety of human performance. Kemp (2006) believes that education has not kept up with the changing world; that the information age requires our educational institutions teach new skills such as “the development of initiative, creativity and skills in critical thinking and problem-solving, mental and physical skills needed for productive work, using advanced technologies, engaging in group-processes and developing good habits for self-direction and personal growth” (p. 20). The ends have changed, and the means through which we prepare students must change also.

Bates' (2013) research on the use of systems thinking in United Kingdom public education suggests, however, that first order systems thinking on its own can be detrimental rather than the educational panacea many had hoped for. Referred to as the "self-improving" system of public service, the United Kingdom has adopted a model for public services reform predicated on four interrelated factors: "top down performance management, capability and capacity, market incentives, and users shaping the service from below" (Bates, 2013, p. 41). Applied to public education, however, this approach treats schools as closed systems and ignores the dynamic variables of pedagogy, children, local variability and needs, teachers, and so forth—which does not honour the unique contexts in which they take place, and which are not accounted for through systems thinking (Alhadeff-Jones, 2008; Bates, 2013). Ultimately, the United Kingdom example reflects the need for second order systems thinking:

Education as a public service needs to be recognised by policy-makers and school leaders as a complex phenomenon which cannot be reduced to abstract measures without diminishing the humanness of the children that it has a duty to serve . . . 'seeing like a state' can sever our connection to the real-life substance upon which ideas of improvement were based in the first place. (Bates, 2013, p. 52)

Alhadeff-Jones (2008) suggests a third order of systems thinking that entails a recognition that, in fact, complex systems are complex and often defy explanation, reduction, or specific definition. Harless (1998) would, more particularly shift focus from trying to predefine the system as a sum of its parts and rather focus on the outcomes—or what he refers to as "accomplishments."

Accomplishment-based Teaching and Learning

According to Harless (1998), the primary goal for education needs to be accomplishment (a high quality end) focused "to produce graduates who have the knowledge, skills, information, and attitudes relevant to becoming accomplished citizens" (p. 20). He holds that the ultimate goal of education is not to go to college or even find a well-paying job but rather to become an accomplished citizen of society who has the soft and hard skills necessary to be competent and productive in life. An accomplishment reflects the short-term and long-term result or outcome of behaviour, or an output of doing the right things. Harless (1998) believes that there are three fundamental problems with education. First, it needs to shift its focus to WHAT it is trying to teach students rather than HOW it is educating its students. The WHAT needs to shift from subject content to societal accomplishments required, such as a strong work ethic, engineering skills, technology skills, and other product based accomplishments. In other words, it is less of what you know, and more what you can do.

Second, is a general lack of skills and knowledge of teachers on how to produce such accomplishment-based learning in their students because they only know how to teach as they were taught as students; the process is still focused on subject-driven content rather than application. Lastly, is low student motivation, which is linked directly to the first two causes—not seeing the relevance of subject-based content. Harless (1998) believes that solving these three problems in education will represent the systemic paradigm shift called for by others: 1) Focus on learning goals that are accomplishment-based, 2) Improve teaching so that it focuses on attained ends rather than content, 3) Improve student motivation by improving on 1 and 2.

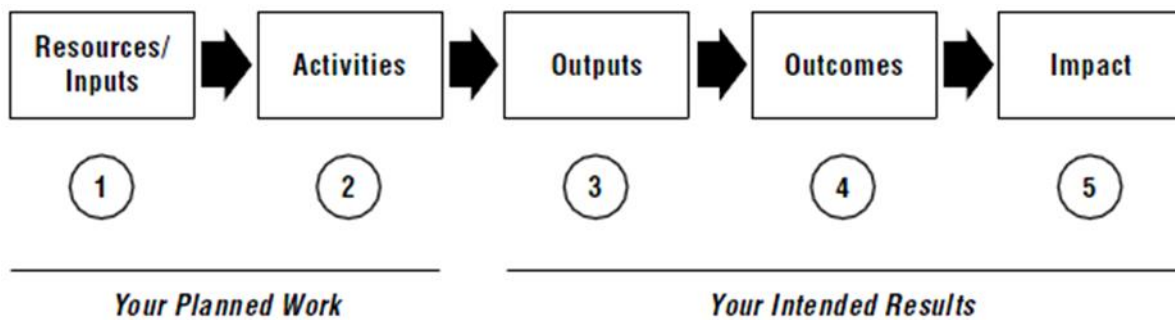
The Logic Model: A Framework for the Application of Systems Thinking in Education

The W. K. Kellogg Foundation (2004) defines a logic model as a "systematic and visual way to present and share your understanding of the relationships among the resources you have to operate your program, the activities you plan, and the changes or results you hope to achieve" (W. K. Kellogg Foundation, 2004, p. 1).

Logic models help defines, “a picture of how your organization does its work—the theory and assumptions underlying the program [that]. . . . links outcomes (both short- and long-term) with program activities/processes and the theoretical assumptions/principles of the program” (W. K. Kellogg Foundation, 2004, p. III). The five elements of a logic model are inputs, activities, outputs, short-term outcomes, and impact or long-term outcomes (see Figure 3).

Figure 3

A Logic Model (W. K. Kellogg Foundation, 2004)



Inputs reflect the resources that are allocated, *activities* are the actions taken (using the inputs) toward achieving the desired *outputs*, which are the direct results or products of the activities; *outcomes* are the specific changes in behaviour, and *impact* is the long term, fundamental change that has been achieved (W. K. Kellogg Foundation, 2004). The National Science Foundation (NSF) refined the logic model to reflect only four elements—inputs, activities, outputs, and outcomes (Westat, 2002).

The logic model has been derived from Kaufman’s Organizational Elements Model (OEM) and reflects an operational process for applying systems thinking to organisational performance. For the IMPACT V grant, each school was allocated state funds to infuse technology into their classrooms, and the logic model (see Figure 4) helped establish that technology and technology training represented inputs and activities rather than the actual ends of the project.

Figure 4

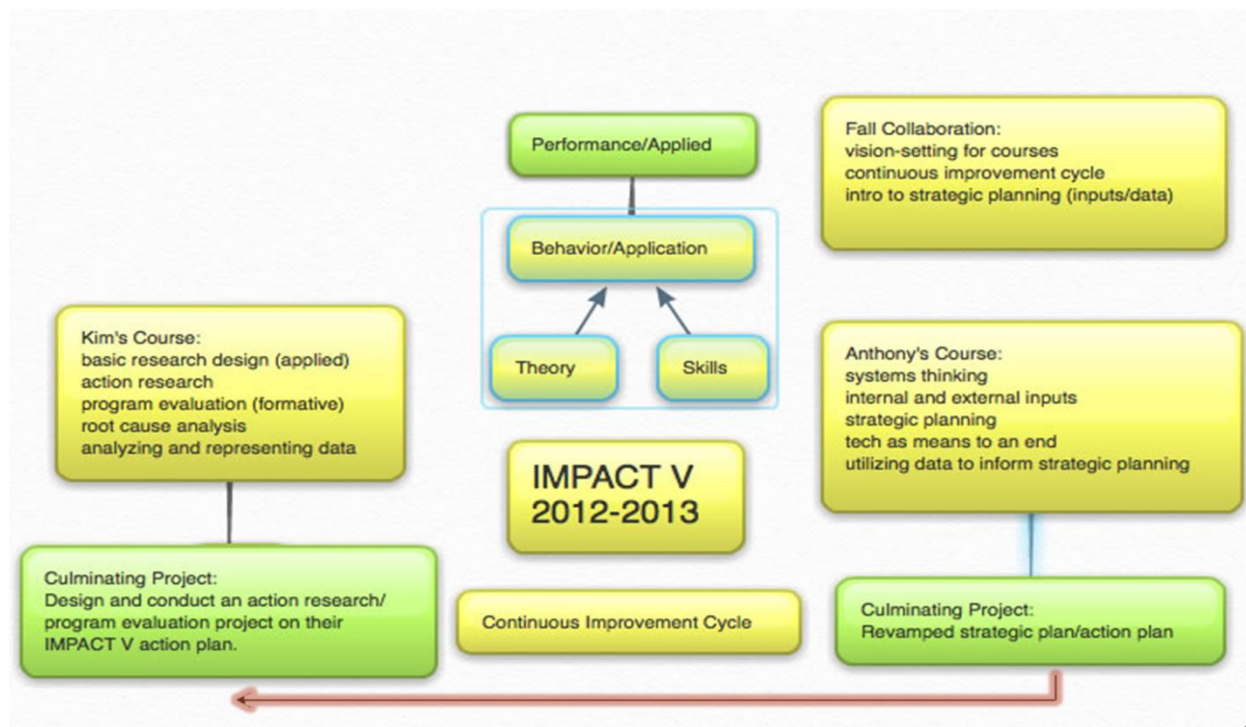
IMPACT V Logic Model

Goals (Ends)	Inputs	Activities	Outputs	Short-term Outcome	Long-term Outcome
	✓	✓	✓	✓	✓
Goal 1		T E C H N O L O G Y	P A R T I C I P A N T S	I M P A C T	
Goal 1 objectives					
Goal 2					
Goal 2 objectives					

Two courses in particular were co-designed around the educational administrators, in pursuit of their EdS degree as part of the grant, of each of the participating schools as part of their respective technology integration action plans: basic methodology, action research, and program evaluation in the first course; and the systems approach to planning, integrating technology, and utilizing research data, which involves strategic planning and utilizing data, in the second. The end goal for both courses would be for administrators to be able to take skills from both courses and apply them in their respective schools using the theory and skills taught to them (see Figure 5).

Figure 5

IMPACT V Courses for Principals



Research participants were introduced to the logic model after developing their initial action plans for technology integration. Our study examines the impact of using the logic model and the systems thinking that it reflects by seeking to answer three research questions:

- What are the barriers, strengths, and supports to implementation of the IMPACT V action plans?
- How do the participants' action plans change over time?
- How do principals' attitudes about action planning change over time?

Method

The results of our study have been collected and analyzed through participant interviews of the principals and artefact analysis of their initial and revised action plans.

Design: Pre–post design using artefacts and interviews

Interviews

Participant interviews to date have taken place with six of the 11 administrators (two have dropped out of the project). The interviews were comprised of 12 open-ended questions about the project (See Appendix A). All interviews were 60–90 minutes in duration and were transcribed and examined for major themes.

Interview data were examined holistically and then coded analytically for themes and patterns (Bogdan & Biklen, 2007; Cresswell, 2003). Using initial and focused coding (Lofland & Lofland, 1995), data were examined vis-à-vis the research questions using an iterative process of developing and clarifying data categories. Memoing (Cresswell, 2003) was instrumental in ascribing meaning to categories and refining them (Rossman & Rallis, 1998). Throughout the data analysis process, the authors were mindful of the “problematic and sometimes contradictory nature of data” (Fontana & Frey, 2005, p. 714). So, for example, as themes under *barriers* emerged, some interviews reflected barriers specific to implementing the specifics of the project while another reported barriers in implementing the project in general. Frequent mentions of the first, however, as opposed to a single mention of the second, helped further enrich the qualitative data presented in our findings.

Artefact Analysis: Action Plan Rubric Development and Scoring

Through this part of the study, the researchers sought to 1) derive instruments that explored data naturally occurring (required from the grant and class activities), and 2) develop tools for investigation of both qualitative and quantitative data that could be used repeatedly to gather longitudinal data—allowing the research team to look across time at the program artefacts.

First, data naturally occurring as a result of participation in the program were investigated. The team developed a rubric for scoring the action plans on seven categories (see Table 1) in order to probe the second research question. Rubrics are assessment rating scales that are commonly used in education (Allen & Knight, 2009; Hogan, 2005; Mertler, 2001; Moskal, 2000). For this task, an analytic rating (Mertler, 2001) scale scored on a 5-point scale, with 1 being defined as poor and 5 being defined as excellent, was developed to separate out the characteristics of the parts of the action plans that the participants were required to do in the ACTION V project. The parts of the action plan correspond directly with the seven categories on the rubric; the examples were required and delineated by the ACTION V grant, and definitions were developed by the research team to assist in defining common criteria for scoring the action plans.

Schools’ initial action plans and their revised action plans at the end of Year 1 were then scored using the scoring rubric. To ensure consistency and to adhere to the recommendations in the literature, definitions were set before the scoring commenced (Hogan, 2005), and the same person scored all.

Table 1**IMPACT V Action Plan Rubric Categories, Definitions, and Examples**

Rubric Category	Definition	Examples
Introduced Vision for the IMPACT model at the school	Degree of completeness and clarity of the goals (i.e., what the project hopes to change) as a result of participation in the overall program.	Goal: All faculty members will be 21st century professionals, using technology for teaching & learning, collaborating, and communicating. Goal: All students will be 21st century learners, using technology for thinking & learning, collaborating, and communicating.
Outlined Priorities and Objectives	Degree that the objectives (i.e., specific priorities that are measurable and lead to the overall goal of the program) are clear, accurate, and informative for the reader and are aligned with the overall goals of the program.	All teachers will be encouraged and supported to advance along the Technology Use in Classrooms continuum (from "productivity" to "instructional presentation and student productivity" to "student-centred learning" through the effective Implementation of the IMPACT Model
Identified Steps/Strategies	Degree that the steps are complete clear, understandable, and are consistent with the objectives of the program.	All teachers will have access to professional development and point-of-need coaching.
Delineated inputs/activities with Timeline and responsible persons	Degree that the inputs are complete, accurate, and provide an overview of the program scale and size with specific timelines and personnel (i.e., what people and resources are needed to achieve the objectives with concrete and realistic dates).	Needs Survey "IMPACT Workshops" August 2011 Needs Survey Aug. IMPACT V Professional Development
Explained Evaluation Questions	Degree that the evaluation questions reflect an understanding of what the program needs to ask that are observable, measurable, and realistic in giving an overview of the projects' implementation, value, and impact.	What type of support do teachers need? Are teachers using what they learn in professional development sessions in their classes? How so?
Identified Evaluation Data sources	Degree that the data sources, collection techniques, and corresponding indicators to monitor the progress toward achieving the objectives are outlined for the program and are realistic.	Needs Survey Data Anecdotal Evidence Overall conclusion.
Summary and Next Steps	Degree that the evaluative information above were used and summarized to discuss the implementation, value, and impact of the program of what actually happened and/or changed for the program constituents or community as a result of participating in the program and how this informs future directions.	Interpretation of Data and Action Steps: What do the results mean? What are you going to do now?

Note: All categories were scored based on the degree they met the criteria set in the definition. These were scored on a 5-point scale, with 1 being defined as poor and 5 being defined as excellent.

Sample, Setting, and Ethical Issues

All participants were educational administrators of each of the IMPACT V schools. Interviews were conducted at the University of North Carolina at Greensboro's School of Education. Each participant was provided with an informed consent form and interviewed by a research assistant so that both the anonymity and confidentiality of the interviewee was maintained and they were free to speak openly and candidly about the project.

Ethical considerations centred on the fact that two of the researchers were also instructors of record and responsible for the grades of each participant. The university institutional review board, however, found minimal risk was involved because the study's research questions and goals of the interview were not focused on the quality of instruction or the roles played by their instructors but rather the evolution of the

technology integration project. Furthermore, all participants were informed they had the right to refuse to participate, which half did, and research assistants were used to conduct the interviews to avoid biasing responses and so that each participant could speak freely and openly.

Data Analysis

Descriptive statistics on pre- and post-participation rubric scores were done. Next, the Wilcoxon test for non-parametric data and matched pairs was used to observe differences between the means for the pre- and post-participation, because this is the most appropriate analysis with this particular sample size and the available data.

Results

Interviews: Initial Findings

With little exception, each of the interview participants recounted consistent experiences with the grant and their action plans. While each participant's school context was unique, and while those unique elements certainly nuanced each school leader's perceptions of the grant, data were surprisingly consistent across participants. The following sections present findings for each of the three guiding research questions.

Barriers

To be considered for the IMPACT V grant, eligible schools had less than two weeks to submit a proposal, including an action plan, for how the grant would be used to promote substantive school change. For most participants, those initial plans were hurriedly constructed and were primarily designed to be attractive to the granting agency as opposed to serving as a guiding document for change. As one respondent recounted: "We had to say certain things. But to be honest, it was a document we did not refer to, we did not refer back to it the whole first year." Another respondent explained:

Well, the action plan, when we initially had to create this—it was just because, you know, this was something they said you had to do. It didn't really take on a whole lot of meaning until we took a class in which we started looking at it a little more closely and actually understood that we needed to make measurable goals . . .

Each of the participants discussed the action plans as being living documents that "evolved" over time. The most frequently and vociferously cited barrier to the development and implementation of their action plans was a lack of clarity regarding what was expected of the action plans by the granting agency. One participant confided, "The whole first year, I could not have defined what I thought that IMPACT grant was." One participant explained:

We didn't know what the IMPACT grant was all about. The whole first year, IMPACT was about like sticking Jell-O to the wall. It was one thing one month, it was a different definition the next, nobody could define it. I actually was told it's whatever you want it to be in your school. The first year it was very hard to write good goals and to write an action plan because you didn't know really what, I hate to use the term "what they were looking for" because I truly think it is what we want it to be, but within certain guidelines. At the end of this past—the second summer—we got clarity.

Each of the participants used the word “frustrating” to describe this lack of clarity. Participants described clarity developing over time and especially being a function of a “course correction” announced in the second summer of the grant by the head of the granting agency. The course correction included a focus on four expected outcomes of schools’ participation in the grant. These four outcomes would serve as the structure for grant reporting to the agency.

For some participants, there was a sense of “why didn’t they just tell us this stuff in the beginning,” while for others there was a sense that the granting agency was “building the plane in the air, with not having a clear understanding of what [sic] final product was expected . . . that’s always been kind of a moving target.” And another stated: “But as we got more direction, the requirements also have changed.”

Related to this was a lack of effective communication among the partners in the grant: state granting agency, the universities providing the EdS and MEd programming, the leadership coaches, and the state agency technical support consultants. Another participant explained:

I also think that maybe you need to get your ducks in a row to start with—that would be very, very helpful to the process, and I think it would have alleviated a lot of frustration and a lot of stress for a lot of people. And it just seems to me that there is a real lack of communication amongst the agencies that are responsible for all of us. The university, DPI [the state agency], it just seems like there’s a lack of communication. It’s interesting, the summer institute, one of the ladies that was leading that kept talking about us having to create a plan, and when we finally, it was my table we finally called her over. ‘Cus I kept telling my team, I think she is referring to the action plan that we’ve already written, and they kept saying, I think she wants something different. And she didn’t even know that we had action plans written . . . How does someone not tell you that?

Several participants noted attempts by the university to “bridge” or connect the state agency’s expectations from the grant to the university coursework.

Another barrier to planning and implementation of IMPACT action plans was the inundation of other initiatives and changes expected of schools. Statewide there was a shift to the Common Core State Standards and Essential Standards, requiring new curricula in almost all instructional content areas and new achievement testing aligned to the revised curricula. The first year of the IMPACT grant was also the first year of a new state educator evaluation system, which—for the first time ever—included a measure of educator effectiveness based on student test results. Additionally, each school had other initiatives that vied with the IMPACT initiative for time, energy, and attention. From one respondent:

When you’ve got to do the Common Core, and you’ve got to do PBIS [Positive Behavioral Interventions and Supports], and you’ve got to do AVID [program for encouraging students to seek and plan for higher education], and you’ve got to do all these other acronyms, then it just becomes consuming. So that affects the buy-in, when there’s so much on your plate. It’s like a family reunion: You might have the best pot of peas ever made, but you’ve got to taste a little bit of everything so you don’t offend Aunt Betsy. That’s the whole thing—being able to give [IMPACT] its just due.

Another respondent echoed this sentiment, emphasising that so much change was:

overwhelming for our staffs. It's just an overwhelming time. Is that stopping us from starting to implement IMPACT and doing good things with our teachers? No, it's not. But is it an impediment to effective implementation? Yes, it is. It's a lot to learn at one time.

Additionally, school leaders in the cohort felt overwhelmed by being administrators and graduate students simultaneously:

plus me being in school, plus having—we're still working full time jobs that are more than full time jobs. Sometimes things do get put on the back burner, and this is one of those things that's easy to put on the back burner.

Another barrier to planning and implementation of IMPACT was staff turnover. Three of the initial building leaders in the IMPACT cohort had left the program by the beginning of the second year because they left their positions as building leader of an IMPACT school (e.g., to accept another administrative position or because they were transferred). When this happened, the school was dropped from the IMPACT program. Other staff turnovers proved tumultuous and disruptive as well. In one IMPACT school, one of the assistant principals (AP) was going to serve as the IMPACT school leader; shortly before the first IMPACT event, the AP was transferred to another school, and another AP was assigned as the IMPACT school leader. The new AP overseeing the school's IMPACT program had not participated in developing the school's initial IMPACT plan, and she "literally read it the day before" her first IMPACT event. Within the same school, the media specialist suffered an injury and:

was out for almost the whole first semester, and it was her last year before retirement, so she had kind of disengaged from everything. So, we spent the first year really focused on ... nothing related to media, which is really the foundation of this whole thing.

Luckily, though, the IMPACT team at this school was instrumental in the selection process of the new media specialist, who was quickly on-boarded and gelled well with the IMPACT team.

Several of the building leaders in the IMPACT cohort were assistant principals, as opposed to principals. This created some tensions and challenges. As one participant explained, even though she was given "free reign" by her principal to lead IMPACT:

It has been awkward trying to fit my vision for IMPACT into someone else's larger school vision. And the communication has been good. It's not that it hasn't happened, but it's two separate people trying to work toward a goal coming at it from two directions. And him not being the person who was going to the meetings. For me, it's my life right now. For him, it's just another thing going on in our school.

Strengths and Supports

Overwhelmingly, participants noted various people as their most important supports for planning and implementing their action plans. Most commonly, they noted their building IMPACT teams (comprised of four core content teachers and the media specialist), the leadership coaches assigned to them, fellow students in the cohort, and their university instructors. Some participants also mentioned district leadership, especially technology personnel. Each of the participants felt that there were people

instrumental in bringing the plan together and then breathing life into it; these people also nudged the leaders when needed:

The IMPACT team . . . Just by being willing to do the work, by being willing to ask questions, by being willing to be open, by kicking me in the rear end when needed to be kicked, and by listening to my thoughts. Again, my technology department—technology coordinator—has been instrumental in what we’ve been able to do . . . And UNCG faculty, and the leadership training has been very, very helpful. And the coaching, the coaching aspect of it. I get frustrated because every time they come, they leave with me being half ticked-off because of, they ask the questions they need to ask, so I wish we had more time with them.

Participants also noted their university coursework as being instrumental in planning and implementing their action plans:

Working with Dr. Hollis [pseudonym used] now, for the first time, Dr. Hollis is starting to put together the pieces of ok, this is how we monitor what we’re doing to make sure we’re getting the impact that we should out of IMPACT. How we monitor our professional development (PD)? Is the PD being successful? Do we need to change something we’re doing based on what our data says? Is our student data aligned with the professional development that we’re providing? Are we doing the right things for children? You’ve got to monitor that for data and that part of our plan is still evolving. We’re still learning as practitioners how to do that now in our graduate courses. . . . That is an important part of implementation and monitoring as a leader and teaching our teachers how to look at data to see if what we’re doing is either effective or ineffective. And it’s okay to fail; it’s just not okay to keep doing it.

Without exception, participants lauded their fellow cohort members as being invaluable supports:

Oh my God, we talk all the time. The cohort has been an extraordinarily close cohort. We talk all the time about how our plans are set up, what are you doing with this, maybe that’s something I need to be looking at . . . We have looked at each other’s plan and we coach each other along and it’s been not only a coaching thing but a cheering each other along as well. It’s an arduous process doing these things . . . We don’t have anybody better to call than our peers in this game. We talk to each other more than we talk to our professors or our coaches.

In addition to people as supports, participants named several components of the grant that served as strengths for the project, including the emphasis on professional development (50% of grant funds had to be allocated to professional development), an emphasis on sustainability, and the relevance of the IMPACT project to other required initiatives (e.g., Common Core).

Changes in Action Plans

Each of the participants’ action plans changed substantially over time. Respondents referred to their plans as being a “living document” that “evolves” over time. All eventually saw their plans as guiding change in their schools, as opposed to—as many originally did—considering them artefacts “on a shelf”:

So we all wrote this action plan in the beginning when we wrote the grant, and I can tell you I don’t think any of us are using that iteration of our plan. And that iteration of the plan is pretty much defunct for us.

Some participants wrote their original action plans by themselves or with limited collaboration; over time, further iterations of the action plan were “much more of a collaborative effort” with the school’s IMPACT team.

Participants also talked about their plans becoming more narrowed and focused over time, and not so “pie in the sky.” The biggest change to the substance of the plans was to align goals with data for the purposes of monitoring and evaluation:

One of the things we said we wanted to do was raise test scores. Well, that’s a horrible measure, looking at it now. Yes, the score may have gone up. Was it related to technology? So through the process of the clarification . . . we’ve learned how to do some measurement . . . and to write a good goal that’s measurable. Those things have changed; it’s created better leaders.

Changes in Attitude toward Action Planning

Initially, most participants saw the required action plan as a pro forma step to accessing sizable grant funds. Over time, they came to see their revised action plans as authentic, guiding documents and to see the value of action planning: “It’s a living document that we [IMPACT team] review weekly in my office. Where are we? What’s on the calendar? What did we say we were going to do?” Further, as leaders, they gained the ability to apply their learning to other leadership endeavours:

When I first started, I had no idea how to even begin planning, setting the goals and how to measure it, and all of those things. Over the course of this time, I feel like I have a much better idea now of how to do this if I had to do it again with a different project.

Participants moved from the frustration of amorphous and possibly shifting expectations to a place of empowerment and energy:

In regard to IMPACT V, for about a full year, was pretty negative. We whined, we complained, and that was pretty much to [the state agency’s] face. I was pretty astounded at some of the, I don’t think venom is the right word, some of the angst . . . [now] I feel very comfortable that we’re going to do what we set out to do. I feel comfortable that we’re making the strides.

Increasing clarity regarding the IMPACT model and expectations, as well as coursework and instruction on topics such as data and evaluation, and the impact of early stages of implementation led to excitement and hopefulness:

We’ve moved so far ahead of where we were so I’m really proud of my whole school and all my teachers because there’s definitely that effort there. We’re not perfect and again, we’re not where we want to be, but gosh darn we’re a lot further than we were. So I’m really proud of them.

Participants also recognized the long-term benefits of the implementation of their action plans:

It has been a growing experience for me, and I think it’s becoming a growing experience for my staff, which is as I would expect it. It’s hard to lead something you don’t understand yet. I’m getting to a place now where I understand it, I understand what it should look like, and it’s

changed my vision for where I'd like to see my school two or three years from now. But I also understand that these changes don't happen overnight necessarily. I'm starting to learn now a lot more than I understood last year.

Overall, participants believed that their work with IMPACT made them better leaders:

I'm at a different place now in my leadership capability than I was a year ago . . . In short, the grant, I think, in the end is going to be an extraordinarily powerful grant . . . And I think it will be extraordinary in my school. It's just going to take a couple of years. And I mean a couple more years.

Artefact Analysis

Artefact analysis supports the qualitative findings that the project action plans significantly changed and evolved since the introduction of the logic model into the project. Evident from Table 2 below, the participants' action plan artefacts garnered between a 0 and a 1.78 mean on the pre-participation rubric, and between a 1.44 and a 3.89 mean on the post-participation rubric. A Wilcoxon test was conducted to evaluate whether the post-participation rubric scores were statistically significantly higher. The results indicated significant differences on six of the seven rubric categories with the post-participation means being higher. The rubric categories with the highest gains were evaluation-related items, including explained evaluation questions (with mean differences of 2.64 from 0.92 to 3.56) and identified evaluation data sources (with a mean difference of 2.39 from 1.50 to 3.89).

Table 2

Analysis of Rubric Categories from Pre to Post Participation in the Class (Wilcoxon matched pairs test)

Rubric Category	Pre-Participation		Post-Participation		Difference	Significance of Difference*
Introduced Vision for the IMPACT model at the school	1.92	0.97	3.11	1.36	1.19	0.062
Outlined Priorities/Objectives	1.33	0.83	3.22	1.09	1.89	0.011
Identified Steps/Strategies	1.42	0.83	3.22	0.83	1.81	0.011
Delineated inputs/activities with Timeline & responsible persons	1.58	1.13	3.22	0.83	1.64	0.017
Explained Evaluation Questions	0.92	1.30	3.56	0.88	2.64	0.007
Identified Evaluation Data sources	1.50	1.24	3.89	1.05	2.39	0.007
Summary and Next Steps	0.08	0.00	1.44	1.74	1.36	0.041
Totals	1.21	0.44	3.10	0.33	1.89	0.008

*Calculated using the Wilcoxon matched pairs test at $p < .05$.

Discussion

Our study is not complete at this time with four months remaining until the conclusion of the project. Our preliminary findings, however, allow us to suggest tentative answers to each of the study's research questions:

RQ1: What are the barriers, strengths, and supports to implementation of the IMPACT V action plans?

In terms of barriers, two major themes arose. First, was the sense that there was no initial direction, consistency, or continuity. This involved everything from everyone's plans looking very different from one another, inconsistent feedback, and even changing requirements of the project itself. The second theme was that because of the changing requirements, the results "did not make a lot of sense" and represented documents to just be "put on a shelf." Strengths of the process included the plans making more sense, and serving as a working document in which to evaluate progress of the project with measurable goals. Primary supports included the IMPACT V coaches, their fellow principals, project teachers, and the action research course they were taking at the same time.

RQ2: How did the participants' action plans change over time?

Through artefact analysis, it was clear that participant action plans were significantly different pre and post the introduction of the logic model. One high school action plan, for example, initially began with ten objectives focused on activities centred around technology integration. The central problem, however, was that this encouraged an emphasis on means or integrating technology in the absence of pathways towards specific and measurable goal attainment. Using a logic model framework which involved six elements—goals, inputs, activities, outputs, short-term outcomes, and long-term outcomes—the plan was rewritten into six specific goals followed by appropriate resources necessary to attain them, and with measurement strategies. Most importantly, outside of becoming more of a working document, use of the logic model allowed principals to prioritize technology integration activities based on goals and available resources.

RQ3: How do principals' attitudes about action planning change over time?

Their action plans, in fact, did change substantially over time to both their great frustration and ultimate satisfaction. According to one principal, he/she knew it was going to be a working document and it was "worded beautifully but couldn't be evaluated and measured . . . nobody told me that until just this past August." Frustration ensued because they had "put a lot of hours into this document, it (has) been to the entire school improvement team, the IMPACT team, central services, —thought it was good . . . but feedback needed, we are finally getting now." As participants were nearing the end of the project, one respondent remarked, "while it (has) been a frustrating process and we wish that we could have . . . inserted some of this at the beginning part of it, it is what it is."

Limitations and Implications

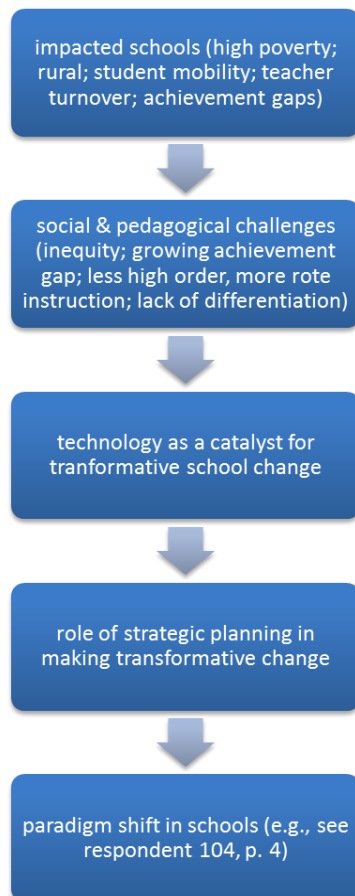
Limitations

The study has two primary limitations. First, only 11 principals and schools were involved, which reflects a low sample size and therefore limited generalisability. Second, the two-year grant project is still in process. As such, data is not yet available on the ultimate impact of the grant and action planning process on student learning and school culture.

Despite these limitations, the use of participant interviews and artefact analysis allowed us to triangulate data to identify emerging implications. The lessons learned may be useful in implementations with similar conditions. Figure 6 illustrates the theory of action underlying the IMPACT V approach to social change created by the authors. By pairing technology as a catalyst for substantive school change with systemic planning, pedagogical changes (e.g., increased expectations; higher order instruction) can influence social change (decrease in achievement gaps and increase in equity). The true impact and outcomes of the IMPACT V project in participating schools, however, remains to be seen in the future.

Figure 6

IMPACT V and Social Change



Implications

The use and integration of technology is intuitively a necessary and positive move in ensuring children are educated with the knowledge and skills they will need to be successful in a rapidly changing future. Systems thinking provides a logical framework from which to plan, implement, measure, and continuously improve technology integration projects that ultimately effect social change. This calls for the application of all three orders of system thinking: understanding the sum of the whole and its respective parts; adding constructivist meaning and perspectives to the natural order of complex systems (especially those involving human variables); and recognising that, in fact, complex systems are indeed complex and should often remain open and undefined and unreduced to a common denominator (Alhadeff-Jones, 2008). Harless (1998) operationalised all three through his accomplishment-based curriculum development (ABCD) process that emphasised end outcomes as opposed to rigid process or assessment benchmarks.

Conclusion

The preliminary results of our study suggest that principals, their action plans, and respective school implementations underwent a journey of discovery in how best to practice technology integration in a systemic fashion. As one respondent put it, their original plan was “beautiful” and vetted by the school stakeholders but was completely immeasurable and therefore difficult to achieve. Artefact analysis suggests that the original plans did a good job of articulating how schools were going to integrate technology but were done in a vacuum without clear pathways toward attaining specific short-term and long-term goals. The use of action planning must be situated within clear expectations and professional development and coursework related to systemic planning, logic models, and measurement. Additionally, participants need to know that action planning is an iterative process and that action plans are living documents that will necessarily evolve over time. Professional development, coursework, and experience with action plans significantly improve the quality of action plans. Finally, principals leading for substantive change need support systems that include coaches or instructors, and peers.

Additional trends and more comprehensive answers to the study’s research questions will take place after the study concludes in spring, 2013. The long-term implication of the study’s results is that it may serve as a playbook for future technology integration projects that will allow those that follow a clearer, more advanced pathway towards success. This should allow for others who follow a more precise process in which to frame the context of technology integration within the larger window of higher-level school outcomes and teacher-student accomplishments rather than as a goal and end in itself. Technology by itself is not directly correlated to higher student achievement; rather the goal is to appropriately integrate technology in such a way as to help facilitate and enhance the teaching and learning process towards achievement of clearly identified and negotiated student accomplishments.

References

- Alhadeff-Jones, M. (2008). Three generations of complexity theories: Nuances and ambiguities. *Educational Philosophy and Theory*, 40(1), 66–82.
- Allen, S., & Knight, J. (2009). A method for collaboratively developing and validating a rubric. *International Journal for the Scholarship of Teaching and Learning*, 3(2), 1–17.
- Banathy, B.H. (1991). *Systems design of education*. Englewood Cliffs, NJ: Educational Technology Publications.
- Bates, A. (2013). Transcending systems thinking in education reform: Implications for policy-makers and school leaders. *Journal of Education Policy*, 28(1), 38–54.
- Betts, F. (1992). How systems thinking applies to education. *Educational Leadership*, 50(3), 38–41.
- Bogdan, R. C., & Biklen, S. K. (2007). *Qualitative research for education: An introduction to theories and methods* (5th ed.). Boston, MA: Allyn & Bacon.
- Checkland, P. (1981). *Systems thinking, systems practice*. Hoboken, NJ: Wiley.
- Chow, A. (2008). Systems thinking and 21st century education: A case study of an American model for *high school educational reform*. Saarbrücken, Germany: VDM Verlag.
- Chow, A., & Whitlock, M. (2010). Systemic educational change and society: Georgia’s central educational center and career academies. *The International Journal of Science in Society*, 1(4), 127–134.
- Cresswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, CA: SAGE.
- Dawidowicz, P. (2012). The person on the street’s understanding of systems thinking. *Systems Research and Behavioral Science*, 29, 2–13.

- Fontana, A., & Frey, J. H. (2005). The interview: From neutral stance to political involvement. In D. K. Denzin & Y. S. Lincoln (Eds.), *The SAGE handbook of qualitative research* (3rd ed, pp. 695–728). Thousand Oaks, CA: SAGE.
- Harless, J. (1998). The Eden conspiracy: educating for accomplished citizenship. Wheaton, IL: Guild V.
- Harless, J. (2009). Joe Harless – HPT Practitioner 2009. Video podcast retrieved from http://www.youtube.com/watch?feature=player_detailpage&v=ZRbz2csfmwI
- Hewitt, K. K., Lashley, C., Mullen, C. A., & Davis, A. W. (2012). Game changers: Developing graduate faculty for a technology-rich learning environment. In J. Tareilo & B. Bizzell (Eds.), *Handbook of online instruction and programs in educational leadership* (pp. 45–59). Ypsilanti, MI: NCPEA Press.
- Hogan, T. P. (2005). *Educational assessment: A practical introduction*. Hoboken, NJ: Jossey-Bass.
- Instructional Design Central Website. (2009). *What is Instructional Design?* Retrieved from <http://www.instructionaldesigncentral.com>
- Kaufman, R. (1988). Preparing useful performance indicators. *Training & Development Journal*, 42(9), 80–83.
- Kemp, J. (2006). Foundations for systemic change: Societal evolution and the need for systemic change in education. *TechTrends*, 50(2), 20–26.
- Lofland, J., & Lofland, L. H. (1995). *Analyzing social settings: A guide to qualitative observation and analysis* (3rd ed.). Belmont, CA: Wadsworth.
- Mertler, C. A. (2001). Designing scoring rubrics for your classroom. *Practical Assessment, Research & Evaluation*, 7(25), 1–10.
- Moskal, B. M. (2000). Scoring rubrics: What, when and how? *Practical Assessment, Research & Evaluation*, 7(3). Retrieved from <http://pareonline.net/getvn.asp?v=7&n=3>
- Normore, A. H. (Ed.). (2008). *Leadership for social justice: Promoting equity and excellence through inquiry and reflective practice*. Charlotte, NC: Information Age Publishing.
- North Carolina Department of Public Instruction. (2005). *IMPACT model schools*. Retrieved from <http://www.ncwiseowl.org/impact/TOC.htm>
- Papa, R., & Papa, J. (2010). Leading adult learners: Preparing future leaders and professional development of those they lead. In R. P. Papa (Ed.), *Technology leadership for school improvement*. Thousand Oaks, CA: SAGE.
- Reigeluth, C. (1992). The imperative for systemic change. *Educational Technology*, 32(11), 9–13.
- Reiser, R., & Dempsey, J. (2002). *Trends and issues in instructional design and technology*. New Jersey, NJ: Pearson.
- Schrum, L., & Levin, B. B. (2009). *Leading 21st century schools: Harnessing technology for engagement and achievement*. Thousand Oaks, CA: Corwin.
- Senge, P. (2012). What is systems thinking? – Peter Senge explains systems thinking approach and principles. Retrieved from <http://www.mutualresponsibility.org/science/what-is-systems-thinking-peter-senge-explains-systems-thinking-approach-and-principles>
- Rossman, G. B., & Rallis, S. F. (1998). *Learning in the field: An introduction to qualitative research*. Thousand Oaks, CA: Sage.
- Westat, J.F. (2002). *The 2002 User-Friendly Handbook for Project Evaluation*. Washington, DC: NSF Directorate of Education and Human Resources.
- W.K. Kellogg Foundation. (2004). *Logic model development guide: Using logic models to bring together planning, evaluation, and action*. Battle Creek, MI.

Appendix A

Interview Questions

1. Describe your school and its role with IMPACT V and how you came to participate.
2. Talk about how you designed and refined your action plans over time and what had the greatest impact on them?
3. To what degree, and in what ways, have the action plans been implemented at your school?
4. What are the barriers to planning and development of the IMPACT V action plans?
5. What went well in the planning and development of the IMPACT V action plans?
6. What are the barriers to implementation of the IMPACT V action plans?
7. What went well in implementation of the IMPACT V action plans?
8. Describe who has supported you through the IMPACT V action plan planning process. How?
9. Describe your general perspective towards the IMPACT V project in general and the planning process.
10. How has your perspective towards the project and action planning changed from when you first started?
11. Talk about the general perspectives of your principal peers toward IMPACT V action planning.
12. Is there anything else you would like to share (anything they would like to say)?

Appendix B

Action Plan Analytic Rubric

NAME _____ SCHOOL _____

Total Score _____/35

Action Plan Category	Definition and Examples	Excellent				Poor	Non-existent
		5	4	3	2	1	0
Introduced Vision for the IMPACT model at the school	Degree of completeness and clarity of the goals (i.e., what the project hopes to change) as a result of participation in the overall program. Examples: Goal: All faculty members will be 21st century professionals, using technology for teaching & learning, collaborating, and communicating. All students will be 21st century learners, using technology for thinking & learning, collaborating, and communicating.						
Outlined Priorities/ Objectives	Degree that the objectives (i.e., specific priorities that are measurable and lead to the overall goal of the program) are clear, accurate, and informative for the reader and are aligned with the overall goals of the program. Examples: All teachers will be encouraged and supported to advance along the Technology Use in Classrooms continuum (from "productivity" to "instructional presentation and student productivity" to "student-centred learning" through the effective Implementation of the IMPACT Model.						
Identified Steps/ Strategies	Degree that the steps are complete, clear, understandable, and consistent with the objectives of the program. Example: All teachers will have access to professional development and point-of-need coaching.						
Delineated inputs/ activities with Timeline and person	Degree that the inputs are complete, accurate, and provide an overview of the program scale and size with specific timelines and personnel (i.e., what people and resources are needed to achieve the objectives with concrete and realistic dates). Example: August 2011 - Needs Survey on Professional Development						
Explained Evaluation Questions	Degree that the evaluation questions reflect an understanding of what the program needs to ask that are observable, measurable, and realistic in giving an overview of the projects' implementation, value, and impact. Example: What type of support do teachers need? Are teachers using what they learn in professional development sessions in their classes? How so?						
Identified Evaluation Data sources	Degree that the data sources, collection techniques, and corresponding indicators to monitor the progress toward achieving the objectives are outlined for the program and realistic. Examples: Needs Survey Data; Anecdotal Evidence.						
Summary and Next Steps	Degree that the evaluative information above were used and summarized to discuss the implementation, value, and impact of the program of what actually happened and/or changed for the program constituents or community as a result of participating in the program and how this informs future directions. Interpretation of Data and Action Steps: What do the results mean? What are you going to do now?						

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Mobile Instant Messaging (MIM) Applications to Assist Learning in South Africa

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Abstract

A typical problem experienced by Computer Application Technology (CAT) learners in mainly township and rural schools is that they do not have access to textbooks out of the classroom. The most common scenario is that these learners have access to textbooks during lessons, but then the books are left behind in class to be shared with other learners. This problem is made worse by the fact that these learners usually also have very little access to computers. Similar problems are experienced regarding the teaching of Mathematics.

This paper mainly reports on a mobile instant messaging application that was developed at the Nelson Mandela Metropolitan University, aimed at assisting CAT learners with a glossary of terms related to computers and related technologies. Furthermore, other mobile applications, developed at NMMU to assist learners, are discussed. The paper highlights, from the different usage data, the popularity and effectiveness of such applications. After investigating the issues that need to be addressed for such applications to be really effective and useful, suggestions for future work are made.

Keywords: Mxit; Mobile; Cell Phone; mLearning; Mobile Instant Messaging.

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Introduction

It is a generally known fact that learners in schools from mainly poorer and rural communities in South Africa have to overcome various challenges during their schooling careers. Of these challenges, the huge problem of good Mathematics education receives the highest media attention. The authors became aware of the fact that, in addition to Mathematics, many learners doing Computer Application Technology (CAT) as a subject do not have regular access to computers as well as to textbooks. Furthermore, interaction with

school learners via the instant messaging platform Mxit (<http://dev.mxit.com/>) highlighted a great need for study and career guidance, especially for learners in rural and disadvantaged areas.

Since the turn of the century instant messaging (IM) has become a preferred on-line activity mainly for teenagers, prompting several studies related to the use of IM in the learning environment. Kinzie, Whitaker, and Hofer (2005) from the University of Virginia investigated the use of IM in the classroom. Although they found that students were comfortable with the use of this technology, they could not conclude that it contributed to the learning process. Contreras-Castillo, Perez-Fragosa, and Favela (2006) found in a study conducted in Mexico that an IM system was a useful communication tool in a learning environment, with most of the communication taking place between students, rather than between teachers and their students.

Mxit is a popular IM service in South Africa, popular amongst young people, and since the penetration of smart phones, mainly used in less affluent communities. The aim of this paper is to present different Mxit applications developed by the Department of Computing Sciences, Nelson Mandela Metropolitan University (NMMU), and the results and impact of these applications on the target sample users. The purpose of the research surrounding each of these applications was to determine the viability of using a mobile instant messaging as a platform for education. Case studies presented in this article where research results are discussed, have obtained the necessary ethical clearance and have followed appropriate research strategies.

A general background is provided before different case studies in South Africa as well as at the NMMU are discussed where Mxit is used to address the educational needs of young people. The following sections then discuss new projects in the Department of Computing Sciences which address the issues relating to Mathematics, CAT, and career guidance.

Background

A goal of the South African government is for South Africa to become an active participant in the global information society (Gudmundsdottir, 2008). The vision is that quality information and communication technology (ICT) services should benefit learners in school and also the local population (Department of Education [DoE], 2004, p. 6).

Computer Applications Technology (CAT) is a subject that is offered in approximately 1,600 South African secondary schools for learners from Grade 10 to Grade 12. CAT teaches the effective use of ICT in different sectors of society through the use of end-user computer applications such as word processors, spreadsheet, and database programs (DoE, 2008, p. 9). CAT learners require prolonged exposure to computers and end-user applications to become ICT literate and to develop 21st century skills. However, sporadic use of computer technology, due to the limited number of computers, affordability, limited electricity supply, and lack of infrastructure has led to a general lack of ICT literacy (Ford & Botha, 2010). This situation is worsened by the shortage of qualified teachers, and under-resourced and under-supplied schools. CAT learners in rural and township schools lack sufficient access to computer technology and resources, especially after school hours (Ford & Botha, 2010).

The studies done by the Centre for Development and Enterprise (an independent policy research and advocacy organisation in South Africa) found a strong correlation between socio-economic factors and the mathematics performance of learners. The studies found that less affluent schools, generally, did not produce good results for mathematics when compared with more affluent schools. The pass rate is very poor. Only 75% of South African schools are producing passes, but these are very few. These poor results

were attributed to the shortage of teachers in these areas and consequently, teachers have less contact with learners who do not have adequate access to educational resources (Centre for Development and Enterprise, 2010).

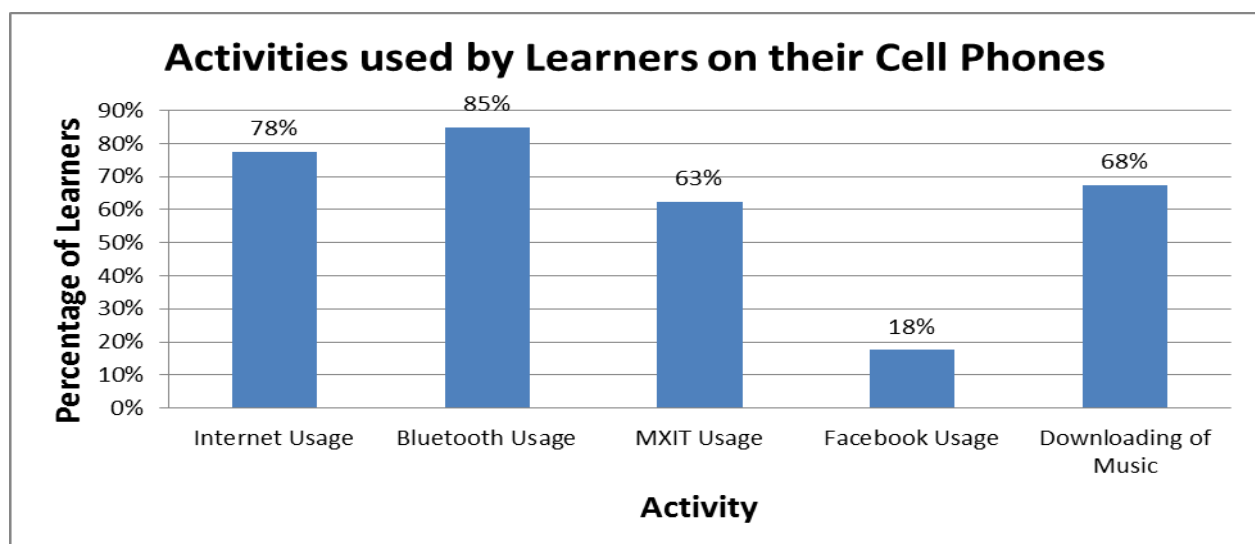
It is estimated that 95% of the South African population have mobile phones (Nitsckie & Parker, 2009). The mobile phone is considered more accessible than the landline telephone (Bhavnani, Chiu, Janakiram, Silarszky, & Bhatia, 2008). Mobile phones now have access to the latest internet tools including social networking and instant messaging. The costs of instant messages are far less than the cost of SMS messages. Mxit is a popular South African instant messaging service with around 10 million users per day (Knott-Craig, 2012), of which the majority are in the age group 13–24 years. The Mxit service is easy to use and its low costs make it a popular social networking tool for South African youth (Nitsckie & Parker, 2009). This mobile instant messaging (MIM) application service is the ideal platform to bring computer application technology information and access to South African school learners.

Surveys conducted by Kreutzer (2009) and Foster (2009) confirmed that learners in socio-disadvantaged schools mainly make use of feature phones. Although these phones are regarded as “low-end” mobile phones with fewer features when compared with smart phones, it must be noted that these phones do provide internet access. This makes Mxit accessible to these phones.

As a follow up to the above-mentioned surveys, Joubert (2010) conducted a survey amongst Grade 12 learners participating in workshops presented by the NMMU Govan Mbeki Mathematics Development Unit (GMMDU). One hundred and twenty surveys were handed out of which 35 were returned fully completed.

Image 1

Activities on cell phones (Joubert, 2010)



Ninety-one percent of the phones belonging to these learners had capabilities which allowed them access to the internet. The fact that learners possess phones with internet access does not imply they made use of that capability. Consequently the survey also enquired about the internet activities of cell phone users. Image 1 provides the results. For this paper it is important to note that 78% had access the internet, and 63% made use of Mxit. A further question in the survey tested whether learners would be open to receiving mathematics content on their mobile phones. On this question 85% of the learners responded positively, indicating a general acceptance of using their phones for educational purposes.

Before discussing different educational Mxit applications developed at NMMU, the next section will give an overview of two of the most effective applications that have been produced in South Africa.

South African Case Studies

Because Mxit is such a popular social networking tool in South Africa, various projects have been launched to make effective use of this tool to the benefit of society. This section reports on the Dr Math project initiated by Meraka Institute as well as the use of the JamiiX platform to provide guidance regarding drug abuse and HIV.

Dr Math

Butgereit et al. (2010) recognise the fact that on the one hand, 93% of South African first year university students have insufficient mathematics knowledge, while 97% of all South African teenagers have cell phones. Meraka Institute in Pretoria consequently initiated the Dr Math project in 2007, allowing teenagers to have access to math tutoring using Mxit on their cell phones. Initially users would only interact with tutors from the University of Pretoria. This proved to be very popular, with 4,500 pupils making use of the tool within the first two years of launching it. Tutors would interact with approximately 100 pupils per hour. The following is a verbatim example of a conversation a learner had with a tutor (Butgereit et al., 2010):

Learner: May i ask a question about applying there?

Academic: I have 5 minutes. Ask.

Learner: If u wr0te BCom(c0mputer science) nd if u want BSc . . . hw cn I change?

Academic: Give me your ID, full names and cell phone number. I will find out for you.

The Dr Math service has been extended to include various automated competitions and games (Butgereit, 2009). The first of these was an Arithmetic competition where pupils were tested on problems in Addition ranging from 1+1 to 12+12. A Top Score was kept, which resulted in learners regularly returning to defend their Top Score title. Some participants ended up doing hundreds of calculations.

Another game in Dr Math was a text-based adventure game which was based on a plot with a mathematical twist (Image 2). It was soon realised that competition was important to keep the attention of participants. Many played for nearly an hour while doing various mathematical calculations.

Image 2

Dr Math text-based adventure game (Butgereit, 2009)



An underlying concern regarding the Dr Math application is related to the fact that tutors are used to interacting with the learners. From literature it is clear that the tutors are trained before becoming involved. It is, however, not clear whether it is possible to monitor the answers that are provided. The section discussing applications developed at NMMU will acknowledge the importance of the gaming element and attempt to address the above-mentioned concern.

Drug Advice Support (DAS)

Nitsckie and Parker (2009) highlight the fact that the increased use of alcohol and drugs in South Africa has increased the demands on abuse treatment and counselling facilities. Access to these services, especially for socio-economically disadvantaged communities is often very limited.

The Drug Advice Support (DAS) platform, a project of the Athlone Living Lab, was born out of the above-mentioned need. A community-based organisation (Impact Direct Ministries) in Athlone, an impoverished suburb of Cape Town, decided to use technology to provide this support. From that endeavour, the Athlone Living Lab was founded as the result of collaboration between Impact Direct Ministries, Cape Peninsula University of Technology, and the Bridgetown community in Athlone.

DAS conducted its services using instant messaging via the Jabber IM platform. People seeking advice were able to communicate with advisors who were not necessarily in the same location or even in the same time zone. The following advantages of the system were identified:

- **Productivity.** Incoming conversations can be distributed evenly and shared between advisors, allowing advisors to have multiple conversations.
- **Convenience.** DAS is a web application, thus advisors need not be in the same location. The only requirement is a computer connected to the internet.

- **Archiving.** All messages and conversations are archived in a database which allows an advisor to view a full history.

DAS showed that instant messaging was a very effective way of communicating with people, especially those from disadvantaged communities who do not have easy access to traditional communication platforms. A total of 16,609 conversations between persons in need and advisors took place over a period of 186 hours. Five advisors could effectively manage 178 conversations during a two-hour session.

In an extension of this project, Cell-Life and LifeLine worked together to provide HIV counselling. Although calls to the National AIDS Helpline (NAHL) are free from a landline, this does not apply to mobile phones. Many people, therefore, either experience problems because they cannot afford airtime or they are forced to phone from public phones where it is difficult to have confidential conversations. Mxit made HIV counselling available not only at affordable costs, but anonymous conversations could take place from, for example, the privacy of a bedroom. The result was that conversations were much more open and to the point when compared to calls made from a fixed-line telephone (Cell-Life, 2011). It is further interesting to note that the number of hoax calls (up to 80% on the telephone service) was reduced greatly on the Mxit platform (Nitsckie & Parker, 2009).

Applications developed at Nelson Mandela Metropolitan University

The following section will discuss various applications in the NMMU Department of Computing Sciences which address the needs of learners regarding study guidance, CAT, and Mathematics.

Study Guidance via Mxit

Because the NMMU is situated in the Eastern Cape which is one of the poorest provinces in South Africa, it has to make provision regarding study guidance for school learners from townships and rural areas who do not have regular access to the traditional means of communicating with the university (for example, phoning or sending emails). During March 2011 the Department of Computing Sciences assisted a group of students who went into the rural Transkei to inform learners about aspects related to studying at NMMU. After returning, the authors realised that follow up communication would often take place by making use of SMS or Mxit. This highlighted the fact that by using Mxit as a communication tool, the university could become much more accessible to learners who do not have easy access to phones or email. Consequently two interventions were launched to address this need, namely, one-on-one interaction via JamiiX, and using a mobile information portal.

One-on-One Interaction via JamiiX

Through collaboration with RLabs in Cape Town (www.rlabs.org), the use of JamiiX (Erasmus, 2010) was obtained. JamiiX is a web service product developed from a refinement of the Drug Advice Support platform reported above. During the NMMU Open Day in May 2011, learners were encouraged to add NMMU as a contact on Mxit (or Google Talk) and interact with the Department of Computing Sciences via JamiiX. Consequently, sessions were arranged where learners could interact via these platforms with either academics or staff from the university marketing department.

Short conversations with learners often resulted in the learners providing details, and the responsible academic following up their query with SMS notification to the learner. Within the first five months after the launch of this service in May 2011, 347 subscribers engaged in 1,000 conversations with 4,773 messages being sent. Typical issues covered during these conversations are:

- Subjects needed at school to qualify for certain degrees and diplomas
- Information about different degrees or diplomas
- Costs and duration of studies
- Practical information regarding applying or changing on application.

Whenever a postal address was requested to follow up on a conversation, learners were always from the target group (township or rural communities). Learners would also often comment during conversations that they were very thankful to have this medium since they actually had no other way of communicating with the university. One learner summed it up by concluding a conversation with the following comment: "Thank you for this, because phoning is so difficult!"

Although JamiiX proved to be a very popular way of interacting with learners who did not have an easier means of interacting with the university, the following needs were noted:

- Many questions regarding specific degrees or programs were asked via JamiiX which the staff member from Computing Sciences could not answer. Consequently some learners could not be assisted.
- It became very time consuming to be available on a regular basis for learners to interact and discuss their problems, which made this mode of communication difficult to sustain within the department.
- A definite pattern of frequently asked questions began to develop and it became cumbersome to give similar answers repeatedly.
- While using the JamiiX communication platform, some learners merely wanted to have informal conversations which had nothing to do with the subject matter.

All of this pointed to the obvious need of an information portal accessible via Mxit which could address many of these issues. The development of this portal will be discussed in the next section.

Using a Mobile Information Portal

JamiiX provided a system of communication between learners and academics. While the JamiiX platform allowed for an effective form of communication between learners and advisors, it created some challenges, which were highlighted in the previous section.

The science.nmmu Mxit application (Ngundu, 2012) was developed to address the problems of redundancy, informal conversations and 24/7 response system availability. The application provides quick and easily accessible information to learners and makes it easier for academics to publish the content that they want learners to access via the Mxit platform. The learners have access to this information at any time of day.

The information for the science.nmmu Mxit application requires the academic to provide information that is accessed by learners. A Windows-based desktop application was developed to provide the academic with an easy-to-use content management system which could be used to create menu items and pages that did not need programming knowledge. The menu items and pages form the information architecture of the Mxit application. Learners are able to access the answers (stored in a SQL server 2008 database) for the typical questions that they would want answers for, including the following:

- What subjects are needed at school to qualify for certain degrees or diplomas?
- What different degrees or diplomas are offered in the NMMU Science Department?
- What are the costs and duration of various science courses?
- What are the requirements for courses or degrees?

Image 3 shows the main screen for the Windows-based desktop application where the academic can manage menu items and various pages of information. On the Mxit platform, the learners are able to view the information they require about Science academic programmes at NMMU. This one-way information sourcing reduces the opportunity of informal conversations between a learner and an academic. The science.nmmu Mxit application makes it easier for the learners to access information that would otherwise have been on the Department of Computer Science website. When web pages are viewed from a mobile phone they are sometimes not quite visible, and it is usually difficult to navigate the website via a mobile browser. By using a Mxit application, information is clearly visible and navigation is easier because of the text-based interface and there are few or no images.

Image 3

Desktop interface for the academic (Ngundu, 2012)

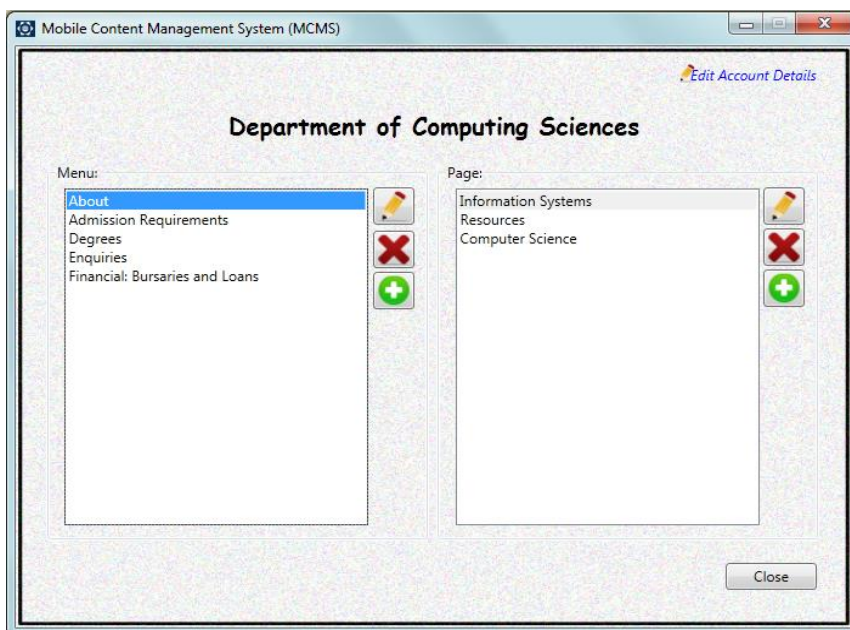
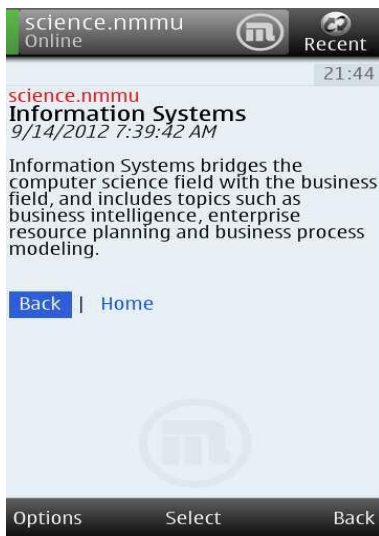


Image 4 shows the result of a learner's request for information about what Information Systems entails. Users are provided with a short description of the topic selected. The topics and associated descriptions are derived from data entered by academics using the desktop interface (Image 3).

Image 4

Information delivered on the Mxit platform (Ngundu, 2012)



A study was done with eight learner participants who were tasked to populate a portal about sciences at NMMU. The following individual tasks were given to each participant (the average satisfaction rating per task is provided):

- Log in as system administrator (92.19%)
- Create an account (78.06%)
- Edit account details as system administrator (90.63%)
- Log in as content administrator (92.19%)
- Add a page (87.50%)
- Edit a page (76.56%)
- Move a page to another menu (54.69%)
- Edit account details as a content administrator.

The results of the study showed that the content management system had a System Usability Scale (SUS) score of 75 which showed that the system was usable, efficient and effective. Sauro (2011) considers that satisfaction ratings of higher than 68 are above average.

An additional evaluation was conducted of the Mxit application, determining whether eight participants were able to view the content that had been stored using the content management system. A 100% success rate was achieved by all eight participants (Ngundu, 2012).

Mxit Support for Computer Application Technology (CAT)

The Department of Computing Sciences launched a CAT application on Mxit in order to provide explanations of computing-related terms that learners would encounter in the CAT subject at school level. A user can send a word or term to the application using an application on a mobile phone and receive an automated response providing a description of the term. The database is continuously updated manually

Educational Research for Social Change, April 2013, 2 (1)

Faculty of Education: Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

by including descriptions of requested terms that could not be found and that were relevant. In addition to the glossary, a menu is also made available to users to provide general information on computing careers as well as on the Department of Computing Sciences.

Usage Data

The usage data of the application was collected over a 6-month period (March–August 2011). It includes the user's Mxit ID which is a unique alphanumeric identification for users on the Mxit system, the term sent by the user, and the date and time at which the term was sent. It must be noted that, with this application, there is no data available on the demographics of the users. These would include the age, geographic location, and whether the user is actually a CAT learner.

Table 1

Career information

Job Title	No. of Requests
Games Programmer	4,169
Computer Programmer	2,408
Software Engineer	2,304
Business Analyst	1,935
Computer Auditor	1,778
Web Developer	1,610
Total	14,204

Usage patterns varied greatly from day to day, but the general trend was that 75–250 different users interacted per day, requesting 400–900 different terms. In total 34,749 terms were requested by 6,877 registered users over a five-month period. An additional menu option was provided to users regarding information on computing careers and the Department of Computing Sciences at NMMU. An important observation that must be made from usage data of this component (Tables 1 and 2) is that 23,483 requests out of the total of 34,749 requests (68%) were made regarding the menu options related to job descriptions and information about the Department of Computing Sciences.

Table 2**Information about the Department of Computer Sciences**

Category	No. of Requests
Degrees Offered	2,609
Undergraduate Subjects	1,823
Research Areas	1,751
Staff	1,349
Contact Details	938
Postgraduate Subjects	809
Total	9,279

Since all interactions were logged, it was possible to have a breakdown of when, during a 24-hour period, terms were requested. This gave a very good indication of when Mxit users were active. As would be expected, since the typical users were expected to be learners, usage increased from around 3:00 p.m. (after school). Other usage patterns are interesting to observe:

- The maximum usage was just after 11:00 p.m. which is probably not too surprising, assuming that the users are teenagers.
- There was considerable activity during school hours (8:00 a.m. to 2:00 p.m.).
- There was never a time during a 24-hour day when there was not activity. This included the early hours of the morning.

The usage data results were encouraging and improvements to the application were considered, based on these results. Version 2 of the CAT application provided users with more functionality to assist their understanding and learning of the CAT-related content.

Version 2 of the CAT Application

The development group decided to expand the functionality of the application to improve its usefulness for CAT learners, and the following functions were added:

- Random facts related to computers were provided to users.
- Solutions to common problems that could be experienced when working with computers could be requested from different categories.
- Users' knowledge of computers and computer-related topics was tested by making use of a quiz.

In Version 1 of the CAT application, users had to submit a word for which they required a definition. Users thus had to initiate interaction with the application. The random facts function was included as a way of encouraging interaction with the application without the users having to send a word or term with which they required assistance.

Providing solutions to common problems was an idea that originated from the CAT examination paper to assess CAT learners' subject knowledge. Learners were required to troubleshoot computer-related problems. The application could allow users who were CAT learners to prepare for assessment examinations.

The quiz component consisted of a test of 10 randomly selected multiple-choice questions from the database. The previous best result of a user was recorded. Users (Ngundu, 2012) were provided with feedback at the end of the quiz indicating which questions were answered correctly. Users were also provided with an explanation of the correct response.

Version 2 immediately proved to be very popular with 200,000 requests within the first six weeks after the launch. The quiz proved to be the most popular of the different components, confirming the importance of building some competitive format into any educational application. An encouraging confirmation of the usefulness of the application was the fact that usage doubled during the two days before the two matriculation CAT exam papers were written in November 2011. This is proof that the targeted group (CAT learners) was reached through the application.

Toolbarz Application

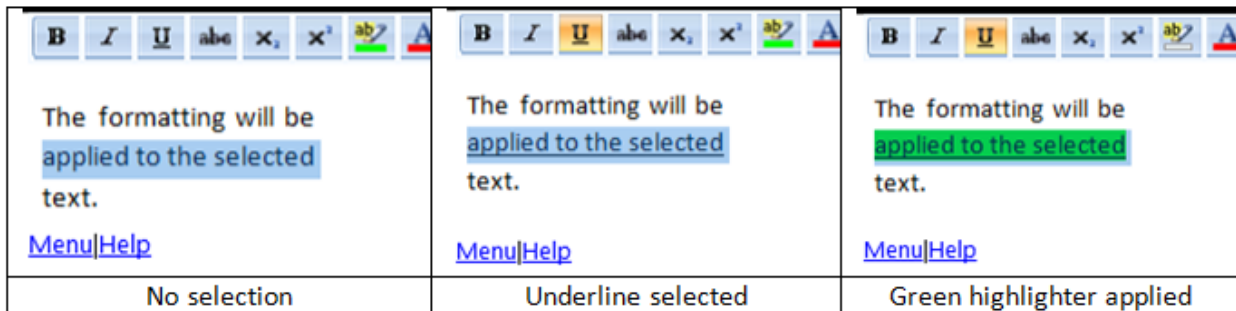
Mxit applications can display images to users if the user device is able to display images. In-line images are used in the CAT application to improve user understanding of the description provided for a word or term. In addition to in-line images, Mxit also supports the use of image strips in tables allowing developers to implement the look and feel of a graphical user interface.

Image strips consisting of a number of tiles containing images for a blank cell, a highlighted cell, and a selected cell, for example, can be registered. Image strips can also be set to different layers. This allows the Mxit application to support games such as chess or tic-tac-toe where users are presented with a board and are able to click on different areas of the board to make a move.

The image strip functionality was used to develop an application that could simulate the use of standard toolbar buttons specifically found in word processing or spreadsheet software applications. Users can select between standard, paragraph, and shape toolbars. Image 5 indicates the use of the image strip in a table to simulate the application of formatting to selected text. The first sub-image (left) indicates no formatting, the middle indicates that underlining has been applied while the last sub-image (right) indicates that underlining and highlighting have been applied. The text provided is an image which is changed based on the buttons selected on the toolbar. Image strip tiles are changed to indicate which buttons have been selected.

Image 5

Toolbarz application interface for the standard toolbar



The purpose of the application is to allow users who do not have access to a computer to become familiar with the use of a toolbar and standard formatting options. The aim is that users who are learning to use a computer and office suite software are able to focus on learning other aspects of the application software without being hindered by a lack of skills related to the use of the toolbar.

The number of users of the Toolbarz application is not as high as the number of users using the CAT application. The purpose of the application may be too simple for users who are able to use the toolbar functionality. The use of the image, together with the tables to implement an interface, creates the possibility of developing more interactive interfaces that could support user understanding of computer-related application software.

Mathematics Support via Mxit

The department launched two projects with the aim of addressing the challenges regarding mathematics education. Mentalmaths is a compilation of games aimed at stimulating an interest in the subject, while Mathwars combines the gaming aspect with content directly linked to the Grades 10–12 curriculum.

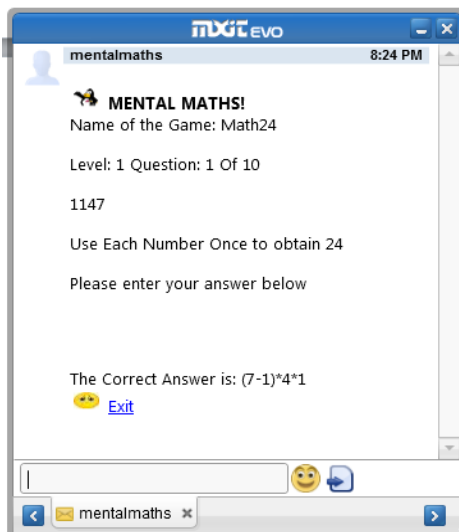
Mentalmaths

This project expanded on the functionalities of the arithmetic competition offered in Dr Math. A set of mathematical games collectively named Mentalmaths was developed that could be accessed by learners over Mxit (Kyazze, 2012). The usage data is stored in a remote database and accessed over the web by the educators of the participating learners. In addition to basic addition, subtraction, division, and multiplication table games, the following games were also implemented:

- **Math 24:** A learner is presented with four numbers and is tasked to obtain the value 24 by making use of each given number once and the arithmetic operations of addition, subtraction, multiplication and division (Image 6).
- **Numbers:** A learner is presented with six randomly selected numbers from the *High* and *Low* groups. High contains 100, 75, 50 and 25 while Low contains each of 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10. A random total is given and the learner is tasked to compute the total by making use of the given numbers.

Image 6

Self-Assessment feature (Kyazze, 2012)



The following are specific features of Mentalmaths which need to be noted:

- Hall of fame: Learners can compare their performance against the overall best for each game.
- Viewing of the correct answer to a question: Learners are able to view the correct answer to a problem when they get it wrong; this facilitates the learning process.
- Time-based competition: Learners actively compete to have the best finish time for a given level.
- Educator access to learner data: Educators can view data about their learners through a web interface.

An evaluation study was conducted to determine the effectiveness and usability of the mobile application. Twelve learners (chosen randomly) participated in the study. This was because the games are meant to be simple and intuitive for any learner to use. The positive aspects about the games identified by the participants were:

- Self-assessment: Test participants liked viewing the correct answer to a problem they had failed.
- Simple interface: Most participants commented positively on the simple layout of the game interface.
- Variety of games: The participants liked having a wide selection of math games.

The System Usability Scale (SUS) questionnaire was used to determine user satisfaction (Bangor, Kortum, & Miller, 2008). The overall system usability score was 76.8%. This implies that the participants viewed the application positively. Design improvements, however, should be made to ensure that the score is above 80% because this is the point at which users are more likely to recommend the games to their friends

(Sauro, 2011). The learnability score achieved was 72.9%, which shows that users found the application easy to learn.

Mathwars

The Mathwars Mxit application was initially developed and deployed specifically to support the improvement of mathematics literacy and problem-solving skills. The first version of the application implemented multiple-choice questions sourced from previous Mathematics Olympiad questions organised by the Association for Mathematics Education of South Africa (AMESA).

The questions were graded into different levels of difficulty based on the school level academic grade for which they were intended (South African Mathematics Olympiad, 2012). Users of the application start at Level 1 and progress up the levels to more difficult questions if a minimum number of tests have been completed, and if their average is above a certain threshold value. The 10 questions presented to users are randomly selected. Based on the user's average, the question set consists of a combination of questions from the current level of the user as well as questions from the previous level if the user's average is less than 50% or from the next level if the user's average is above 65%.

During the first four months after its launch, 210 users registered to use the application. Table 3 provides a summary of the usage of the application. None of the users have progressed further than Level 4. Level 4 questions are sourced from Grade 4, First Round, Olympiad question papers, whereas 80,4% of the users indicated that their school academic grade level lay in the range, Grades 8–12. Level 1 consists of basic addition and subtraction (for example, $7 + 2$), while Level 2 questions include the addition and subtraction of larger values (for example, $52 + 27$).

Table 3

Mathwars usage

Level	No. of users	Mean no. of tests	Min. no. of tests	Max. no. of tests	Mean level average
1	107	2	0	15	52%
2	46	10	2	36	39%
3	53	36	4	217	35%
4	5	50	10	136	53%

The usage data indicated that users at Level 1 did not actively participate in the use of the application, while users who progressed to higher levels were inclined to complete more tests. The average score at each of the levels was also a problem because users needed an average of approximately 60% to continue to the next level. The threshold value to determine progression to the next level, as well as the minimum number of tests that require completion, has been adapted to make it easier for users to progress.

The results may indicate that the poor performance of users is because of their knowledge and understanding of Mathematics content. Level 1 and Level 2 evaluate numeracy skills. However, the remaining levels evaluate problem-solving and logical skills because Olympiad questions have been used. The questions are in no way based on current Mathematics subject content for the respective grade levels.

The Mathwars application will be used to promote enthusiasm amongst school learners to participate in the official Mathematics Olympiads. Further functionalities that will be added to the Mathwars application include access to mathematical subject content as well as assessment of this content by using a quiz interface. Quiz tournaments and functionality to challenge other users will also be implemented in future to encourage users to participate actively in the quiz component provided, and to leverage the social aspect of the Mxit platform.

Conclusions

The work reported on has confirmed the fact that instant messaging (and in our scenario, Mxit) is a medium of communication that typically reaches the socioeconomically disadvantaged parts of our society because it remains the most cost-effective instant messaging system (Chigona, Radic, & Mpazanje, 2012). With the development of smart phones and consequently other instant messaging possibilities such as Blackberry Messenger and WhatsApp, Mxit is becoming less popular in more affluent communities where smart phone penetration is more prevalent. It is, however, still a medium that cannot be ignored for institutions that typically need to reach township and rural communities.

The use of the Mxit platform to support the Dr Math application and enable drug advice support, has highlighted the fact that mobile instant messaging still has a role to play in social upliftment. The use of instant text messaging to converse with Mathematics tutors or drug advisors where users can remain anonymous and communicate freely with facilitators is an advantage of using the Mxit platform to support these applications.

The implementation of simple text-based message-driven applications that can run on the Mxit platform with support for images and links has also proven to be an opportunity to develop applications to support education and social upliftment. The applications developed and implemented in the Department of Computing Sciences, NMMU, have explored different ways of leveraging the functionality provided by the Mxit platform. The applications are aimed at providing users with specialised subject knowledge as well as to allow users to assess their knowledge of subject content, specifically Mathematics and CAT subject knowledge, by using multiple-choice test assessment. Different methods of encouraging active participation have been explored and implemented. Usage data collected has indicated interesting usage patterns regarding, for example, the time of the day Mxit users are most active.

The authors believe that the usage data reported in this paper confirms that instant messaging can go a long way to address the problem of CAT learners who have limited access to computers as well as to text books. It also shows that there is great potential in expanding this application into other school subjects.

Future work on the Mathwars application will include promoting social interaction specifically in respect to the quiz component. Further data collection and analysis of user patterns regarding the viewing of question solutions and the time taken to complete tests will be conducted. User surveys to gather qualitative feedback from users regarding their usage of the applications would also assist the analysis of application usage. It is hoped the qualitative and quantitative collection and analysis of the usage data will provide insight into the use of the quiz as a learning tool for users.

References

- Bangor, A., Kortum, P.T., & Miller, J.T. (2008). An empirical evaluation of the system usability scale. *International Journal of Human-Computer Interaction*, 24(6), 574–594.
- Bhavnani, A., Chiu, R. W. W., Janakiram, S., Silarszky, P., & Bhatia, D. (2008). The role of mobile phones in sustainable rural poverty reduction. *ICT Policy Division Global Information and Communications*

- Department (GICT). Retrieved from http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/The_Role_of_Mobile_Phones_in_Sustainable_Rural_Poverty_Reduction_June_2008.pdf
- Butgereit, L. (2009, May). *How Dr Math reaches pupils with competitions and computer games by using Mxit*. Paper presented at IST-Africa Conference, Kampala, Uganda.
- Butgereit, L., Leonard, B., Le Roux, C., Rama, H., De Sousa, M., & Naidoo, T. (2010, May). Dr Math gets MUDDY: The “Dirt” on how to attract teenagers to Mathematics and Science by using multi-user dungeon games over Mxit on cell phones. Paper presented at IST-Africa Conference, Durban, South Africa.
- Cell-Life. (2011). RedChatZone: HIV counselling via mobile instant messaging chat. Retrieved 30 September, 2011, from <http://www.cell-life.org/home/123-c4h-case-study-using-Mxit-for-hiv-counselling>
- Centre for Development and Enterprise. (2010). The maths and science performance of South Africa's public schools: Some lessons from the past decade. Retrieved from <http://www.cde.org.za/images/pdf/Maths%20and%20science%20performance.pdf>
- Chigona, W., Radic, M., & Mpazanje, F. (2012). Uses and gratifications of mobile instant messaging amongst the South African youth. In A. Koch & P.A. van Brakel (Eds.), *Proceedings of the 14th Annual Conference on World Wide Web Applications* (pp. 4–16). Retrieved from <http://www.zaw3.co.za/index.php/ZA-WWW/2012/paper/viewFile/598/219>
- Contreras-Castillo, J., Perez-Fragoso, C., & Favela, J. (2006). Assessing the use of instant messaging in online learning environments. *Interactive Learning Environments*, 14(3), 205–218.
- Department of Education. (2008). *National Curriculum Statement Grades 10–12 (General): Learning programme guidelines, Computer Applications Technology*. Retrieved from <http://www.education.gov.za/LinkClick.aspx?fileticket=0rl5T6iNUxU%3d&tabid=247&mid=595>
- Department of Education. (2004). *Draft whitepaper on e-Education: Transforming learning and teaching through ICT*. Retrieved from <http://www.info.gov.za/whitepapers/2003/e-education.pdf>
- Erasmus, J. (2010). Jamiix: from the Cape Flats to the world. Retrieved from <http://www.medioclubsouthafrica.com/themedia/1781-jamiix-040610>
- Ford, M., & Botha, A. (2010). A pragmatic framework for integrating ICT into education in South Africa. In P. Cunningham & M. Cunningham (Eds.), *IST-Africa 2010 Conference Proceedings* (pp. 10–20). Retrieved from: <http://hdl.handle.net/10204/4098>
- Foster, G. (2009). *A survey on mobile phone usage*. (Unpublished raw data). Nelson Mandela Metropolitan University, Missionvale Campus, Port Elizabeth.
- Gudmundsdottir, G.B. (2008). Digital competence and the language issues in South African classrooms. Retrieved 30 January, 2013, from <http://www.openroad.net.au/conferences/2008/papers/gudmundsdottir.pdf>
- Joubert, J. (2010, October). *Influencing factors of a M-Learning application*. Paper presented at South African Institute for Computer Scientists and Information Technologists Masters & Doctoral Symposium, Bela-Bela.
- Kinzie, M.B., Whitaker, S.W., & Hofer, M.J. (2005). Instructional uses of instant messaging (IM) during classroom lectures. *Educational Technology & Society*, 8(2), 150–160.
- Knott-Craig, A. (2012). *Mobinomics: Mxit and Africa's mobile revolution*. Johannesburg: Bookstorm.
- Kreutzer, T. (2009). Assessing cell phone usage in a South African township school. *International Journal of Education and Development using ICT*, 5(5), 43–57.

- Kyazze, M. (2012). *Mobile self-assessment of arithmetic skills*. (Unpublished Honours treatise). Nelson Mandela Metropolitan University, Port Elizabeth.
- Ngundu, T.H. (2012). *Mobile content management system*. (Unpublished Honours treatise). Nelson Mandela Metropolitan University, Port Elizabeth.
- Nitsckie, W.B., & Parker, M.B. (2009). Mobile instant messaging: "Help at the fingertips of addicts". In P.A. van Brakel (Ed.), *Proceedings of the 11th Annual Conference on World Wide Web Applications* (pp. 4–18). Retrieved from <http://www.zaw3.co.za/index.php/ZA-WWW/2009/paper/viewFile/62/27>
- South African Mathematics Olympiad. (2012). Retrieved from <http://www.samf.ac.za/QuestionPapers.aspx>
- Sauro, J. (2011). Measuring usability with the System Usability Scale (SUS). Retrieved from <http://www.measuringusability.com/sus.php>

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Pre-service Primary Teachers' Use of iPads to Support Teaching: Implications for Teacher Education

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Abstract

In this article the use of iPads in primary schools by a group of pre-service teachers completing their professional experience is reported on. The study was developed as part of the university's activities in the national Teaching Teachers for the Future (TTF) project. The study is a qualitative case study and the data gathering tools consist of participant journals, pre-service teacher focus groups, and staff interviews. Participants consist of 16 fourth-year Bachelor of Education (Primary) pre-service teachers completing a Maths Education subject, and two Maths lecturers at an Australian university. The results indicate that the teachers in the study used a variety of apps as well as inbuilt features of the iPad to support learning across a range of subjects. The teachers also used the iPad for self-reflective and assessment purposes. The implications of iPad use by pre-service teachers for teacher training in universities are discussed.

Keywords: iPads; Mobile Learning; TPACK; Primary Schools; Pre-service Teachers; Pedagogy.

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Introduction

Tablets such as the iPad have only been available since 2010 and the uptake of these tablets into the general population has been rapid. Results of a survey called "A Portrait of Today's Tablet user, Wave II" (Frank N. Magid Associates Inc, 2012) indicate that in the US for example, during 2011, 12% of the population aged between eight and 64 years old were tablet users. This figure was 31% in 2012 and is expected to reach 47% by 2014. This rise is similar across other countries. To support iPad use, there are over 140 000 apps to choose from specifically for the iPad (Bonnstetter & VanOverbeke, 2012). This increased use of mobile technologies is changing the way that young people learn outside of the classroom

with access to vast amounts of digital content, easily shared photo viewers, cameras, and “rich full featured game platforms” (Johnson, Adams, & Cummins, 2012, p. 16).

As a result of the use of iPads and other tablets by young people in their homes, schools are responding by purchasing sets and integrating their use into teaching. However, iPads and other tablet devices, like many technologies, were not developed with classroom use in mind (Williams, Wong, Webb, & Borbasi, 2011). The opportunities for supporting educational outcomes are currently being explored by teachers as they adapt apps to suit their needs and the needs of their students. As a result of this exploration, iPads are beginning to be used in novel ways in primary school classrooms (Reid & Ostashewski, 2011).

The introduction of the iPad and associated apps has the potential to change educational and social practices in schools as well as in pre-service teaching courses. Understanding the parameters of such change is important for educators and researchers.

The contemporary uses of mobile learning technologies in schools and teacher education in an Australian setting is outlined which in this article which sets out the study in the context of a national Australian project—Teaching Teachers for the Future (TTF) project—aiming to develop pre-service teachers’ Information and Communication Technology in Education (ICTE) proficiencies. All 39 teaching institutions in Australia participated during 2011–2012 to help implement the use of technologies into subjects. Maths was the focus area for this study.

The aim of the research project was to gain an understanding of the way mobile technologies are being used by pre-service teachers whilst on professional experience in schools which would then help the introduction and on-going use of them in a university teaching course. The research question relevant to this study was: How do pre-service primary teachers use iPads to support their teaching?

Sub questions included:

- What apps do the pre-service teachers use?
- How do the apps contribute towards educational outcomes?
- What implications does the use of iPads in schools have for pre-service teaching courses?

In answering these questions an outcome of the study was to identify ways in which teaches are using the iPads for teaching and learning within the classroom as well as way that they use them to support non-teaching related areas.

Literature on iPad use in schools

Whilst iPads have only been available since 2010, their uptake into schools has been rapid and there have been a large number of research projects carried out—both large scale projects and smaller case studies. Some of the studies indicate strong interest by Education Departments in the use of iPads to support learning, and are examined below.

Early studies by Education Departments have been conducted on touch-sensitive mobile devices across a number of states in Australia. One of the earliest studies was undertaken in Victoria, Australia, and focused on three primary schools. Here the authors examined the use of the iPod Touch, focusing on the “impact on

student learning, on teacher pedagogy, curriculum and assessment, and on external technical issues involved in implementing emerging technologies” (Murray & Sloan, 2008, p. 1).

A smaller study involving one primary and one secondary school in Australia was undertaken by the Queensland Department of Education and Training (DET) in 2011. Here it was found that “The iPad was viewed unanimously by participating teachers as a cross curriculum device that is not constrained to a specific subject area” (DET, 2011 p. 25). A trial was also undertaken by the Department of Education and Communities (DEC) in Sydney, Australia, in the second half of 2011 involving three primary schools (Goodwin, 2012). Findings indicated that both teachers and students believed the iPads supported and enhanced student learning.

One recent larger scale study was conducted in Scotland (Burden, Hopkins, Male, Martin, & Trala, 2012) during early 2012. Eight schools ranging from primary through to secondary level were involved in the study. An outcome of this study was that “The device also encouraged many teachers to explore alternative activities and forms of assessment for learning” (p. 9).

In a study conducted during 2012 at Longfield Academy in Kent, students in the secondary school, their parents, and teachers participated in an iPad research project (Heinrich, 2012). One of the outcomes of the study was that appropriate use of apps aids learning. Henderson and Yeow (2012), in conducting semi-structured interviews with key school personnel at Redoubt North Primary School in Auckland, New Zealand, focused on the use of apps and found that one of the most compelling features of the iPad was the range of apps available.

Research on the use of iPads in primary schools has also been carried out in the United States where in one study, six Pre K–4th grade classes participated (Milman, Carlson-Bancroft & Vanden Boogart, 2012). Results of the study showed high student engagement, which is one of the hallmarks of iPad use. Differentiation of content to address various learners’ educational needs and interests was also noted. The apps on the iPad can support differentiation to meet the learning topics and themes that an individual requires (Melhuish & Falloom, 2010)

Theoretical framework

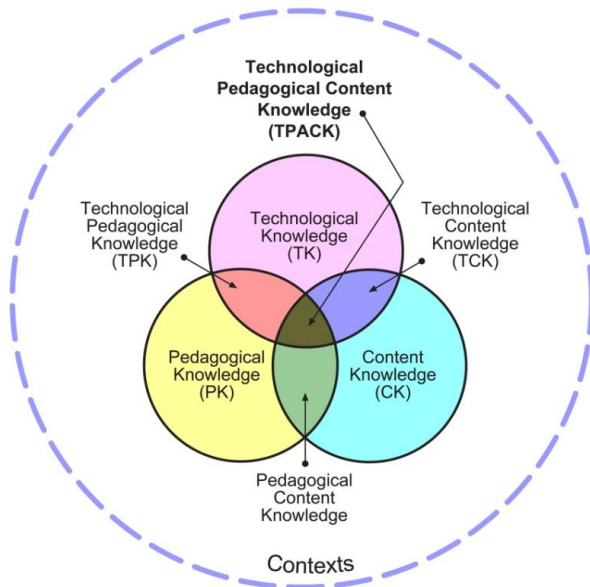
Technological Pedagogical Content Knowledge (TPACK) (Koehler & Mishra, 2009) is used as a theoretical framework to understand the types of knowledge that the pre-service teachers were drawing upon during the study.

As the image in Figure 1 shows, the TPACK model is made up of three sections which include Technological Knowledge, Content Knowledge, and Pedagogical Knowledge. It is the intersection of these three areas that provides for Technological Pedagogical Content Knowledge (TPACK) The TPACK framework builds on Shulman’s (1986; 1987) Pedagogical Content Knowledge framework.

As suggested by Koehler and Mishra (2009), and drawing on from a sociocultural theory of learning (Vygotsky, 1978), all resources such as a pencil or an iPad are technologies. There are some differences between these two technologies. Primarily, a pencil has a specific use: it has stability over time and its function is clear. New technologies such as the iPad, on the other hand, “are protean (usable in many different ways; Papert, 1980); unstable (rapidly changing); and opaque (the inner workings are hidden from users; Turkle, 1995)” (Koehler & Mishra, 2009, p. 61). These features of new technologies present both new opportunities and challenges to teachers.

Figure 1**TPACK framework (<http://tpack.org>)**

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The TPACK model, as discussed above, has intersecting areas that bring together the three knowledge concepts in different ways. In drawing on the TPACK framework as a way of conceptualising pre-service teacher choices, some of the major components and the intersecting knowledges are drawn upon.

Methodology of the research

Because the use of iPads by pre-service teachers in their classroom practice is examined, this research requires the subjectivity of a qualitative framework. As suggested by Patton (2002), case studies are predominantly relevant to researchers in the qualitative domain because they provide extensive details of the experiences or phenomena being studied. Another of the advantages of a case approach is that its use allows close collaboration between the researcher and the participant, which provides opportunities for participants to tell their stories (Crabtree & Miller, 1999). The “case” in this study is bounded by pre-service teachers, primary school students and iPads.

Participants were 16 fourth-year Bachelor of Education (Primary) pre-service teachers completing a Maths Education subject and two Maths lecturers at an Australian University. Most participants were issued with an iPad2 purchased by the University for the duration of the semester three pre-service teachers and one lecturer used their own devices). The project focused on participants’ use of their iPads to support their teaching whilst undertaking professional experience in primary schools. Many of the classes the teachers taught were in the early years, K–6, which included kindergarten (the first year of primary school) and ranged up to Year 6 which is the last year of primary school in New South Wales (NSW). These teachers’ use of the iPads reported on here took place in schools, in their homes, and in informal settings.

Data were collected during Semester 1, 2012, using participant journals, pre-service teacher focus groups, and staff interviews. The pre-service teachers were asked to keep a journal reflecting on their experiences throughout the period of the research. They were asked to write one entry each week which many of them did. Some students chose to write their journals whilst other students recorded themselves speaking. The

journals were then provided to the researchers at the end of the study on the iPads each student used. The journals were also supplemented with artefacts the students created to support their teaching.

There were eight focus group sessions which were held towards the end of the study after the pre-service teachers had completed their professional experience placements. A series of questions were prepared to guide the focus groups which lasted for about 30 minutes. Two students were in each group along with the two researchers. The purpose of having two teachers and the two researchers was so that ideas that were discussed could be explored in greater detail.

The interviews with staff took place on a one-to one basis with one researcher interviewing one staff member and lasted for about 20 minutes. These were semi-structured interviews and were audio recorded. Each interview was analysed by the researcher that ran it and key themes were developed. The decision to interview on a one-to-one was based on staff availability.

Analysis

The data were analysed using thematic analysis. This approach to analysis involves categorising data through “careful reading and re-reading of the data” (Rice & Ezzy, 1999, p. 258). The research required that a number of different types of data be read which included spoken text, written text, images, and video. As is shown in the analysis and discussion section, one of the main themes to emerge was the focus on maths which was not surprising given that the teachers were engaged in a maths subject. They did use the iPads for other Key Learning Areas (KLAs) and purposes. Other themes that emerged through analysis of the data include using iPads for English and Drama as well as for English Second Language (ESL) students. Non teaching use of the iPads was also a focus, and included assessment and self-evaluation.

Limitations of the study

In many of the classrooms that the pre-service teachers taught, there was only the teacher’s iPad or there were a limited number of up to five iPads to be shared. Another limitation of the study was that there was no Wi-Fi access in most of the schools in which the pre-service teachers taught. Both of these factors reduced the activities that could be carried out in classroom using the iPads. A further limitation of the study was the small number of pre-service teachers that participated in the study. The small number of participants limits the findings to a broader school setting.

Results and discussion

As a result of using the iPads in a maths university subject, a great deal of the apps were focused around Maths although other KLAs or subjects were also supported. The teachers also used built-in features of the iPad such as the camera to assist with learning. The iPads were also used for non-teaching purposes by the teachers. In this first section of results and discussion, the focus is on how the iPads were used to support teaching practices.

Maths

The main apps that the teachers used to support learning in Maths included Show me, Virtual Die and Songify. Some of the areas of Maths covered included number, fractions and symmetry.

Although many teachers were restricted to having only one iPad in the classroom they were able to design group activities that enabled the students to gain maximum educational benefits. In focusing on Maths, the use of Show Me is examined.

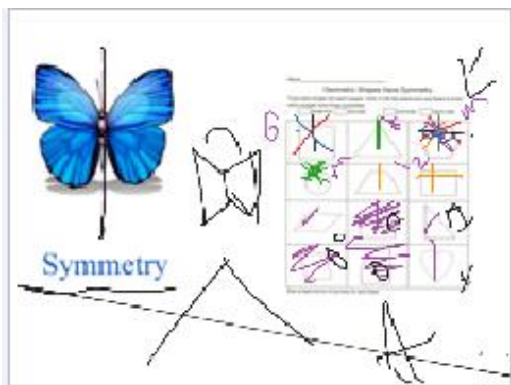
Using Show Me

The use of Show Me was used by the pre-service teachers involved in the study in a variety of different ways. Show Me is a whiteboard app which can be drawn on using multiple colours. Pictures can be imported and audio allows voice-over to be recorded. When playing back the file, the drawing unfolds in real time along with the narration much like a movie.

Sally used Show Me to help her Year 2 daughter understand the concept of symmetry as part of the school work she was doing. Her daughter located an image of a butterfly which she then imported into the app. Sally explained in her journal: "She then recorded her explanation whilst drawing in lines of symmetry on the two-dimensional shapes shown to support her explanation." Figure 2 shows a screen shot towards the end of the file.

Figure 2

Screen shot of Show Me



The Show Me app in Figure 2 can be used in two different ways: the first with the teacher explaining the process, and the second with the student explaining the process. In the figure, Sally's daughter was explaining the process. Using Show Me allows teachers to understand the process involved in students' thinking when working on problems which in turn allows the teacher to understand where errors are occurring and then to remediate the errors. Allowing students to record their work on Show Me would then mean the teacher could review their narrative later, which would assist in assessment.

Suzie used Show Me to explore the concept of equivalent fractions with a Year 6 boy in her class who was having a great deal of difficulty with the concept. As she stated in her journal: "I was able to use show me to physically demonstrate how to work out equivalent fractions." Suzie also used Show Me to investigate fractions of the moon with her class.

Suzie noted the potential of using Show Me to differentiate for students in the class where she described the functionality of the app allowing for differentiation. As noted by Tomlinson (2001) differentiation can occur in three ways: content—what students learn; process—how students learn or make sense of the content; and product—how students show what they have learned. Here, the Show Me app allowed for differentiation of process. Research carried out by Milman, Carlson-Bancroft, and Vanden Boogart (2012) supports this notion where it is demonstrated that the iPad can be used effectively to differentiate for process.

Suzie demonstrated Technological Pedagogical Knowledge (TPK), by adapting the use of the app to accommodate the needs of the Year 6 boy. “Technological Pedagogical knowledge is knowledge of the existence, components and capabilities of various technologies as they are used in teaching and learning settings, and conversely, knowing how teaching might change as the result of using particular technologies” (TPACK, n.d.). The iPad was able to support the individual learning needs of the student. This knowledge is confirmed by Jaipal and Figg (2010) who state that TPK is characterised by practical teaching competencies such as differentiated support resources.

Other apps that the teachers used for maths included: Colouring Smart for addition, Compass for position, Evernote for algebra, Maths Trainer for revision, as well as Hungry Fish, Number Math, and Splash Math which were used for numbers.

Teachers’ understanding of maths through using iPads

The use of the iPads was able to support the teachers in their understanding of maths in a more in-depth way as explained by one of the teachers in her journal entry:

The iPad is helping me ‘see’ maths. I have always been aware of the issue of children not ‘seeing’ maths in their worlds. They often do not seem to see the connection between algorithms, maths concepts and generally maths in the classroom and their lives and worlds.

In her interview, lecturer Isabelle stated she believed this type of mobile learning exercise allowed pre-service teachers to generate artefacts depicting rich contexts that enhanced their recognition and observation skills and developed more positive attitudes towards Maths. The iPad allowed them to follow-up and discuss the maths associated with these artefacts. As she stated: “Seeing it [the phenomenon] was spectacular. Having the facility to do something about it was also important.”

It is clear both from the student’s journal entry and the lecturer’s interview comments, that the noticing of maths is important for pre-service teachers so that they can then support the maths learning and noticing of their students. The use of the iPad was able to support this noticing for the teachers. This noticing has also been reported on in an earlier publication by the researchers (Kearney & Maher, 2012), focusing on pre-service teachers’ use of the iPad in the real world.

Other Key Learning Areas

The teachers used the iPads across many other KLAs which included English, Drama, Human Society and its Environment (Geography, History, Environmental studies), Art, and Physical Education. ESL students were also able to be catered for. In this section the use of Puppet Pals to support English and Drama is examined as well as the use of flash cards to support for ESL learners

Puppet Pals

A number of teachers used Puppet Pals to support narrative writing in English and Drama. The Puppet Pals app allows the user to make a short movie and the free version comes with backdrops and characters. The app allows voice-over to be added. The teacher who worked with Puppet Pals in English wrote about how her children used the app to write a story. In describing the process of constructing a movie, the teacher set out in her journal: “They chose their own background and characters for their story and included a voice recording to tell the story.” Figure 3 is a screen shot of a movie made by one of the children.

Figure 3**Screen shot from Puppet Pal movie**

The use of Puppet Pals is able to support a multimodal way of learning. A multimodal approach (Jewitt, 2006; Kress & Van Leeuwen, 1996) is used to examine how a variety of resources including written text, image, animation, sound (spoken words, sound effects, and music), and colour can be drawn upon by students to make meaning. Culén and Gasparini (2012) reported on a research project with fifth-grade students where Puppet Pals was used on the iPad to write a story. They found that the “app engaged multiple senses (touch, sound, vision) in an easy to master storytelling process” (p. 2).

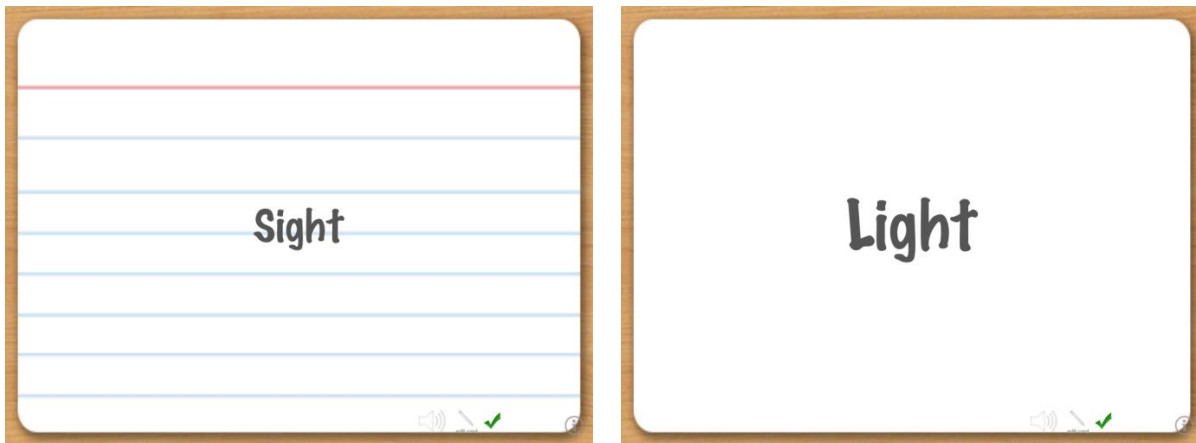
Multimodality can be considered using the TPACK framework focusing, in part, on Pedagogical Content Knowledge (PCK) which is defined as knowledge that includes “knowing what teaching approaches fit the content, and likewise, knowing how elements of the content can be arranged for better teaching” (TPACK, n.d.). Kang, Wu, Ni, and Li (2010) have mapped PCK from a multimodal perspective and state “pedagogical practice itself is taken as a design activity: teachers make choices all the time about what texts to work with, how to work with them, how to interact with the students and how to assess their semiotic work” (p. 1985).

Other apps that the teachers reported using during the research project included Singing Fingers for English, Map Pad and iBooks for Human Society and its Environment (HSIE), Jumbo Watch for time management, and QR Reader.

Supporting ESL students

One of the other KLAs that the teachers wrote about in their journals was English, which also included English as a Second Language. The apps that the teachers used to support ESL students included Flashcards, Futabla, and Puppet Pals.

One teacher discussed the use of Flashcards in her journal where she created a list of words ending in “ght”. The functionality allowed the teacher to shuffle cards to ensure children weren’t memorising the order of the words. Figure 4 shows one set of cards she created.

Figure 4**Flash card of “ght” words**

The teacher recommended that the app would be beneficial for ESL students. She suggested that: “I would integrate the added functionality which enables the teacher/student to record the word shown so that students can hear the word as they see it.”

According to Meurant (2010), “the primary uses of English by non-native speakers will increasingly be computer-mediated” (p. 230). The simple interface of the iPad should be easy to learn without a great deal of instruction, allowing the English content to be focused on (Hicks, 2012). These uses of apps also offer ESL students the ability to engage with visually appealing content beyond textbooks and pencil and paper (Woods, 2011).

The teacher involved with the flash cards demonstrated Technological Knowledge through using the app and the iPad. “Technology knowledge is knowledge about standard technologies such as books and chalk and blackboard, as well as more advanced technologies such as the Internet and digital video” (TPACK, n.d.). She displayed Content Knowledge of words by focusing on phonics that are appropriate for ESL students. Content Knowledge is the “knowledge about actual subject matter that is to be learned or taught” (Mishra & Koehler, 2006, p. 1026). These two knowledges coming together to form Technological Content Knowledge was also evident where the use of the app allowed content to be delivered in new ways.

Using the camera

One of the significant changes from the iPad1 to iPad2 models is the inclusion of a built-in camera. The teachers used this in a variety of ways to support learning in the classroom and capture evidence of learning.

The KLAS that teachers reported using the camera for included art and physical education. The camera was also used on excursions and to provide feedback for students. As reported by Elliott, Livengood, and McGlamery (2012), the use of the iPad’s camera can be integrated into the curriculum to “challenge students to use higher order thinking skills, as well as to reinforce content” (p. 4085).

The main theme that emerged in looking at the teachers’ use of the camera for learning was that it allowed students to receive immediate feedback on their actions. Helen used the video feature of the iPad with a

student who was learning to do cartwheels. As she explained: “I took a video of her to give her immediate feedback and so she could see where she was going wrong. It also helped me analyse where she needed to improve.” The teacher noted that the immediacy of feedback that the iPad provided, allowed for students to improve their learning.

Feedback has two important functions for students. First, it can motivate students and second, it is able to provide information that they can use to correct or improve their learning (McClenaghan & Ward, 1987). Immediate feedback is able to help learners to alter their style so that incorrect behaviours are not established which leads to improved achievement (Zahorik, 1987).

In allowing students to videotape or capture still images of activities they were undertaking, the iPad was able to facilitate immediate feedback. From a TPACK perspective, the teachers showed an understanding of Technological Knowledge where they adapted new technology for use in the classroom (Koehler et al., 2011). There was also Technological Pedagogical Knowledge evident where the teachers used the iPad to provide new possibilities for learning for the students.

Non-teaching use of the iPad

There are many uses the iPad can be put towards that do not directly relate to student use in the classroom. This section focuses on how the pre-service teachers used the iPads to support non-teaching areas. The teachers commented in their journals that they were able to use the iPads to support activities such as assessment of students. Being able to use the iPads for self-reflection was also a major theme commented on by teachers and is examined in this section.

Assessment

Quillen (2011) noted that most apps:

don't allow teachers to monitor student progress or garner student data in the same way that's typically possible with educational programs operated through a laptop or desktop computer. . . . Most app developers are gearing more of their educational content toward the parent-child interactions rather than the teacher-student interactions.

Despite this limitation, the teachers were able to use the iPads in innovative and varied ways to assess students.

Grace discussed both through her journal and in the interview how she used the iPad to assist with assessment of students' work. Her supervising teacher sent her a class list on Excel via Drop Box which she downloaded onto her iPad. She did a pre-assessment on division with her students which she then used to group students. Figure 5 shows the colour coding she has used for the different groups.

Figure 5:**Screen shot of an Excel spreadsheet**

Based on her assessment of students she then devised differentiated learning tasks for each group. As the students were doing the work sheets Grace was carrying the iPad around with her. She was able to refer to her assessment of the students which enabled her to focus on students who needed extra assistance. She was also able to supplement her notes on students based on her observations. Because Grace did not have an in-depth knowledge of the students' abilities, having access to assessment data whilst working with them in the class enabled her to have a greater insight into their mathematical understanding and to record changes to this understanding.

Here the teacher was displaying Content Knowledge which Schmidt et al, (2009) state includes "knowledge in classroom management, assessment, lesson plan development, and student learning" (p.125).

Self reflection

The iPad was also able to be used as a vehicle for self reflection as described by Anna:

I find the iPad useful to write my reflections on. . . . I like that I can take my iPad into the staffroom and write my reflections straight after I have completed the lessons, while it is fresh in my mind.

Jay and Johnson (2002) suggest that the role of reflecting for pre-service teachers is vital in that they learn to think like teachers. It also helps them to deal with the inevitable uncertainties and tradeoffs involved in everyday decisions that affect the lives of students (Larrivee & Cooper, 2006). It has been recognised that reflection in teaching is a growing and evolving practice and that it is important to be motivated by this in order to create effective teaching (Jay & Johnson, 2002). In Australia, for example, a national curriculum is in the process of being established which provides a "framework by which teachers can judge the success

of their learning and assist self-reflection and self-assessment” (Australian Institute for Teaching and School Leadership, 2011).

The iPad can assist in the important process of critical reflection by allowing teachers to use a variety of media for example, images, video, text, and audio to capture their reflections at a time when their thoughts are fresh in their minds. This was noted by Anna in the quote above and by Sally who stated in her journal that the iPad offers immediacy to the teacher. The use of video for reflection by pre-service teachers allows them to reflect effectively on their teaching as well as develop valuable skills involving new technology (Cunningham & Benedetto, 2002).

Having their reflections in one place allows teachers to easily combine the different media to strengthen their reflections using different apps and built in features of the iPad. These reflections can then be easily shared with lecturers and peers at university and then with colleagues and supervisors when the teachers start teaching in schools.

Using the iPads to capture evidence and for self-reflection was evidence of the teachers’ Technological Knowledge. In relation to self-reflection, Gao, Tan, Wang, Wong, and Choy (2011) found that to a large extent, their “interventions for engaging the preservice teachers in reflection had an impact in the initial development of TPK” (p. 1009).

Implications for pre-service teacher education

The discussion here is based on personal reflections on the ways pre-service teachers used the iPads in their professional experience and some of the implications this has for the current and developing practice in pre-service teacher courses.

As stated in the NMC Horizon Report: 2012 K-12 Edition, tablet computing has a Time-to-Adoption Horizon of one year or less (Johnson, Adams, & Cummins, 2012). The pre-service teachers of today will be working in primary schools increasingly mediated by mobile devices such as tablets. This necessitates that pre-service teacher courses do develop their programs to include the use of mobile technologies.

Norris and Soloway (2011) suggest that mobile devices enable, or even require, new pedagogies.

As was shown earlier in this paper, the pre-service teachers were making pedagogical decisions but they were not consciously doing so by drawing on a particular framework. The pre-service teachers would benefit by learning to use the iPads through a framework such as TPACK. Having such a framework would allow them to more critically understand the affordances of the iPad and what knowledges they need to develop to support their teaching. A key implication of their research on teacher education stated by Finger, Jamieson-Proctor, and Albion (2010) is that there needs to a greater understanding and strengthened use of TPACK as a shared language among teacher educators and their pre-service teachers.

The pre-service teachers reported on varying levels of infrastructure in relation to the amount of iPads that were available in the classroom and access to Wi-Fi. In some instances there was only one iPad and no Wi-Fi. This resulted in some feelings of frustration as highlighted by a pre-service teacher with the following journal entry:

To be honest, I am surprised at how little I used my iPad over the practicum placement I think the reason for this was the difficulty with the logistics of having one iPad and 26 eager kindergarten students. The class I was in conducted all maths lessons in a group scenario, which meant I was able to use the iPad on some occasions when working with these small groups.

This situation will face many pre-service teachers once they enter schools as in-service teachers so it is important that they are prepared to use iPads in different ways throughout their teacher training.

Results of the study demonstrated that the pre-service teachers were using the iPads for a range of purposes—some which related to teaching, and others which were non-teaching related purposes. Pre-service teachers will need to be trained to use mobile technologies in the learning areas such as Maths and English as well as for supporting students with special needs, for assessment, and for critical reflection. These are only a few of the purposes for which the teachers might use them.

In order to successfully support pre-service teachers' training in the use of iPads, the training of university teaching staff in the use of the iPads is also necessary. As suggested by Ananiadou and Rizza (2010), to integrate ICT in teacher training institutions, the teacher trainers need to feel confident in using ICT themselves but this is not always the case. In recognition of this, staff training with the iPad is crucial and needs to be sustainable. Training should include both full-time and casual staff. As stated this training needs to be developed around TPACK as a shared language as well as on pedagogical practices in the classroom.

Conclusions

The pre-service teachers displayed a good understanding of working with the iPad using the TPACK framework. They were able to quickly learn how to use the iPad and incorporate it into their teaching by having good Pedagogical Knowledge and Content knowledge. They also demonstrated a good understanding of Pedagogical Content Knowledge and Technological Pedagogical Knowledge.

The use of the iPads and the apps were able to contribute towards a variety of learning outcomes in the mainstream K–6 lessons the teachers taught during their professional experience. Through supporting differentiation the apps were able to support ESL learners and students having difficulty in areas of maths. Through the use of multimodal resources, the apps allowed students to learn in different ways to achieve learning outcomes.

The iPads were also able to be used to support non-teaching activities by the teacher such as assessment and self-reflection. The iPads and the associated apps were able to be used equally by the students and teachers which makes it a versatile tool.

The implications of iPad by pre-service teachers were also discussed. It is clear that introducing them into teacher-education subjects requires careful planning with regards to pedagogy. As suggested, a shared framework such as TPACK allows both pre-services teachers and higher education tutors to develop a shared language which can support an understanding of how mobile technologies can support teaching. The importance of on-going training for staff to facilitate such a shared understanding was highlighted.

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References

- Ananiadou, K., & Rizza, C. (2010, July). ICT in initial teacher training: First findings and conclusions of an OECD study. Proceedings of *EDULEARN10 Conference* held in Barcelona, Spain.
- Australian Institute for Teaching and School Leadership. (2011). *National Professional Standards for Teachers: Frequently Asked Questions*. Retrieved from http://www.aitsl.edu.au/verve/resources/AITSL_National_Professional_Standards_for_Teachers.pdf
- Bonnstetter, R., & VanOverbeke, D. (2012). 'APP'lications for mobile computing in K-12 and pre-service education. In P. Resta (Ed.), *Proceedings of Society for Information Technology & Teacher Education International Conference* (pp. 3428-3433). Chesapeake, VA: AACE.
- Burden, K., Hopkins, P., Male, T., Martin, S., & Trala, C. (2012). *iPad Scotland evaluation*. Retrieved from https://wikis.glowscotland.org.uk/@api/deki/files/55298/=Scotland_iPad_Evaluation.pdf
- Crabtree, B.F., & Miller, W.L. (Eds.). (1999). *Doing qualitative research in primary care: Multiple strategies* (2nd ed.). Newbury Park, CA: Sage Publications.
- Culén, A., & Gasparini, A. (2012, September). *Tweens with the iPad classroom—Cool but not really helpful?* Paper presented at e-Learning and e-Technologies in Education International Conference (ICEEE), held in Oslo, Norway.
- Cunningham, A., & Benedetto, S. (2002). Using digital video tools to promote reflective practice. *Proceedings of Society for Information Technology and Teacher Education International Conference*, held in Nashville, Tennessee.
- Department of Education and Training (2011). *iPad Trial: Is the iPad suitable as a learning tool in schools?* Queensland, Australia: Queensland Government. Retrieved from <http://education.qld.gov.au/smartclassrooms/documents/enterprise-platform/pdf/ipad-trial.pdf>
- Elliott, C., Livengood, K., & McGlamery, M. (2012). Teaching with technology: iPad use in the classroom. In P. Resta (Ed.), *Proceedings of Society for Information Technology & Teacher Education International Conference* (pp. 4084–4086). Chesapeake, VA: AACE.
- Finger, G., Jamieson-Proctor, R., & Albion, P. (2010). Beyond pedagogical content knowledge: The importance of TPACK for informing preservice teacher education in Australia. In *Key Competencies in the Knowledge Society* (pp. 114–125). Berlin, Heidelberg: Springer.
- Frank N. Magid Associates Inc. (2012). *A portrait of today's tablet user, wave II*. A report by the Online Publishers Association in conjunction with Frank N. Magid Associates Inc. Retrieved from [http://onlinepubs.ehclients.com/images/pdf/MMF-OPA -- Portrait of Tablet User-Wave 2 -- Jun12 %28Public%29.pdf](http://onlinepubs.ehclients.com/images/pdf/MMF-OPA_-_Portrait_of_Tablet_User-Wave_2_-_Jun12_%28Public%29.pdf)
- Gao, P., Tan, S. C., Wang, L., Wong, A., & Choy, D. (2011). Self reflection and pre-service teachers' technological pedagogical knowledge: Promoting earlier adoption of student-centred pedagogies. *Australasian Journal of Educational Technology*, 27(6), 997–1013.
- Goodwin, K. (2012). *Use of tablet technology in the classroom*. State of New South Wales Department of Education and Communities, 2012. Retrieved from http://rde.nsw.edu.au/files/iPad_Evaluation_Sydney_Region_exec_sum.pdf

- Heinrich, P. (2012). The iPad as a tool for education: A study of the introduction of iPads at Longfield. Academy, Kent. Nottingham: NAACE (The ICT Association).
- Henderson, S., & Yeow, J. (2012, January). iPad in Education: A case study of iPad adoption and use in a primary school. Proceedings of the *System Science (HICSS)*, 2012 45th Hawaii International Conference. Retrieved from <http://Sarahhenderson.info/wp-content/uploads/2012/04/2012-HICSS-iPad-in-Education.pdf>
- Hicks, R. (2012). *Song writing DE module*. Retrieved from <http://eci833.uregina.wikispaces.net/file/view/Ryan+Hicks%27+DE+module+.doc>
- Jaipal, K., & Figg, C. (2010). Unpacking the “Total PACKage”: Emergent TPACK Characteristics from a Study of preservice teachers teaching with technology. *Journal of Technology and Teacher Education*, 18(3), 415–441.
- Jay, J., & Johnson, K. (2002) Capturing complexity: A typology of reflective practice for teacher education. *Teaching and Teacher Education*, 18 (1), 73–85.
- Jewitt, C. (2006). Technology, literacy and learning: A multimodal approach. London: Routledge.
- Johnson, L., Adams, S., & Cummins, M. (2012). *NMC horizon report: 2012 K-12 edition*. Austin, Texas: The New Media Consortium.
- Kang, J.J., Wu, M.L., Ni, X., & Li, G. (2010). Developing a TPACK assessment framework for evaluating teachers’ knowledge and practice to provide ongoing feedback. In Proceedings of the *World Conference on Educational Multimedia, Hypermedia and Telecommunications* (pp. 1980–1987). Chesapeake, VA: AACE.
- Kearney, M., & Maher, D. (2012). Mobile learning in maths teacher education: Driving pre-service teachers’ professional development. *Australian Educational Computing*, 27(3), 76–84.
- Koehler, M. J., & Mishra, P. (2009). What is technological pedagogical content knowledge? *Contemporary Issues in Technology and Teacher Education*, 9(1), 60–70.
- Koehler, M.J., Mishra, P., Bouck, E. C., DeSchryver, M., Kereluik, K., Shin, T.S., & Wolf, L.G. (2011). Deep-play: Developing TPACK for 21st century teachers. *International Journal of Learning Technology*, 6(2), 146–163.
- Kress, G., & Van Leeuwen, T. (1996). *Reading images: The grammar of visual design*. London: RoutledgeFalmer.
- Larrivee, B., & Cooper, J.M. (2006). *An educator’s guide to teacher reflection*. Boston: Houghton Mifflin.
- McClenaghan, B. A, & Ward, D. S. (1987). Health and physical education. In C. A. Maher & S. G. Forman (Eds.), *A behavioral approach to education of children and youth (School Psychology Series)* (pp. 131–151). Hillsdale, NJ: L. Erlbacem Association.
- Melhuish, K., & Falloon, G. (2010). Looking to the future: M-learning with the iPad. Computers in New Zealand schools. *Learning, Leading, Technology*, 22(3), 1–15.
- Meurant, R. C. (2010). The iPad and EFL digital literacy. *Communications in Computer and Information Science*, 123, 224–234.
- Milman, N., Carlson-Bancroft, A., & Vanden Boogart, A. (2012). iPads in a pre K-4th independent school—Year 1—enhancing engagement, collaboration, and differentiation across content areas. Proceedings of the *International Society for Education Conference*, held in Sandiago, CA.
- Mishra, P., & Koehler, M.J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017–1054.

- Murray, C., & Sloan, J. (2008). *iPod Touch Research Report*. Victoria: Department of Education and Early Childhood Development. Retrieved from <http://www.eduweb.vic.gov.au/edulibrary/public/ict/ipodtouchresearch2009.pdf>
- Norris, C. A., & Soloway, E. (2011). Learning and schooling in the age of mobilism. *Educational Technology*, 51(6), 3–12.
- Papert, S. (1980). *Mindstorms: Children, computers and powerful ideas*. New York: Basic Books.
- Patton, M.Q. (2002). *Qualitative research and evaluation methods* (3rd ed.). Thousand Oaks, California: Sage Publications
- Quillen, I. (2011). Apps for Education Evolving. *Education Week's Digital Directions* 4(2). Retrieved from <http://www.edweek.org/dd/articles/2011/02/09/02apps.h04.html>
- Reid, D., & Ostashewski, N. (2011). iPads in the classroom—new technologies, old issues: Are they worth the effort? In T. Bastiaens & M. Ebner (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications* (pp. 1689-1694). Chesapeake, VA: Association for the Advancement of Computing in Education. Retrieved from <http://www.editlib.org/p/38089>
- Rice, P., & Ezzy, D. (1999). *Qualitative research methods: A health focus*. Melbourne, Australia: Oxford University Press.
- Schmidt, D., Baran, E., Thompson, A., Koehler, M.J., Mishra, P., & Shin, T. (2009). Technological pedagogical content knowledge (TPACK): The development and validation of an assessment instrument for preservice teachers. *Journal of Research on Technology in Education*, 42(2), 123–149.
- Shulman, L. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 15(2), 4–14.
- Shulman, L. S. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, 57(1), 1–22.
- Tomlinson, C. A. (2001). *How to differentiate instruction in mixed-ability classrooms*. (2nd ed.). Alexandria, VA: Association for Supervision and Curriculum Development.
- TPACK (n.d). Retrieved from <http://www.tpack.org/>
- Turkle, S. (1995). *Life on the screen: Identity in the age of the Internet*. New York: Simon & Schuster.
- Vygotsky, L. (1978). *Mind in society*. Cambridge: Harvard University Press.
- Williams, P., Wong, W. L., Webb, H., & Borbasi, S. (2011). Mobile technologies in the field: iPads—rescuer or rescuee? In *Ascilite Conference, 2011*(1), 1325–1331.
- Woods, K. (2011). *Vision for the future*. Retrieved from <http://beyondtheclouds.org/Welcome/wp-content/uploads/2012/10/Black-Elementary.doc>
- Zahorik, J. A. (1987). Reacting. In M. J. Dunkin (Ed.), *International Encyclopedia of Teaching and Teacher Education* (pp. 416–423). Oxford: Pergamon Press.

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The Influencers of Scholars' ICT Career Choices

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Abstract

The international Information and Communications Technology (ICT) skills shortage affects the business and the education sectors. Tertiary degree registrations for ICT courses globally have declined since the dot-com boom. The shortage of ICT professional skills has been exacerbated, both nationally and internationally, by the scarcity of scholars entering the ICT career market. The number of scholars choosing ICT careers in South Africa has declined. Many scholars do not meet university entrance criteria in their final examinations. In addition, scholars do not have a good understanding of what ICT is about nor the numerous career opportunities available. In South Africa, fewer than 25% of schools have access to computer facilities, and teachers and parents have never been exposed to the possibilities of careers in ICT.

In this study, the influencers (parents, teachers, friends, and career counsellors) of a scholar's ICT career choice are investigated. This article is based on, and develops further, some aspects of the research work reported in the author's unpublished 2010 doctoral thesis. The data-collection tools used in the study were a comprehensive literature study as well as four questionnaires distributed (in 2011 and 2012) to parents and first-year students. Parents, teachers, and friends with knowledge of ICT careers influence a scholar's ICT career choice. Exposure to technology and social media were found to further influence a scholar's choice of career. Education and creating an awareness of ICT career opportunities must become a national priority that will positively affect educational change.

Keywords: ICT Skills Shortage; Scholar ICT Career Choices; ICT Career Influencers.

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Introduction

The availability of suitably qualified Information and Communication Technology (ICT) educators can have a positive effect on educational change. ICT plays an increasingly important role in education and the use of modern technologies such as e-learning, blended learning, and mobile technologies can be a critical catalyst for educational change. The ICT education and training of educators in South Africa has not achieved the required standards of continual teacher professional development.

The professional development of teachers and specifically that of Information Technology (IT) teachers should be compulsory and on a continual basis. Teachers require re-skilling of their ICT skills, and schools that offer Computers Applications and Technology (CAT) and Information Technology (IT) often require teachers offering these subjects to provide the required training and skills development to colleagues (Koorse, Calitz, & Cilliers, 2010). Schools offering CAT and IT as subjects are faced with additional problems of finding suitably qualified teachers and ICT infrastructure.

The ICT skills shortage in South Africa is of national concern and industry and educational institutions are increasingly looking towards tertiary institutions to address the ICT skills crisis (Calitz, 2010). Globally, tertiary institutions are experiencing a decline in student enrolment in ICT courses. The number of students enrolling for ICT courses in South African higher education has decreased over the past decade. Internationally and nationally, universities are investigating reasons for the declining numbers of high school children pursuing careers in ICT (Babin, Grant, & Sawal, 2010).

The number of students enrolling for ICT courses at tertiary institutions in South Africa has decreased considerably since the late 1990s. A similar trend was found internationally, however, enrolments have started to stabilise in the United States and Canada since 2007 (Conference Board of Canada [CBC], 2009). Internationally, various government bodies and academics at universities have voiced their concern about the ICT skills shortage. The shortage results primarily from low student enrolments which lead to a smaller number of graduates and a scarcity of skilled ICT professionals in almost every computer-related field (Alexander et al., 2010).

In April 2008, the National Department of Labour indicated in their National Master Scarce Skills List that a minimum of 37,565 IT professionals were needed in the ICT sector to ensure that there were enough skills within this sector. In the 2011 ITWeb survey, the estimate for ICT skills needed in South Africa had nearly doubled to 70,000 practitioners (Cohen, 2012).

A limited number of ICT students and professionals enter the industry every year. Universities are not taking in their maximum capacity of students because a limited number of scholars pass Mathematics and Science in matric with the necessary requirements (Cohen, 2012). The basic education system in South Africa needs to be more involved with promoting an interest in technology in scholars from an early age to cultivate a large and relevant ICT skills base (Cohen, 2012).

Research has indicated that scholars choosing a career and specifically ICT careers are influenced by parents, teachers, career counsellors, and role models (Babin et al., 2010). Parents and teachers were ranked as important sources of information when deciding on a future ICT careers (Ross, 2007). Research conducted in South Africa indicated that scholars are influenced by parents and teachers when making career choices (Alexander et al., 2010). In a Canadian study, the majority (83%) of scholars indicated that they consult with their parents or guardians for education and career advice (CBC, 2009). Careers in ICT were found less appealing by parents than by scholars in Canada (CBC, 2009). Parents had misperceptions about ICT careers and parents and guidance counsellors perceived that there are no jobs in computing (Benamati, Ozdemir, & Smith, 2010).

Research problem

In South Africa, scholars with an aptitude for ICT are reluctant to pursue Computer Science and Information Systems (CS&IS) degree programmes at universities. Students, scholars, and parents have misperceptions about the ICT job market and salaries (Benamati et al., 2010). The image of computing held by the general public, teachers, and career counsellors is deteriorating even though teenagers use mobile technologies and social networking sites daily. Scholars generally have misperceptions of ICT careers and job descriptions and scholars' disinterest can be attributed to a lack of familiarity with the degree programmes Carter (2006). Koorsse et al. (2010) and Havenga and Mentz (2009) indicate that the lack of interest in IT as a secondary school level subject has been observed by IT educators, the Department of Education, subject co-ordinators, and academics at universities.

South African scholars and their career advisors (parents, teachers, and guidance counsellors) believe that many national and international ICT job opportunities have been lost due to the downturn when the dot-com bubble burst in 2000, and to the extent of offshoring (Alexander et al., 2010; Benamati, et al., 2010). South African schools do not appoint full-time career or guidance counsellors, and teachers and parents have limited knowledge of the ICT career opportunities available. Scholars do not receive appropriate career advice and are not encouraged to pursue careers in ICT, although more than 290 different careers are available in the ICT industry (Calitz, 2010). Scholars' career choices are influenced by role models; however, the majority of scholars in South Africa generally do not have any role models in the ICT industry.

The following research objectives have been identified in this study:

- Determine the role parents, teachers, and career counsellors play in scholars' ICT career choices
- Report on the four surveys conducted amongst parents and first-year students during ICT career awareness events in 2011 and 2012
- Indicate the strategy that the Department of Computing Sciences implemented to increase the awareness of ICT careers in the Eastern Cape.

The important career advice that parents and teachers provide, influences scholars to pursue careers in ICT and is the primary focus of this research study. The literature review investigates which corrective steps can be taken by tertiary institutions to alleviate the ICT skills shortage in South Africa.

Research conducted amongst parents and first-year students indicated the crucial role of parents and teachers in a scholar's career choices. In this study, a survey was conducted amongst high school parents and first-year students to establish the following research questions:

- Who influenced their child's career choice?
- What were the parents' and teachers' roles in influencing their children's career choices?
- Did parents and teachers know of the ICT skills shortage in South Africa and related career opportunities?
- Did parents and teachers encourage their children to pursue careers in ICT and in the ICT teaching and education profession?
- What strategies can CS&IS departments implement to increase the awareness of ICT careers?

Research methodology

Research strategies are based on the selected research philosophy as well as the type of research questions that this study aims to answer. The interpretivist research philosophy primarily makes use of literature reviews, surveys in the form of questionnaires, focus groups, and case studies. A combination of related literature and data collected from questionnaires was used for this study.

The parent questionnaire and first-year student questionnaire were designed in a research study by Calitz (2010). The consistency and reliability of the questionnaires were validated in the research study. Parents of prospective ICT students attended parent and scholar evenings hosted by the Department of Computing Sciences at Nelson Mandela Metropolitan University (NMMU) during the period 2010 to 2012. The parents were given a presentation on the different career opportunities in Computer Science and Information Systems and various guest speakers in the field of Computer Science addressed the parents.

The parent questionnaire was distributed at these events to gather information about what career advice the parents had provided to their children as well as any other sources of career advice their children had used. The parents were questioned about their own studies and ICT career knowledge. The parent questionnaire aimed at assessing the parents' knowledge of CS and IS to establish whether they were able to provide their children with career advice in the ICT field.

The parent questionnaire consisted of biographical and career questions. It also investigated which specific people had given their children career advice, namely themselves as parents, teachers, career counsellor, or guidance counsellors and, specifically, what career advice these people gave the children. The questionnaire asked parents if they would recommend that their children pursue a career in ICT and whether they knew the difference between the CS and IS degree programmes. Lastly, the current employment status of the parents was established. The parent questionnaire comprised of open-ended and closed questions, including contingency questions.

The first-year CS&IS student questionnaire developed by Calitz (2010) was used in 2011 and 2012. First-year BSc and BCom CS&IS students completed the questionnaire at the beginning of their studies in the Department of Computing Sciences at NMMU. The first-year questionnaire comprised open-ended and closed questions. The first-year questionnaire established the following:

- Where did you hear about the NMMU Department of Computing Sciences?
- Who influenced your ICT career choice?
- What career advice was provided and by whom?
- What is your knowledge of the different ICT careers?

The parent and first-year questionnaires were statistically analysed, obtaining descriptive statistics and using thematic analysis for open-ended questions.

Research ethics

The research conducted in this study included vulnerable groups namely, undergraduate students. The questionnaires utilised in this study, the consent forms for students and parents, and letters to relevant parties and bodies were approved by the NMMU Research Ethics Committee, Ethics number: H 2010 BUS BS 15.

Literature study

Scholar perceptions of ICT

The National Association of Colleges and Employers in the USA indicated that Computer Science graduates were amongst the highest paid of any major with an average starting salary of \$53,000 per annum in 2007 (Ross, 2007). However, students entering tertiary education are not selecting CS&IS majors because of the perceived dot-com bust and the effects of outsourcing (Carter, 2006; Benamati et al., 2010).

In the USA, Ross (2007) found that people with the aptitude for computing lack the interest to pursue an ICT career. Jill Ross, Director of the Image of Computing National Task Force at the University of Colorado, identified the following four root causes for the lack of interest in computing:

- The general public's image of computing
 - They think that computing is only programming
 - Only nerds pursue computing careers
 - Computing is only related to iPods and cell phones
 - There are no jobs due to offshoring and outsourcing
- The teen's image of computing
 - Teens aged between 12 and 17 years increasingly use social networking sites
 - Teens use mobile technologies daily
 - Computing is part of teens' daily life and they think they already know everything about computing
- The undergraduate's image of computing
 - High school teachers influence the choice of computing programs
 - IT students like to solve problems
 - Computing projects are not exciting
 - IT is only coding (writing programs)
- The computing professional's image of computing
 - They have a positive impact on society
 - Computing needs a more human and less abstract orientation
 - Computing intends to preserve the rigour of computer science as a discipline
 - Computing requires interdisciplinary collaboration
 - There is an underrepresentation of women and minorities in IT.

The *Running on Empty* Association for Computing Machinery (ACM) report by Wilson, Sudol, Stephenson, and Stehlik (2010) indicated that approximately two-thirds of the states in the USA have limited Computer Science education standards for secondary schools and that most high schools include Computer Science as an elective and not as part of the core education. The downward spiral of Computer Science is continuing and little is done to redirect the trend (Roman, 2010).

The Conference Board of Canada (CBC, 2009) conducted an extensive study on secondary school students' views about ICT and why limited numbers chose careers in ICT. Researchers interviewed 1, 034 Grade 9 and 10 scholars, 60 parents, and 54 guidance and career counsellors. The results indicated that 36% of the scholars considered ICT career opportunities and their decisions were only marginally influenced by job availability and job security. Scholars (37%) found ICT jobs to be creative and 77% indicated that they believed ICT jobs provided better salaries.

The concerns scholars identified were that ICT jobs were difficult and complex (34%), the jobs were “not fun” (31%), and “not cool” (25%). The study found that girls’ enthusiasm for ICT was lower than boys’. The majority (83%) of scholars reported that they consulted with their parents or guardians for education and career advice. The study found that parents and guardians found ICT less appealing than scholars. Career and guidance counsellors (75%) viewed ICT careers in a positive light.

Scholars may develop a negative attitude towards computing as a result of high school education (ACM Bulletin, 2009). In South Africa, research indicates that the high school subject, IT, has a negative impact on future career choices by scholars (learners) and has direct impact on the number of ICT professionals entering and graduating from tertiary institutions (Havenga & Mentz, 2009; Koorsse et al., 2010). The numbers of scholars selecting IT as a subject in Grades 10–12 are further declining (Koorsse et al., 2010).

Research conducted by Babin et al. (2010) and Biggers, Brauer, and Yilmaz (2008) has focused on identifying reasons for the lack of interest by scholars in choosing computing as a career choice at tertiary level. The results indicate that scholars are uninformed or misinformed about ICT career opportunities, salaries, and job availability. The scholars’ perceptions are that a career in computing is asocial, only focused on programming, and ICT professionals have limited interaction with other individuals (Biggers et al., 2008).

Scholars at school level over the last decade are less inclined to consider ICT career programmes at tertiary level (Becerra-Fernandez, Elam, & Clemmons, 2010; Benamati et al., 2010). Ross (2007) found that talented young people are turned off by computing’s image. High school scholars, specifically, have a negative perception about a lack of high-paying ICT careers, career opportunities, and ICT academic programs offered by tertiary institutions.

Interventions by tertiary institutions

A number of interventions by tertiary institutions at secondary school level to address the problems of scholars not choosing ICT careers have taken place worldwide. Choudhury, Lopes, and Arthur (2010) implemented an IT Careers Camp, a specific promotional initiative designed to improve enrolment in IT-related courses, and aimed at high school scholars and teachers. The IT Career Camp was specifically designed to convince participants that:

- Career prospects in the ICT industry are excellent
- There are numerous ICT career possibilities and career tracks
- ICT work is creative and interesting.

The camp was designed in collaboration with industry partners and allowed for industry visits, thus allowing scholars to gain hands-on experience in solving business problems by utilising ICT in a practical environment. The camp was very successful in changing scholars’ perceptions about the nature of ICT work and the ICT job market. Choudhury et al. (2010) indicated that they believed the camp could be a useful tool to create a pipeline of well-informed scholars interested in ICT careers.

Ericson, Guzdia, and Biggers (2005) supported the proposal that tertiary CS&IS departments should assist computing teachers at school level, for example, presenting workshops on programming for computing teachers. The workshops made computing teachers more confident and provided the opportunity for

teachers to keep up-to-date with current technologies. Post-graduate students seconded to a specific teacher at a school to provide programming technical assistance, proved to be very valuable for computing teachers and scholars.

The Computer Science Education Week (CSEdWeek) in the USA was the second government-supported event promoting ICT specifically at school and tertiary institution level (ACM MemberNet, 2010). Computer Science Unplugged (CS Unplugged) is a series of activities to expose scholars to central concepts in Computer Science and Information Systems in an entertaining way and has been implemented in New Zealand and Israel (Taub, Ben-Ari, & Armoni, 2009). The activities do not require access to a computer and the research results indicate that CS Unplugged did start a process of changing scholars' views about ICT.

The CSEdWeek 2010 included CS Unplugged, CSEdWeek Pledge, and various computing activities and visits to schools to promote the importance of Computer Science and Information Systems education. CSEdWeek 2010 in the USA sought to improve involvement of students, educators, parents, and industry leaders in signing a pledge to participate in, and support, a national effort to promote ICT careers and to promote the importance of computing education (ACM MemberNet, 2010).

In the Eastern Cape, South Africa, the Department of Computing Sciences (NMMU) has implemented similar initiatives for IT school teachers. The department has been working closely with IT teachers in the region providing IT teacher seminars, programming training courses, scholar ICT career presentations, and educational support. Various initiatives such as gaming days, school IT project competitions, promotional brochures, and IT trophies for IT scholars achieving at individual schools have been initiated by the department.

The department regularly produces a departmental newsletter that is distributed to schools in the region. The Department of Computing Sciences has appointed a professional journalist on a contract assignment to interview graduates working in industry and produce articles that are included in the departmental marketing materials, newsletters, and web site. The Department of Computing Sciences *NEWS*, Issue 2 (2011) included an article on department alumni and the perks of having a formal qualification, specifically a post-graduate qualification and working in the ICT industry.

The Department of Computing Sciences and TELKOM SA further presented a Computer Literacy Programme to 350 teachers in Port Elizabeth during 2009 and 2011. The programme aimed at providing continual education to teachers, included introductory and advanced courses of the Microsoft Office Suite 2003/2007 and Expression Web. The File Management and Word Processing Beginners and Intermediate courses were rated the most useful by teachers. The effectiveness and success of the programme was confirmed and teachers applied the skills learnt, both in their personal lives and in their profession.

ICT career interest at school level and influences on ICT career choice

Research internationally, has indicated that scholars choosing a career, and specifically ICT careers, are influenced by parents, teachers, career counsellors, and role models (Babin et al., 2010). The ICT skills shortage globally has sparked renewed interest in research into what influences scholars' career choices. Authors and panels have cited the need to attract more high school scholars to enrol in CS&IS tertiary degree programmes. Current research is focusing on how and why scholars make decisions to pursue ICT careers and degree studies (Babin et al., 2010; Biggers et al., 2008; Calitz, 2010).

Parents are one of the most important sources of advice to scholars (Trusty, Watts, & Erdman, 1997) and have expectations and aspirations for their children. Parents are often seen as role models and further

motivate and support their children. Parents play a significant role in assisting their children make career decisions. Career counsellors are also a valuable source of advice for scholars; however, the advice given is often rated lower in importance than that of parents (Alexander et al., 2010). In a recent study, students ranked their sources of advice in decreasing order of influence. Parents were ranked first, then friends, then teachers and lastly counsellors (Babin et al., 2010).

Parents help to shape the perceptions of their children regarding the appropriateness of their career decisions and are valuable sources of encouragement. Parental encouragement significantly influences the learning experiences, efficacy, and outcome expectancies of scholars. Parents and guidance teachers at schools assist scholars to develop confidence concerning career competence, career planning, and occupational exploration (Turner & Lapan, 2002).

Babin et al. (2010) interviewed and surveyed Canadian career counsellors (n=111), ICT university students (n=141), and first-year Business and IT Management students (n=1,335). The survey findings suggest that parents have the strongest influence on career choice and guidance counsellors the weakest influence. Recommendations from the research study are that ICT industry representatives must speak directly to scholars, students, and parents to improve the number of scholars and students choosing ICT careers. The study found that scholars were attracted by the relatively high income of ICT professionals.

Gender, socioeconomic background and access to computers and technology all have an influence on ICT career choices. The research study conducted by Miliszewska and Sztendur (2010) that investigated the perceptions of ICT studies and careers among female secondary school students in an educationally disadvantaged metropolitan region of Melbourne, found that female students had positive perceptions of ICT; however, this interest did not translate into the consideration of ICT as a career choice.

Cosser (2010), in a longitudinal study, further found that a wide disparity exists between scholar career preferences and actual enrolments in higher education institutions. The study found that fewer than 20% of the total number of scholars specifying areas of study for which they planned to register, enrolled at higher education institutions. The study found that although scholar preferences were predominantly for studies in the fields of Science, Engineering, and Technology (SET), student graduations were predominantly in the Humanities.

Research conducted on the reasons why scholars do not choose ICT careers in South Africa, are based on two main studies: one conducted by Seymour, Hart, Haralambous, Natha, and Weng (2005) in the Western Cape and the other by Jacobs and Sewry (2010) in Grahamstown (Eastern Cape) respectively. The studies were conducted to determine Grade 12 scholars' inclinations to study Computer Science and Information Systems at a tertiary level in South Africa. It was found that students' previous experience with computers affected their attitudes toward any future use. Both studies found that learners with no access to computers at school were more inclined to study Computer Science than those with access to computers. The studies also found that scholars who have negative perceptions of ICT jobs available are less inclined to study Information Systems or Computer Science. Both studies found that scholars do not know what Information Systems as a field of study comprises although the perceptions of Computer Science were slightly more accurate.

Jacobs and Sewry (2010) conclude that educational institutions need to promote accurate representations of ICT-related subjects and career fields to scholars. Their research results indicate that, of the scholars who take IT as a school subject, very few continue with CS&IS courses at a tertiary level. Thus, after being exposed to the IT curriculum at school, scholars then did not decide to continue with a career in computing.

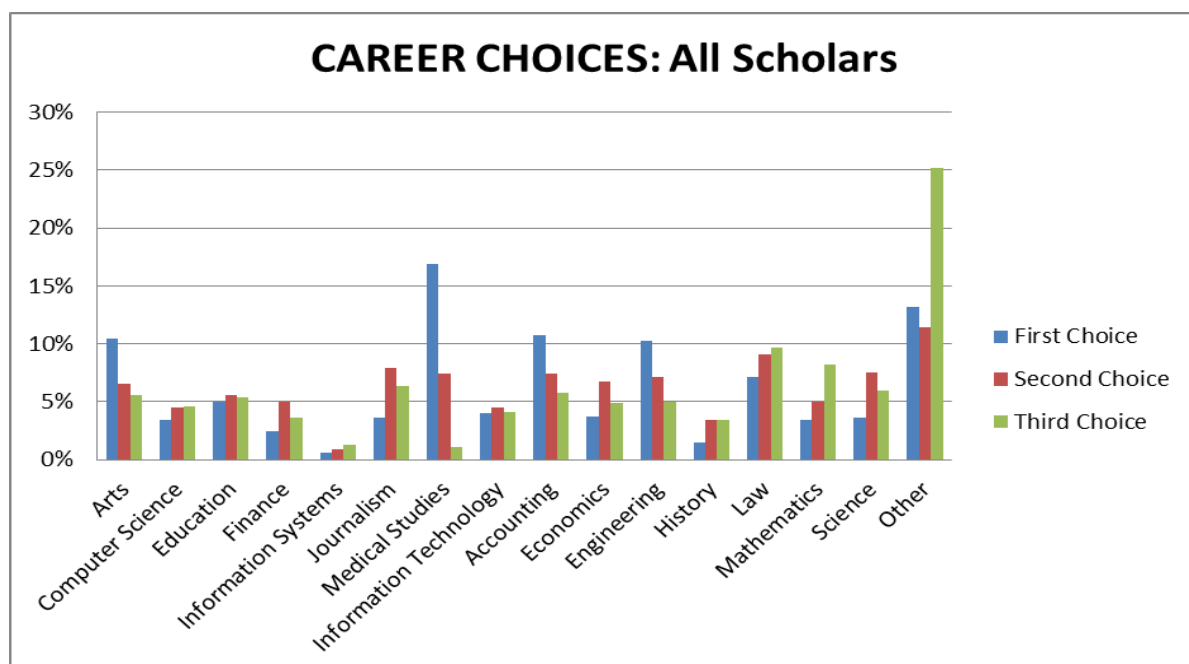
Scholars career choices

Research has indicated that scholars' interests and career choices, including ICT careers, are influenced by parents, teachers, career counsellors, and role models (Babin et al., 2010). The ICT skills shortage worldwide has sparked renewed interest in research into what influences scholars' career choices.

In a study by Calitz (2010) in 11 secondary schools in the Eastern Cape, a total of 1,536 scholars returned a completed a career interest questionnaire. The career choices of all scholars (Grades 9, 11 and 12) that participated in the study (Figure 1) indicate that scholars' first career choice is Medicine (17%), "Other" (13%), Arts and Engineering (10%), Computer Science (3%), Information Systems (1%) and Information Technology (4%).

Figure 1

Career choice by all participants in the study (n=1,536)



The "Other" category, out of the 16 categories, received the most responses: first choice (13%), second choice (11%), and third choice (25%). This indicates that scholars are increasingly considering other fields of study not identified in the questionnaire.

National decline in ICT registrations

The International decline in ICT enrolments has been echoed in South Africa. Seymour et al. (2005) examined why scholars were not enrolling for CS&IS. It was found that the schooling system in South Africa was partly to blame and that many scholars did not meet university criteria when they left school. Scholars also did not have a good understanding of what ICT was about. With only 24% of schools having access to computer facilities in South Africa, many scholars have never been exposed to the possibilities of careers in ICT (Seymour et al., 2005).

The shortage of qualified science and technology teachers in South Africa has influenced the ICT career shortage dramatically because scholars are not being exposed to ICT, and a lack of training has led to poor

ICT standards. Rhodes University in Grahamstown, South Africa experienced a significant increase in ICT enrolments after the dot-com boom from 2000 to 2003, but that was followed by a significant decrease in enrolments up to 2008 (Jacobs & Sewry, 2010).

A decline in first time ICT registrations has also been experienced at NMMU in the Department of Computing Sciences. In 2002, a large number of first-year CS and IS students (307) registered for the first time in a degree program in Computer Science. This number steadily decreased over the next decade and only 91 first-year students were registered for a degree in Computer Science in 2012. Table 1 illustrates the registration figures for first-year CS and IS students taking Programming as a subject at NMMU.

Table 1

NMMU first-year Programming registration figures (Greyling, personal communication, 2013)

Year	Registration figures	% Decline/rise annually	% Decline compared to 2002
2002	307	-	-
2003	270	-12.05%	-12.05%
2004	103	-61.85%	-66.45%
2005	105	+1.94%	-65.80%
2006	106	+0.95%	-65.47%
2007	74	-30.19%	-75.90%
2008	89	+20.27%	-71.01%
2009	99	+11.24%	-67.75%
2010	84	-15.15%	-72.64%
2011	69	-17.86%	-77.52%
2012	91	+31.88%	-70.36%
2013	106	+16.48%	-65.47%

Table 1 summarises information on first-year registration figures. The average decline of first-year registrations between 2002 and 2012 is 65%. This rapid decline in CS and IS enrolments has contributed to the ICT skills shortage. The growth from 69 enrolments in 2011 to 91 in 2012 can be attributed to increased marketing in the Department of Computing Sciences during 2010 and 2011.

Research results and discussion

Parent questionnaire results

The important role of parents in influencing scholars' career choices has been reported in various research studies (Babin et al., 2010; CBC, 2009). The results from a first-year career choice pilot study conducted in 2009 indicated the important role of parents in first-year students' career choices.

Parents of prospective Computing Sciences students completed surveys at the Department of Computing Sciences parent information evenings held in 2011 and 2012. The children of the parents who attended the evening were predominantly in "advantaged" schools. The biographical data of the parents of scholars interested in ICT are presented in Table 2.

Table 2**Parents' gender and race**

Year	Male	Female	Asian	Black	Coloured	White
2011 (n=47)	27 (57%)	20 (43%)	2 (4%)	12 (26%)	13 (28%)	20 (42%)
2012 (n=50)	42 (84%)	8 (16%)	3 (6%)	3 (6%)	9 (18%)	35 (70%)

Fifty three percent of the parents who attended the evening presentation in 2011 studied at university and 56% in the 2012 presentation (Table 3). Parents who completed the survey indicated their children's current school grade. A large number (68%) of Grade 12 scholars who attended the information evenings with their parents had decided on a career.

Table 3**Parents attended university and scholar decided on career**

Year	Parents at university		Decided on career	
	Yes	No	Yes	No
2011 (n=47)	25 (53%)	22 (47%)	30 (63%)	17 (37%)
2012 (n=50)	28 (56%)	22 (44%)	30 (60%)	20 (40%)

The career choices made by scholars, as indicated by the parents in 2011, showed that the majority of respondents (n=30, 63% who answered "Yes") were ICT related careers (programming, web design, Computer Science, software development). Other careers chosen included Psychology, Education, Accounting, and Mechatronics. The career decisions indicated by the 2012 group included ICT, Accounting, Teaching, Law, and Engineering. The majority of the scholars who had not decided on a career were considering more than one career option.

Table 4**Career advice provided**

Year	Parents		Teachers		Career counsellors	
	Yes	No	Yes	No	Yes	No
2011 (n=47)	34 (72%)	13 (28%)	27 (57%)	20 (43%)	11 (23%)	36 (77%)
2012 (n=50)	38 (76%)	12 (24%)	28 (56%)	22 (44%)	22 (44%)	28 (56%)

Respondents were asked to indicate who had provided their children with career advice (Table 4). Parents (74%) were the biggest source of advice, followed by teachers (57%) and career counsellors (33%). Thematic analysis of the career advice given to scholars by parents, teachers and career counsellors included:

- Study for a professional qualification
- Pursue a career you are passionate about
- Pursue a career where job opportunities exist
- Follow a career that you are interested in and will enjoy.

A large percentage of parents (98%) indicated that they would recommend ICT as a career for their children. Various reasons were given for recommending ICT as a possible career. Thematic analysis of the results indicated the following main themes:

- ICT is relevant and the sky is the limit
- ICT has a large number of career opportunities
- All business sectors need ICT
- International job opportunities are available
- Modern career, and has a high future demand.

A large number of the parents (67%) indicated that their children had decided to pursue a career in ICT. Parents indicated the career advice they had given their children. Thematic analysis of the results provided the following main themes:

- Study hard so that they can have a bright future
- Do something that one will enjoy
- Explore options and match talent with passion
- Excel at school, especially in mathematics
- Do ICT because it is the future.

Advice given to scholars by teachers and by career counsellors was also requested in the survey. The career advice given to scholars by teachers and career counsellors as indicated by the parents included:

- Areas a scholar likes, suits their abilities and values
- Careers that are in high demand
- Make sure you follow your interests
- Subject choice advice
- Choose a career that they can grow in, and which interests them.

Results of the first-year students' survey

First-year Computing Sciences students completed the first-year survey, in 2011 (n=877) and 2012 (n=388). The group consisted of students registered for first-year Computer Science and Information Systems (programming and end-user computing) as well as students registered for the end-user computing service course. The biographical details for gender and race are presented in Table 5.

Table 5

First-year students' biographical details

Year	Male	Female	Asian	Black	Coloured	White
2011 (n=877)	440 (50%)	437 (50%)	23 (2%)	610 (70%)	75(9%)	169 (19%)
2012 (n=388)	232 (60%)	156 (40%)	20 (5%)	202 (52%)	31 (8%)	135 (35%)

The first-year students were asked where they obtained career information and who influenced their career choice (Figure 2). The 2011 group (n=877) indicated that their parents (n=266, 30%), teachers (n=198, 23%), and friends (n=141, 16%) provided career information and assisted them in deciding on a career choice. The sources of information that assisted in their career choice were the NMMU website (n=170, 19%), Openday (n=127, 15%), and school visits by NMMU staff (n=114, 13%).

Figure 2

First-year students 2011 (programming and end-user courses, n=877)

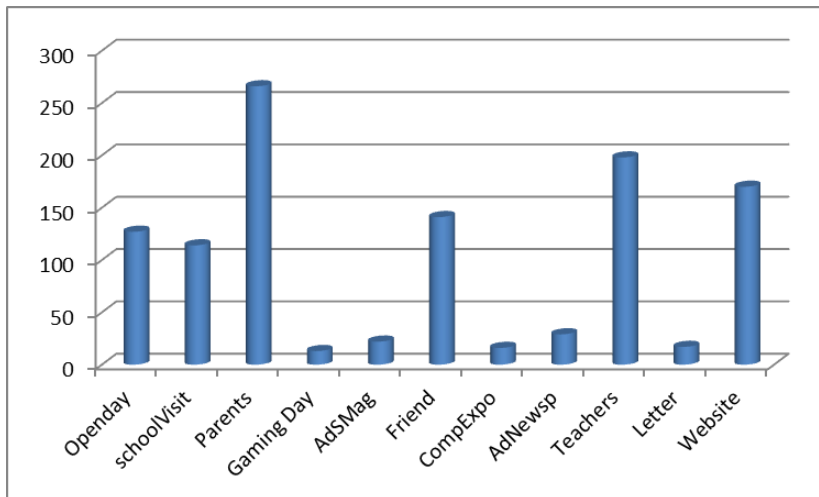
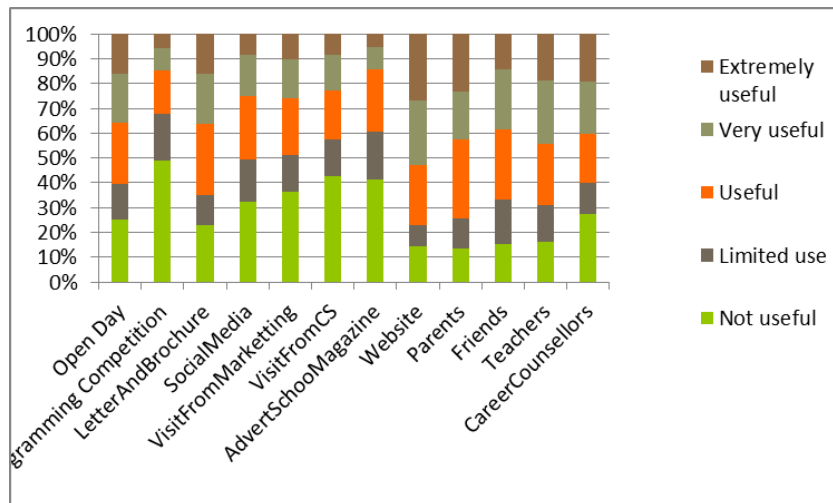


Figure 3

First-year students 2012 (programming and end-user courses, n=388)



The questions in the first-year questionnaire relating to sources of career advice were changed to a 5-point Likert scale in 2012 (1=not useful, and 5=extremely useful). The results (Figure 3) indicate a similar pattern to the 2011 results. The 2012 group (n=388) indicated that their parents (n=268, 69%), teachers (n=249, 64%), friends (n=141, 36%), and career counsellors (n=208, 54%) provided useful to extremely useful career information and assisted them in deciding on a career choice. The results support international research findings (Babin et al., 2010; Biggers et al., 2008; Turner & Lapan, 2002).

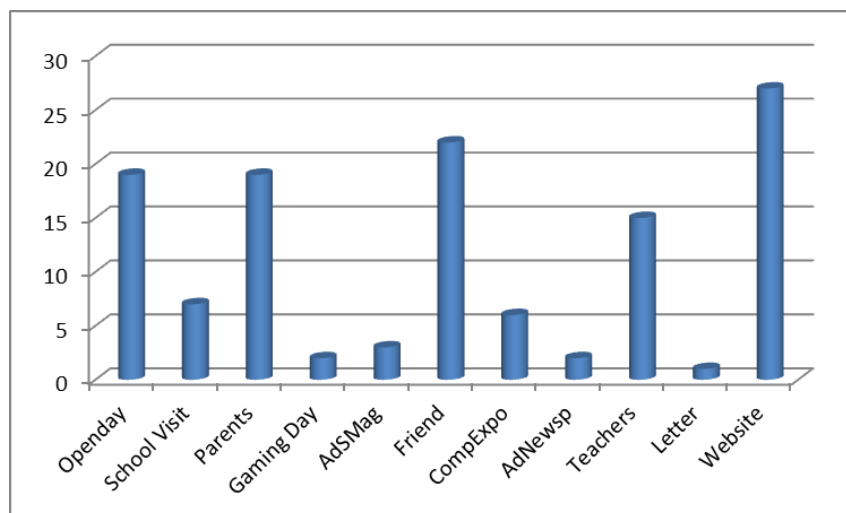
The sources of information that assisted in their career choice were the NMMU and Department of Computing Sciences websites (n=179, 46%), Openday (n=213, 55%), and school visits by NMMU marketing staff (n=164, 42%). Additional sources of information included in the 2012 survey were the use of social media (Facebook, Twitter). The Department of Computing Sciences uses social media (Facebook and Twitter) for marketing purposes and 47% (n=182) of the first-year students indicated that this was useful, very useful or extremely useful (Figure 3). Visits and presentations at schools by members of the Department of Computing Sciences were also found to be useful to extremely useful (n=143, 37%).

The literature and background discussed in this paper focuses on scholars and students considering careers in ICT. The following extracts from the previous surveys discussed will focus on students who have registered in degree programs in Computer Science and Information Systems. First-year Computing Sciences programming students completed the first-year student survey, in 2011 (n=97) and 2012 (n=98). The students who completed the questionnaire included new first year registrations and students who failed and repeated the course.

The first-year Computer Science and Information Systems students, enrolled for an ICT career, were asked where they obtained career information and who influenced their career choice (Figure 4). The 2011 group (n=97) indicated that their parents (n=19, 20%), teachers (n=15, 15%) and friends (n=22, 23%) provided career information and assisted them in deciding on a career choice. The sources of information that assisted in their career choice were the NMMU website (n=27, 28%), Openday (n=19, 20%) and school visits by NMMU staff (n=7, 7%).

Figure 4

2011: First-year CS&IS students taking Programming only, n=97



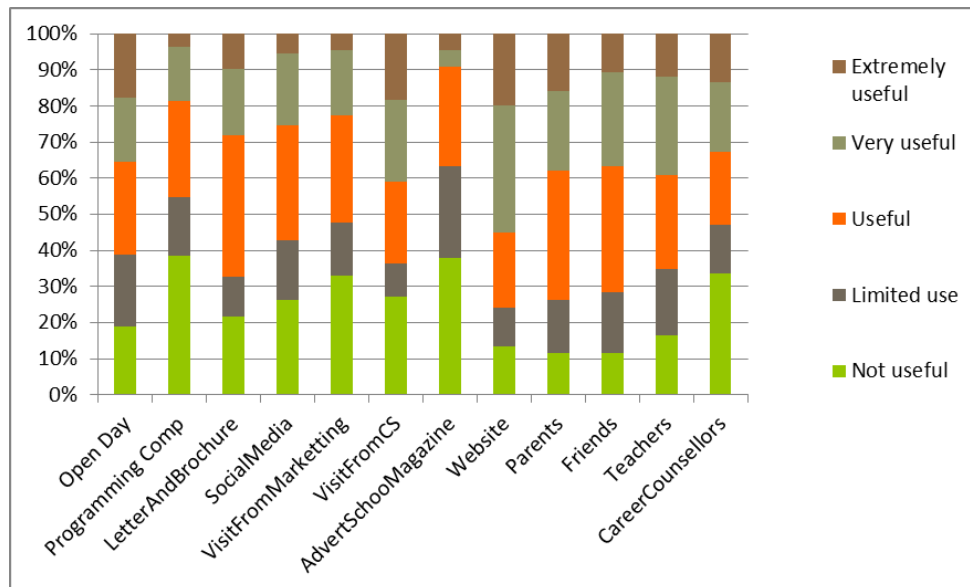
The 2012 ICT programming group (n=98, Figure 5) indicated that their parents (n=70, 71%), teachers (n=60, 61%), friends (n=68, 69%) and career counsellors (n=47, 48%) provided useful to extremely useful career information and assisted them in deciding on a career choice. These results support the research findings by Babin et al. (2010) that ranked parents first, followed by friends, teachers, and career counsellors.

The sources of information that assisted in their career choice were the NMMU and Department of Computing Sciences websites (n=73, 74%), Openday (n=55, 56%) and school visits by NMMU marketing staff (n=46, 47%). Additional sources of information included in the 2012 survey were the use of social media (Facebook, Twitter). The Department of Computing Sciences uses social media (Facebook and Twitter) for marketing purposes and 53% (n=52) of the first-year CS&IS students indicated that this was

useful, very useful, or extremely useful (Figure 5). Visits and presentations at schools by members of the Department of Computing Sciences to schools were also found to be useful to extremely useful (n=56, 57%).

Figure 5

2012: First-year CS&IS students taking Programming only, n=98



The first-year CS&IS students further indicated that they would like to pursue the following popular ICT careers (most popular ranked first):

- Programmer
- Business Analyst
- Software Engineer
- Systems Analyst
- Information Auditing Specialist
- Network Administrator
- Project Manager
- Software Tester
- Mobile Applications Developer.

Strategies that the Department of Computing Sciences have implemented

The Department of Computing Sciences at NMMU has implemented the following strategies to increase the awareness of ICT careers amongst stakeholders over the past 3-year period:

- Schools—doing presentations at schools, making scholars aware of careers in ICT
- Teachers—providing ICT training courses in Microsoft word, Excel, and so forth

Educational Research for Social Change, April 2013, 2 (1)

Faculty of Education: Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

- IT teachers—providing programming training
- Parents—bi-annual parent evenings, including presentations by the ICT industry
- Students—industry presentations, career advice, and implementation of an ICT career portal
- Marketing ICT careers and CS&IS degree programs using social media (Facebook and Twitter)
- ICT career portal for scholars, students, and industry (<http://cs.nmmu.ac.za/Home>).

The final results of the above efforts indicate an increased awareness by parents, teachers, scholars, and students in ICT careers and an increase in CS&IS degree programme registration at NMMU.

Conclusions and future research

Parents, teachers, career counsellors, and friends play an important role in a scholar's career choice and place of study. Parents were generally unaware of the ICT skills shortage in South Africa, and of ICT career prospects, salaries, and numerous career opportunities. The important role of teachers in influencing a child's career choice was emphasised by a number of parents in this study. Scholars need to be made aware of the ICT career opportunities and education-related ICT careers.

The CSEdWeek 2010 (ACM MemberNet, 2010) and the national iCompute campaign (Ross, 2007) in the USA promoting ICT career awareness and targeting people such as parents, teachers, and career counsellors who influence scholars' career choices are important initiatives which universities, governments, and industry should consider. These initiatives could have a positive impact on the ICT skills shortage, encourage scholars to enter the ICT education sector, and effect educational change.

Organisations in industry are also launching initiatives to raise awareness of the ICT skills shortage and make contact with potential future employees whilst they are still in school. Dimension Data has a Saturday school that focuses on computer-based training (Harris, 2011). The Oracle Academy Initiative provides universities with access to Oracle software and training for a nominal fee. IBM also has an Academic Initiative that provides hardware, software, courseware, tools, training, and books at a discount to tertiary institutions (Harris, 2011). Universities are further launching educational programmes and ICT career awareness events at schools and at parent career awareness evenings, which could have a positive effect on educational change.

The results of this survey indicate the urgent need for more interventions and emphasise the important fact that scholars do not pursue CS&IS degree programs due to limited knowledge of the fields of study. The majority of comments provided by students indicated that they required and desired more information about the ICT career prospects and study directions.

The NMMU Department of Computing Sciences has launched an ICT career awareness project in the Port Elizabeth area where Department of Computing Sciences students visit schools and show a departmental video on ICT careers and degree programmes at NMMU. An ICT marketing presentation is also presented, showing the exciting work environments at Google and Facebook. It includes South African companies, ICT salaries, and career opportunities. The Department of Computing Sciences will continue marketing ICT careers and degree programs at schools in the Eastern Cape. The use of social media, specifically integrated social media marketing campaigns, will increase in the future because scholars are familiar with, and increasingly use, social media. The ICT Career Portal linked to the NMMU Department of Computing Sciences' website is further attracting national and international attention.

Parents generally indicated that they advised their children to study a qualification that leads to a professional career. They indicated that they did provide career advice and influenced the choice of university. Teachers and friends were cited as people who further influenced a child's career choice. ICT was considered a career option because South African parents perceived ICT as a career that can provide international employment opportunities. The parents indicated that they considered universities that provided on-campus accommodation in well-managed residences, a vibrant student life, and had a good academic standing.

CS&IS departments at universities in South Africa should engage in parent and teacher ICT career education. The availability of suitably qualified ICT educators can have a positive effect on educational change. Future research will focus on the factors that influence scholars' ICT career choices and on providing educational career information to scholars by using social media and the NMMU Department of Computing Sciences ICT career portal (<http://cs.nmmu.ac.za/Home>). Reaching scholars, parents, and teachers in townships and rural areas remains a major challenge.

References

- ACM Bulletin. (2009). *Congress Passes Resolution to Establish Computer Science Education as a National Priority*. ACM Bulletin Service. Retrieved from <http://www.acm.org/press-room/news-releases/2009/cs-education-week>
- ACM MemberNet. (2010). *CSEdWeek Seeks to Boost Involvement of Students, Educators, Parents, Industry Leaders*. Retrieved from <http://membernet.acm.org/archives.cfm?fo=2010-11-nov/nov-18-2010.html#CS-edweek>
- Alexander, P.M., Holmner, M., Lotriet, H.H., Matthee, M.C., Pieterse, H.V., Naidoo, S., Twinomurinzi, H., & Jordaan, D. (2010). Factors affecting career choice: Comparison between students from computer and other disciplines. *Journal of Science Education and Technology*, 20(3), 300–315.
- Babin, R., Grant, K.A., & Sawal, L. (2010). Identifying influencers in high school student ICT career choice. *Information Systems*, 8(26).
- Becerra-Fernandez, I., Elam, J., & Clemmons, S. (2010). Reversing the landslide in computer-related degree programs. *Communications of the ACM*, 53(2), 127–133.
- Benamati, J.H., Ozdemir, Z.D., & Smith, H.J. (2010). Aligning undergraduate IS curricula with industry needs. *Communications of the ACM*, 53(3), 152–156.
- Biggers, M., Brauer, A., & Yilmaz, T. (2008). Student perceptions of computer science: A retention study comparing graduating seniors with CS leavers. *ACM SIGCSE Bulletin*, 40 (1), 402-406.
- Calitz, A.P. (2010). *A model for the alignment of ICT education with business ICT skills requirements*. (Unpublished doctoral dissertation, Nelson Mandela Metropolitan University Business School, Port Elizabeth).
- Carter, L. (2006). Why students with an apparent aptitude for computer science don't choose to major in Computer Science. *SIGCSE Bulletin*, 38(1), 27–31.
- Conference Board of Canada (CBC). (2009). *Connecting students to tomorrow's ICT jobs and careers*. Retrieved from http://70.33.247.10/~ccictt/wp-content/uploads/2010/11/Connecting_Students_to_ICT_Careers_Report.pdf
- Choudhury, V., Lopes, A. B., & Arthur, D. (2010). Issues and opinions—IT Careers Camp: An early intervention strategy to increase IS enrolments. *Information Systems Research*, 21(1), 1–14.

- Cohen, D. (2012). *The IT skills gap is everyone's business (Part 1)*. IDG Connect. Retrieved from <http://www.idgconnect.com/blog-abstract/429/douglas-cohen-south-africa-the-it-skills-gap-everyone-business-part?region=africa>
- Cosser, M. (2010). The skills cline: Higher education and the supply-demand complex in South Africa. *Higher Education*, 59, 43–53.
- Ericson, B., Guzdial, M., & Biggers, M. (2005). A model for improving secondary CS education. *ACM SIGCSE Bulletin*, 37(1), 332–336.
- Harris, L. (2011). *No end to ICT skills crunch*. ITWeb. Retrieved from http://www.itweb.co.za/index.php?option=com_content&view=article&id=46862
- Havenga, M., & Mentz, E. (2009). The school subject Information Technology: A South African perspective. *SACLA '09*, 76–81.
- Jacobs, C., & Sewry, D.A. (2010). Learner inclinations to study Computer Science or Information Systems at tertiary level. *South African Computer Journal*, 45, 3–10.
- Koorsse, M., Calitz, A. P., & Cilliers, C. B. (2010). The impact of IT at schools on e-skills development. In P. Cunningham & M. Cunningham (Eds.), *eSkills Summit 2010 Proceedings*.
- Miliszewska, I., & Sztendur, E. M. (2010). Interest in ICT studies and careers: Perspectives of secondary school female students from low socioeconomic backgrounds. *Interdisciplinary Journal of Information, Knowledge, and Management*, 5, 237–260.
- Roman, D. (2010). School grades need improvement. *Communications of the ACM*, 53(12).
- Ross, J. (2007). *Perhaps the greatest grand challenge: Improving the image of computing*. Retrieved from <http://archive.cra.org/CRN/articles/nov07/ggc.html>
- Seymour, L., Hart, M., Haralambous, P., Natha, T., & Weng, C. (2005). Inclination of scholars to major in Information Systems or Computer Science. *South African Computer Journal*, 35, 97–106.
- Taub, R., Ben-Ari, M., & Armoni, M. (2009). The effect of CS unplugged on middle-school students' views of CS. *ITiCSE '09*, 99–103.
- Trusty, J., Watts, R.E., & Erdman, P. (1997). Predictors of parents' involvement in their teens' career development. *Sciences-New York*, 23(3), 189–201.
- Turner, S., & Lapan, R.T. (2002). Career self-efficacy and perceptions of parent support in adolescent career development. *Career Development Quarterly*, 51(1), 44–55.
- Wilson, C., Sudol, L., Stephenson, C., & Stehlik, M. (2010). *Running on empty: The failure to teach K–12 Computer Science in the digital age*. Retrieved from <http://www.acm.org/runningonempty>

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Pedagogic Strategies to Support Learning Design Thinking in a Masters Course

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Abstract

The demand for further skills and qualifications in the educational technology field remains strong as the range of technologies increases and their potential use in educational contexts becomes more compelling. Students registering for the University of Cape Town (UCT) Masters level courses are employed in schools, government agencies, universities, non-governmental organisations, or in the corporate sector, where their role in designing educational technology interventions represents part of their responsibilities. Because they have varying levels of experience in designing educational materials and/or using educational technologies, they need to develop learning design thinking and gain practice with a broad range of pedagogic strategies, theories, and technology tools to be productive in the workplace. Over the past four years we have developed and adopted a course for the needs of people who are keen to apply these skills in their work contexts. We describe here, the pedagogic strategies we explicitly adopted to model and support learning design thinking in one of four modules, Online Learning Design.

The module adopts a learning design framework developed by Dabbagh and Bannan-Ritland (2005) to introduce students to design processes, and uses the same framework as a loose structure for the module and assignments. We apply Dabbagh and Bannan-Ritland's classification of pedagogic strategies to model and analyse approaches to cultivating learning design thinking amongst the students. As an analytic device, we draw on Engeström's (2001) Activity Theory to describe the evolving learning context and our changing pedagogic strategies over four years. We focus on key tensions that emerged from the adoption of a range of pedagogic strategies to cultivate the students' learning design thinking when developing learning activities to communicate complex design issues. The key social change highlighted in this paper is that educational technology educators, aiming to cultivate students' learning design thinking, need to apply their design thinking to their own practice.

Key terms: Pedagogic Strategies; Design Thinking; Educational Technology.

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Introduction

We see a strong interest for further skills and qualifications in the educational technology field from applicants to University of Cape Town (UCT)'s Masters level Information Communication Technology (ICT) in Education programme. In considering what such a course might ideally cover, we drew on existing literature (Wakefield, Warren, & Mills, 2012) and our own experience as learning technologists in the Centre of Educational Technology (CET) at UCT to establish the key competencies that employers require. Wakefield et al. identified five key competences which include "excellent communication and related interpersonal skills and managing multiple instructional design projects, but also specific traits, and skills that may make a candidate more successful within the field such as working collaboratively in teams" (2012, p. 3126). In addition, educational technologists must display "design thinking", as noted by a number of speakers at the 2012 International Council for Educational Media Conference¹. This emphasis, to some extent, reflects how professional practices and knowledge are being shifted. These changes have implications for education and how we engage students (Fenwick, Nerland, & Jensen, 2012).

The students registering for the UCT Masters in Education (ICT) are employed in schools, universities, government agencies, non-governmental organisations, or in the corporate sector, where their role in designing educational technology intervention represents a significant, yet comparatively small, part of their responsibilities. Some are not directly involved as online learning developers per se, but use a range of technologies to support learning in their contexts, work as part of an online learning design team, or manage online learning development and dissemination projects. Some have formal educational experience while others have some exposure to technology but not necessarily in an educational setting.

In order to help these students to cultivate learning design thinking, we have over the past four years developed and adopted the module, Online Learning Design, using a range of pedagogic strategies and an ever-changing set of technologies that exhibit the affordances required to meet the online learning tasks. This paper endeavours to explain and justify our pedagogical approach to assisting educational technology students to develop learning design thinking skills, by surfacing some of the key contradictions that arise in the process and suggesting ways of addressing, if not entirely resolving, the social change necessary for future courses.

This paper specifically addresses the question: "How can educational technology educators develop courses to cultivate students' learning design thinking?" This is a companion paper to an evaluation of the ways in which educational technology Masters students developed learning design thinking in the Online Learning Design module during the period 2009–2012 (Deacon & Hodgkinson-Williams, 2013, in progress). The insights are intended to inform our entire teaching team along with other university educators grappling with ways to promote sound design thinking to underpin the successful development of meaningful, coherent, and interesting online learning activities, modules, or entire courses.

Online learning design

Jonassen observes that online learning design is a complex problem-solving approach because it includes "ambiguous specification of goals, no determined solution path, and the need to integrate multiple knowledge domains" (2000, p. 80). In the Online Learning Design course we define online learning design as a complex problem-solving process of determining what is to be learned and why, by whom and how they might learn best, and then designing, developing, and implementing appropriate pedagogic strategies that optimise the affordances of various technologies available within a specific context to devise suitable online activities, and evaluating their effectiveness. In order to undertake online learning design, the key ability that students need to cultivate is design thinking.

¹ <http://icem2012.cardet.org/resources/ICEM2012programFinal.pdf>

Design thinking

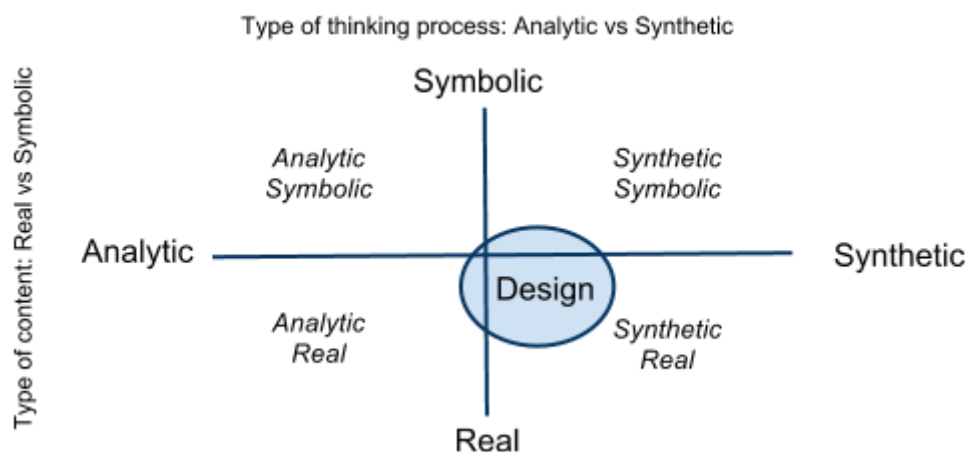
A focus on design thinking is traditionally associated with the arts and engineering education (Huei, 2012). More recently this has been taken up in the educational field (Razzouk & Shute, 2012) and, specifically, in the online learning design discourse as evidenced by blog posts and conference theme¹.

In reviewing the educational literature, Razzouk and Shute found design thinking to be “generally defined as an analytic and creative process that engages a person in opportunities to experiment, create and prototype models, gather feedback, and redesign” (2012, p. 330). Looking more narrowly at the skills needed by educators and more specifically learning designers, Ertmer et al. (2008) explain that online learning design can also be construed as an “ill-structured task”. Mishra and Koehler (2003) refer to teachers who are able to make effective use of educational technology as being “design-wise” (p. 99) and to “learning by design” (p. 103) to capture the way they “learn in ways that ties their knowledge of technology to its educational uses (i.e., authentic problem solving)” (p. 103). A conception of design thinking that is particularly apposite to our context, is that of Stanford University’s REDlab: Research in Education and Design, which conceives of design thinking as focusing on “needfinding, challenging assumptions, generating a range of possibilities, and learning through targeted stages of iterative prototyping” <http://www.stanford.edu/group/redlab/cgi-bin/>. This suggests that a key component of the design thinking process is fostering the ability to not only solve problems, but to define problems.

To deepen an understanding of the nature of design thinking, Razzouk and Shute (2012) adapted a conceptual map conceived by Owen (2007) that contrasts content and processes of thinking in various disciplinary fields (see Figure 1). The horizontal, Analytic–Synthetic, axis classifies the disciplinary fields by process (i.e., the way they work and think). Disciplinary fields on the left side of the axis are preoccupied with finding or discovering; disciplinary fields on the right are focused on making and inventing (Razzouk & Shute 2012, p. 333). The vertical, Symbolic–Real, axis divides the upper part of the map into disciplinary fields concerned with the “abstract, symbolic world” (Razzouk & Shute 2012, p. 333) while the lower part of the map represents disciplinary fields that are concerned with the “real world and the artifacts and systems necessary for managing the physical environment” (Owen 2007, p. 18).

Figure 1

Conceptual map for type of content and type of thinking processes (Razzouk & Shute 2012, p. 334).



² <http://icem2012.cardet.org/resources/ICEM2012programFinal.pdf>

This conceptual map locates the synthetic–real “design-type” thinking that the Online Learning Design course hopes to cultivate in the quadrant in the lower right corner. Our course endeavours to support students in developing learning design thinking by requiring them to create a small-scale, context specific, online learning task and then document each step of the design and re-design process in an eportfolio. Leading up to the development of the eportfolio, we employ a number of other educational technologies for specific pedagogic reasons to foreground design thinking.

Learning Design Thinking

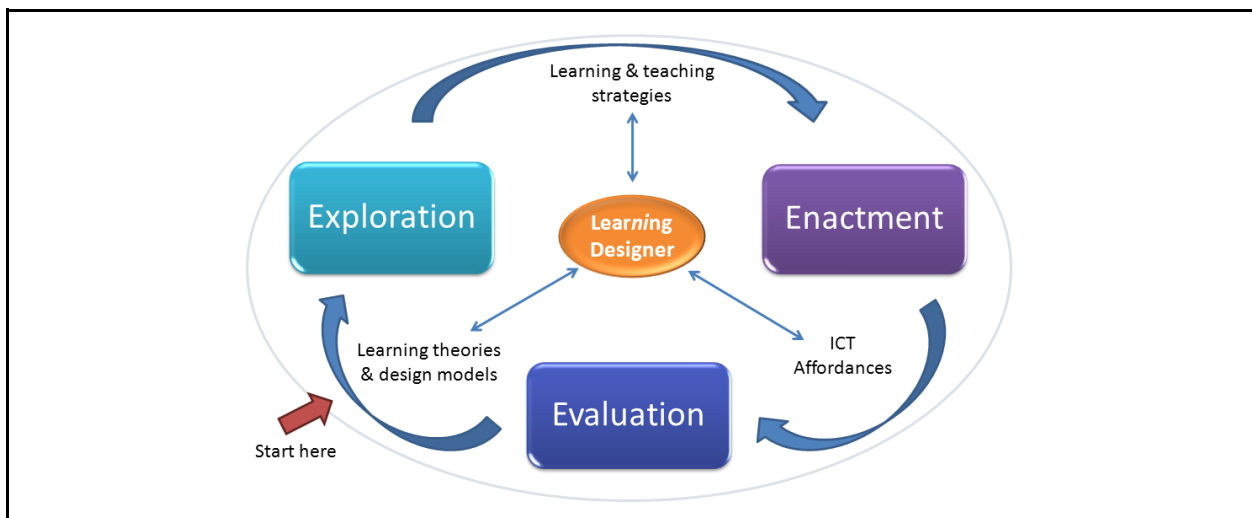
For the purposes of our course, we define learning design thinking as a complex, iterative process of problem-defining and problem-solving of ill-defined learning needs that require a creative and analytic approach through iterative prototyping based on formative feedback. In order to assist students to develop learning design thinking, the Online Learning Design course employs a range of pedagogic strategies.

Online Learning Design course

The core aims of the course are similar to those in instructional design and learning design courses offered elsewhere (e.g., Dabbagh & Bannan-Ritland, 2005). We drew on the Dabbagh and Bannan-Ritland (2005) textbook to provide the learning design framework to introduce students to design processes. This framework provides a common reference point and, in essence, is a variant of the older and widely adapted Analysis, Design, Development, Implement, Evaluate (ADDIE) framework (Gustafsen & Branch, 2007). The design cycle Dabbagh and Bannan-Ritland adopt iterates over three phases: (1) exploration, (2) enactment, and (3) evaluation towards developing a cohesive learning design solution. A feature of Dabbagh and Bannan-Ritland’s framework, is the placing of the learning designer at the centre of the design cycle. The motivation being that the learning designer is responsible for making sense of every phase in the design cycle, which is appropriate for small-scale online learning design projects. The same framework, with exploration, enactment, and evaluation (Figure 2), is also used as a loose structure for the course (Horwitz & Hodgkinson, 2010). The course commences with a focus on the student becoming a learning designer, and then unpacks the learning theories and design models and how these relate to a range of teaching and learning strategies. Only then do we introduce information communication technologies and the affordances they offer. The students then revisit these concepts as they step through the exploration, enactment, and evaluation stages as they develop a small-scale online learning activity. They then document their decision-making process of creating this online learning activity in an eportfolio, providing evidence of each stage of development and links to underpinning design theories, implementation activities, and formative evaluations of their pilot online learning activity.

Figure 2

Design framework for the Online Learning Design course (Adapted from Dabbagh and Bannan-Ritland 2005, p. 114).



The course is offered in a blended mode with online pre-course tasks, a six-day intensive face-to-face session, and then approximately five weeks of online post-course activities which, in this case, involved the development of a small-scale online learning activity and an eportfolio. The course is facilitated by the authors of this paper with specific input from other members of the CET staff.

Pedagogic strategies

The course overtly draws on approaches articulated by Dabbagh and Bannan-Ritland (2005) to inform the pedagogic strategies we adopt in teaching the course and in the course content, the readings we have selected, and in the types of assignments we have devised. Our intention being to explicitly reveal our own practices so students can recognise some of the underlying pedagogic strategies we follow. Many of our students do not have a formal educational background and do not always have what Bernstein (2000) refers to as a language of description; in other words, terms conventionally used in educational texts and research to describe and explain the pedagogic strategies underlying the online learning activities they develop. While the overall pedagogy underpinning the task to develop an online learning activity and explain the design choices in the eportfolio is what Dabbagh and Bannan-Ritland refer to as authentic learning, there are many other pedagogies embedded within this authentic learning strategy.

Dabbagh argues that, "Promoting authentic learning activities is the core of all instructional strategies . . . [and needs to] . . . engage the learner in a realistic and meaningful task that is relevant to the learner's interests and goals" (2005, p. 33). Wilson and Cole observe that "by engaging learners in meaningful and relevant tasks, they can see the direct implications of their actions and apply the knowledge gained in real world situations" (1996, as cited in Dabbagh 2005, p. 33). The primary authentic learning activity in the Online Learning Design module involves students developing their own small-scale online learning activity for a specific learning need in their context, and the explanation of their design decisions in an eportfolio. This is a complex task for students and lecturers alike because of its contextual specificity and ill-defined nature.

Embedded in the authentic learning strategies, the Online Learning Design course also employs a range of other pedagogic strategies that Dabbagh and Bannan-Ritland (2005) classify into three broad categories, namely, supportive, exploratory, and dialogical strategies. These are elaborated upon in subsequent sections. While this is a convenient way to broadly categorise types of pedagogic engagement, we have to make the students aware that this is not an uncontested conceptual framework, but one that can act as a useful heuristic. The value of having some "pedagogic labels" is that students who are not familiar with pedagogical and psychological theories often struggle to explain how they hope their learners will engage in an online learning activity. The broad categorisation into three main strategies also helps students to reflect upon the general engagement they foresee linking the requirements of the task in the online environment and the affordances of the technologies (Bower, 2008) that could assist in achieving the intended outcome(s). Our challenge is to provide students with an experience of a pedagogic strategy so that they have an almost "embodied" experience of how various pedagogies may play out in the online learning context. Merely "teaching" students about these strategies does not provide them sufficient experience to apply these possible pedagogic strategies in an online environment.

Supportive strategies

Dabbagh and Bannan-Ritland (2005) group strategies such as scaffolding, modelling, explaining, and coaching, under the umbrella category, "supportive strategies". Dabbagh notes that:

Providing the right level of supportive assistance in a learning environment is a challenge for instructors and instructional designers. Novice students and students who already have a significant knowledge base require different levels and types of support to push them to perform at their potential development zone. Therefore, a layered structure to scaffolding is recommended in which novice learners get the support and information they need to help them engage in the learning task without slowing down advanced students who may not need the same level and type of support as novice learners. (Dabbagh, 2003, cited in Dabbagh, 2005, p. 38)

With respect to "modeling and explaining", Dabbagh suggests that "when experts model their internal thought processes . . . students are prompted to reflect on their own performance, compare it to that of the expert's, and improve their performance" (2005, p. 38).

Exploratory strategies

Exploratory strategies include problem solving, hypothesis generation, and exploration (Dabbagh & Bannan-Ritland, 2005). Dabbagh contends that "problem-solving activities place more emphasis on learning how to learn, rather than learning specific content" (2005, p. 33) and is closely associated with "hypothesis generation" because in the process of problem-solving the learner is prompted to frame a hypothesis, elicit information from a range of sources, and reflect critically before reaching some kind of resolution to the original problem (Dabbagh, 2005). Exploration is also closely associated with problem solving because it involves "limited instruction and guidance from an instructor and more student-generated learning through exploring and discovering information" (Dabbagh, 2005, p. 34).

Dialogic strategies

According to Dabbagh and Bannan-Ritland's (2005) classification, dialogic strategies include articulation, reflection, acknowledging multiple perspectives, collaboration, and social negotiation. Dabbagh suggests that "when students are provided with opportunities to articulate their knowledge or understanding of something, they are explaining to others what they know" (2005, p. 35). Closely associated with articulation

is reflection which Dabbagh characterises as a “process of analyzing and making judgments about what has happened to give a situation new meaning” (2005, p. 35). The goal of promoting multiple perspectives is to:

generate cognitive dissonance so that firstly learners are aware that there are multiple perspectives on an issue, which is the case in real world situations. Secondly, learners are engaged in exploring each perspective to seek a meaningful resolution to the issue at hand, constructing new meaning in the context of their own experiences and knowledge. (Dabbagh, 2005, p. 37)

Collaboration can be defined as a “collection of activities that emphasize (1) joint construction of knowledge; (2) joint negotiation of alternatives through argumentation, debate, and other means; and (3) student reliance on both fellow students as well as teachers as learning resources” (Dabbagh, 2005, p. 36). Social negotiation is therefore an “integral component of collaboration” (Dabbagh, 2005, p. 36).

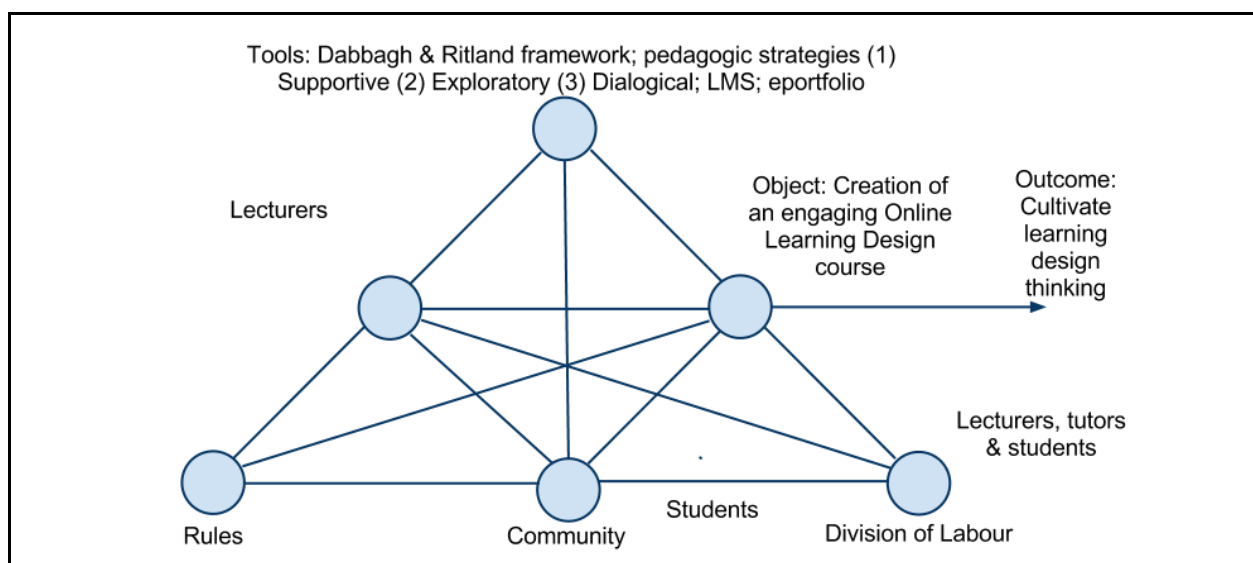
As lecturers, it was our role to use these various pedagogic strategies in concert with various educational technologies in order to mediate, inspire, and model potential pedagogical strategies the students could adopt in the design and development of their specific online learning activity. In this way we hoped to provide students with a learning experience and a language of description to assist them to create an authentic online learning activity and an eportfolio to reflect on design decisions and thereby cultivate their learning design thinking.

Activity theory as an analytical frame

Activity theory, as a conceptual framework, is well suited to investigating the interactions of students and lecturers in the context we have described where there is a common purpose. Activity theory helps identify the unit of analysis, referred to as an activity system. In our case this involves the lecturers (Subject), who use a range of pedagogic strategies and software tools (i.e., mediating artefacts) to assist students to design and develop an online learning activity and reflect upon their design decisions in an eportfolio (Object). Cultivating learning design thinking among students is the intended outcome from this activity (Figure 3).

Figure 3

Activity system for the Online Learning Design course (Adapted from Engeström, 2001, p. 135)



The Finnish educational researcher, Engeström, in extending activity theory recognised five principles in describing an activity system that we will draw upon:

- A collective, artefact-mediated and object orientated activity system, seen in its network relations to other activity systems, is the prime unit of analysis.
- Activity systems are multi-voiced and the division of labour creates different positions for participants, who carry their own diverse histories, and the activity system itself carries multiple layers and strands of history.
- Activity systems take shape and get transformed over lengthy periods of time (historicity).
- Contradictions (historically accumulating structural tensions within and between activity systems) play a central role as sources of change and development.
- There exists the possibility of expansive transformation (i.e., learning) in activity systems. (Engeström, 2001)

These principles are used to describe the model of expansive learning involving staged cycles of transformation. Expansive learning is not the same type of learning experienced by, say, the students in a traditional course involving learning concepts or facts, but closer to that of the learning design thinking we described. In a traditional course the learning outcomes tend to be clearer and the lecturer possesses the knowledge that students are intended to learn. In expansive learning people “learn something that is not yet there” (Engeström & Sannino, 2010, p. 2). The staged cycle can be summarised as (a) questioning practices, (b) analysing past and existing practices, (c) jointly building new models, concepts, artefacts for new practices (d) analysing and discussing models, concepts, artefacts (e) implementing these (f) reflecting on and evaluating processes and (g) consolidating new practices. This cycle closely mirrors Dabbagh and Bannan-Ritland’s (2005) framework for learning design.

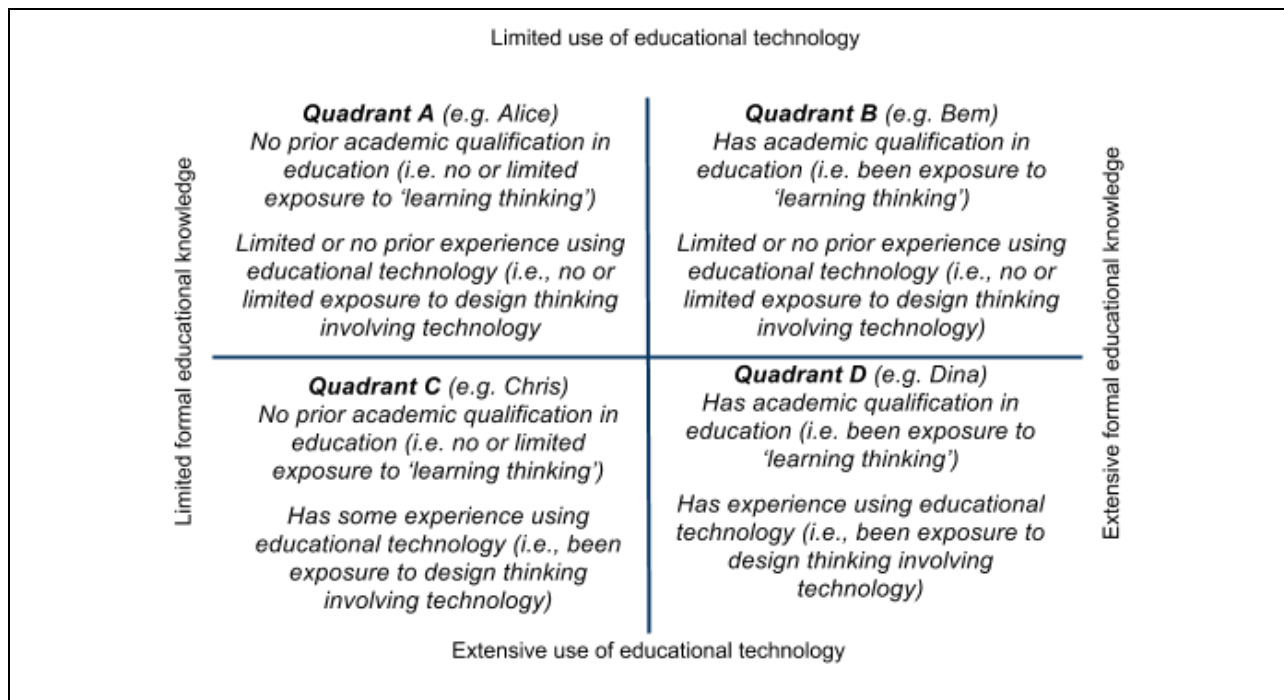
Methodology

This paper is a qualitative case study (Stake, 2005) of the pedagogic strategies adopted in the Online Learning Design course over the period 2009–2012. Of the 58 students there was a roughly even gender split with 27 female and 31 male students. Their ages ranged from 25 to 62 years with the majority in their late 30s, and representing a mid-career stage. This course offers a Mellon Foundation scholarship to students working in higher education institutions in Africa which helped attract a number of students from outside South Africa. There were 33 students from other African countries, 22 from South Africa and the remaining three were working in African countries at the time, but came from Europe or North America. As expected, students’ home languages varied greatly and only 10 of the 58 were mother-tongue English speakers.

As a way of mapping our expectations of the students’ performance to their actual performance, we systematically assigned each of the 58 students as A, B, C, or D in one of four profiles on our map (Deacon & Hodgkinson-Williams, 2013, in progress). This involved assessing their prior exposure to academic educational knowledge and technology design skills using the course documentation (Figure 4). The horizontal axis classifies students’ formal knowledge along a continuum from “limited” to “extensive”. The vertical axis classifies students’ experience of educational technology along a similar continuum.

Figure 4

Classification map distinguishing four quadrants of prior experience



Students' scores over the four-year period were plotted against the student profile types as a measure of pedagogic success in cultivating their learning design thinking.

Content analysis (Bauer, 2000) of the pedagogic strategies evident in the course learning management system, Vula (meaning *open* in Nguni languages), a localised version of the open source learning management software, Sakai, forms the main evidential base for the paper. The companion paper (Deacon & Hodgkinson-Williams, 2013, in progress) provides a detailed analysis of the students' perceptions of the course.

Adoption of pedagogic strategies to support learning design thinking: analysis of the Online Learning Design course

While as lecturers we subscribe to a constructivist view of knowledge, we do not conflate this with constructivist learning because our experience has guided us to use a range of pedagogies dependent on the particular task and the students' readiness to undertake this task. We deliberately adopt supportive pedagogic strategies at the commencement of the course. Although we did not set out to necessarily model every pedagogic strategy that Dabbagh and Bannan-Ritland (2005) identify, a post-hoc analysis of the Vula course site, and reflection on the reasoning behind our decisions, revealed the adoption of a wide range of pedagogic strategies in service of promoting learning design thinking. We group the strategies that we used for each of the three main phases of design, namely, exploration, enactment, and evaluation, because these broadly mirror a pedagogic progression from the more supportive pedagogic strategies, through the exploratory, to the more dialogic pedagogic strategies adopted later in the course. It is important to note that the exploratory strategies as defined by Dabbagh and Bannan-Ritland (2005) should not be conflated with their exploration phase of design.

Exploration phase of design

Supportive strategies

Because the students presented diverse prior knowledge and experience, the course needed to provide sufficient cognitive scaffolding for those new to the field. In order to establish the type of scaffolding required and to model the design practice of assessing students' prior learning we administered a pre-course survey. In 2009 and 2010 the survey results were used to inform the lecturers only, but in 2011 and 2012 the survey findings were reported back to the entire group to give students a sense of the diverse prior qualifications, experience, and expectations in their cohort group.

One of the most basic pedagogic strategies adopted in the course was the use of the Vula wiki, or content outline tool, to provide a hyperlinked class schedule to presentations, associated readings (in the course reader and/or online), assignments and rubrics—to organise and manage the resources used in the course. What emerged from the types of activities on the Vula site was that the scaffolding provided expanded each year as we increasingly appreciated the value of having all the course activities linked to one dynamic page as a way of simplifying a complex course design, and keeping it current.

In 2009 and 2010 the lecturers took prime responsibility for reviewing and explaining some of the key instructional design and pedagogic literature summarised in PowerPoint slides. However, due to the need for the students to engage more deeply with these concepts, we changed our strategy in 2011 to allow the students to take responsibility for explaining particular design theories or elements of these theories to each other during in-class teach-back sessions. This more student-led supportive activity seemed to assist the students to develop at least one or two areas of expertise which they could use as a measure to compare against other design models. At that point they were not yet learning by design, but learning by explaining design. This change in pedagogic strategy altered the balance of power in the class and allowed the students, who were mostly other academics, to take a more central role in supporting each other.

Exploratory strategies

To encourage students to commence their design thinking by exploring their individual contexts, one of the pre-course activities required them to undertake an individual thinking and resource-gathering task. It was explained that:

During the course you will be asked to describe a situation in your context where an online learning activity could be a useful response to a specific:

- learning need (i.e., where school learners, university students or employees have expressed their desire for particular instruction or support)
- teaching need (i.e., where school teachers, university lecturers, staff trainers have expressed their wish for teaching their area of expertise or supporting their learners, students or peers)
- institutional need (i.e., where an institution has decided to offer a course via distance learning or through a combination of distance and face-to-face teaching – sometimes referred to as “blended learning”).

Students were requested to bring along any resources (e.g., lesson plans, curricula, training manuals, evaluation reports, links to URLs, teaching and learning reports), that might help them describe their learning, teaching, or institutional need. This strategy remained constant over the four-year period.

Dialogic strategies

In preparing the teach-back sessions during which they prepared a short lecture on a specific section of the online design implementation process, we initially allocated students to collaborative groups before the face-to-face sessions, but changed our strategy to have students self-select the peers with whom they chose to work because students seemed to be ambivalent about the value of collaborating with an assigned partner, especially for graded tasks.

As a way of encouraging multiple perspectives, in 2009 and 2010 students were introduced to four instructional design theorists broadly representing behaviourist, cognitivist, constructivist, and social learning inspired theories. Because we were concerned that our selection might be too restrictive, and because students seemed to gravitate to the theory they had presented in a teach-back session, we introduced four additional theorists in 2011 and 2012. We suspect that this gave them too many options because many reverted to the Dabbagh and Bannan-Ritland (2005) model alone, unfortunately defeating our initial objective of encouraging multiple perspectives on learning design.

Enactment phase of design

Supportive strategies

In 2009 and 2010, lecturers coached students to develop an authentic online learning intervention and explanatory eportfolio. From 2011 and 2012 students were encouraged to invite at least one peer to review their eportfolio, and in 2012 students without prior educational technology experience were paired with a student tutor or one of the lecturers for one-on-one coaching.

Evaluation phase of design

Dialogic strategies

The key pedagogic strategy adopted in all four years was that of reflection. Students were required to formally reflect, in groups, upon the value of one day of the face-to-face session; individually, upon the lessons learned in the process of developing the eportfolio; and then to provide a short self-assessment of what they felt were the most well-developed sections of their eportfolios, and which they felt warranted further development. Given our prior experience, in a previous course, of students being requested to reflect in blog entries, we realised that students needed some support in what was understood by reflecting so that they moved beyond mere description of the course or their online learning design activities. Although students were free to choose the structure of their reflections, we adapted a framework of Mezirow (originally adapted by Panda & Juwah, 2007) to provide a useful way to prompt students through the stages of observing, questioning, making meaning, validating, appropriation, and transformative learning. Despite this prompting and the in-class opportunities to witness various forms of reflection, the evidence of reflective thinking varied quite widely among the group of students.

Course performance

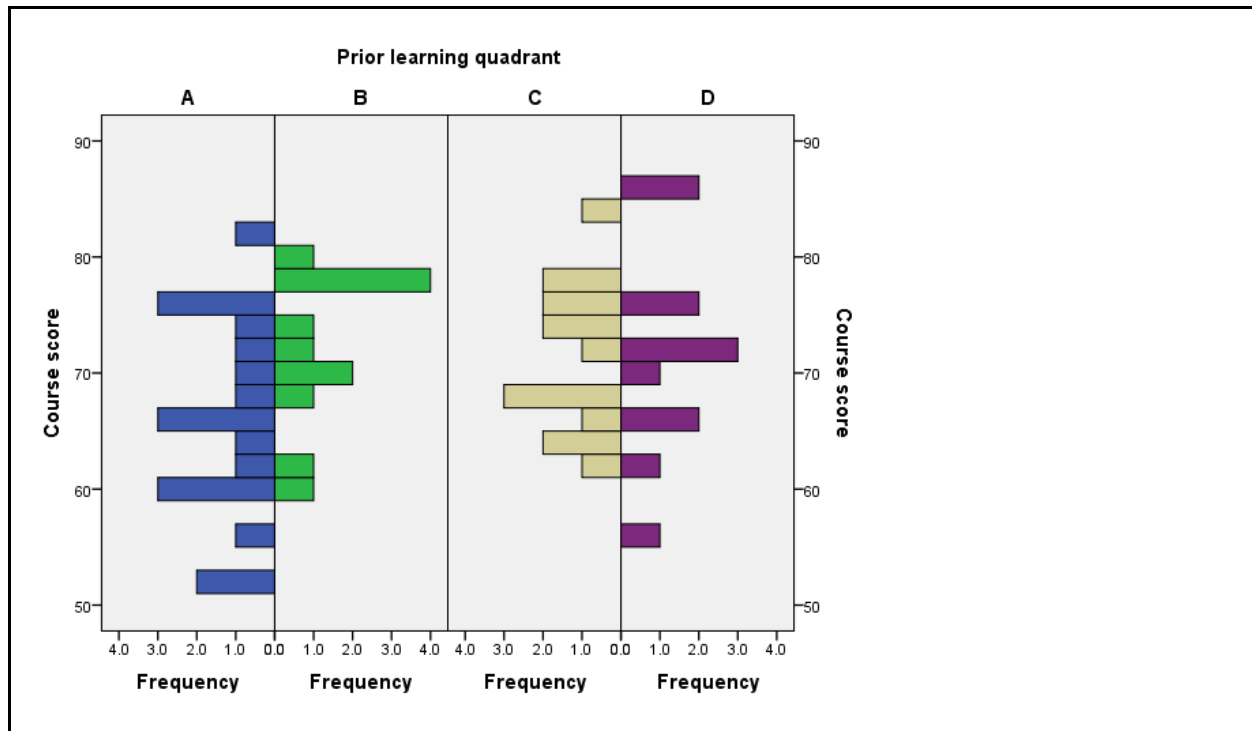
To inform our impressions from past years of how students' prior knowledge and skills impacted on their performance in the course, we drew on the conceptual map (see Figure 1) as a frame to characterise incoming students' prior exposure to learning design thinking (see Figure 4). The course score can be considered a summary measure of the quality of students' eportfolios.

We then systematically characterised students from the previous four years into one of these quadrants. Using this simple classification, we found there were roughly even numbers in each quadrant, with slightly more in the A (19) and C (15) quadrants than in B and D (12 each). Looking at course performance within

each of the four quadrants, there was little difference in the means other than for the A quadrant. The mean score for A was 66%, while B, C, and D clustered between 71% and 72%.

Figure 5

Back-to-back histograms of course scores for the four categories of students



Projecting forward, this analysis had two key implications for the course design. Firstly we were likely to continue to have students in the A quadrant with little or limited exposure to the academic education literature, and little experience in using technology in educational contexts. While there have been capable students in the A quadrant who have been able to demonstrate learning design thinking through their eportfolios, they are the exception. The majority of these students need support especially at the start of the course.

The second implication relates to students in the D quadrant and, to some extent, those in B and C. These students may recognise some aspects of online learning design, but may have conceptual misunderstandings with some aspects. These are difficult to anticipate or recognise since these students may be able to articulate their thinking quite well on specific topics. We had to be alert to the possibility that they may not have understood as much as they assumed they did, and be vigilant of students merely recognising terms rather than genuinely understanding the underlying concepts.

Discussion

Some of the key contradictions include those where our explicit intention to model pedagogic practices to encourage students' development of learning design thinking did not work quite as expected. The first of these contradictions that emerged between the Subject (lecturers), Tools (our pedagogic strategies), and the Object (create an engaging course to cultivate learning design thinking) can be seen in the way in which we modelled the pre-course survey to gather individual student needs. Novice learning design students (A

& B) did not necessarily note that we were modelling a particular practice, but instead seemed slightly overwhelmed by all the questions we posed; inadvertently making them feel anxious about the course. Although some students (mostly from the A quadrant) noted the scaffolding strategy and even copied our survey in their own contexts, expecting novice students to apprehend both their engagement with the task and the embedded design was unrealistic. Pre-course surveys need to include a smaller range of questions about technologies with which students may be familiar to limit the expectation that they should know about and/or be able to use all these technologies. Alternatively, a pre-course survey could merely pose an open-ended question about knowledge of, and skills in, using technologies. More explicit reference can be made to pedagogical strategies embedded in the course, without being overly academic, at the stage where a specific strategy is introduced.

A Subject-Community-Object contradiction arose when we explicitly introduced students to a range of perspectives on learning design. Because the literature informing learning design is quite extensive and emanates from various traditions, we endeavoured to include multiple perspectives on online learning design approaches (different ideas of what is understood as acceptable online design by different scholarly and practitioner-based communities). We introduced students to these through a range of activities. Using a hyperlinked schedule we grouped resources and activities together. Nevertheless, having students engage with a selection of these resources in teach-back sessions did not necessarily mean that they made sense of how all these perspectives linked and overlapped. Over time, we refined our selection of resources to limit their initial engagement with seminal texts and made the links more explicit. There is still a balance to be struck between engagement with the extensive and sometimes contradictory scholarly literature, and students' need for pragmatic design guidance. Many of the novice students came with the expectation that there was one correct way of designing online learning activities, which we endeavoured to dispel by introducing them to the range of online learning design traditions. However, the danger was that they adopted the one example of an online learning design tradition they taught back to the class or, given too many options, they seemed to revert to our adapted version of the Dabbagh and Bannan-Ritland (2005) model.

A second Subject-Tool-Object contradiction arose in relation to how we mediated the scholarly literature about online learning design. Students found some concepts too challenging to engage with on a first reading. Prompted by the external examiner, we moved the introduction to the concept of affordance (Gibson, 1979; Norman, 1999) to the first module to give students more time to understand the concept and its implications for design, and focused more specifically on affordance analysis (Bower, 2008) in the Online Learning Design module. Another strategy we adopted was to include the more seminal texts in the printed course reader and to refer to online versions for additional readings. This had the benefit of reducing the size of the printed reader which students had found intimidating.

A third Subject-Tool-Object contradiction became apparent in our analysis of the course materials and the underpinning pedagogical strategies. Over the period 2009–2012, we gradually relinquished some of the control, and allowed greater participation by the students in crafting and presenting the course. Initially, students presented a section of the Dabbagh and Bannan-Ritland (2005) models as a pre-course task and an example of the design traditions in-class, but later focused more specifically on different pedagogies as a pre-course task and compared at least two online learning approaches. Although this had the benefit of heightened student engagement with specific literature for teach-back sessions, students did not always partake in or even question some of their colleagues' presentations of a specific learning design approach. The move to focus on the more invisible pedagogies underpinning online learning design was prompted by the contradiction we noted in students' leap of faith between the requirements of the task and the affordances of the various technologies. The general design approaches did not necessarily make these sufficiently clear and so we shifted the pre-course task to a collaborative, paired teach-back session on a group of pedagogies drawn from Dabbagh (2005). This assisted students to acquire a language of

description to explain their choice of pedagogies adopted in the online learning activities in their eportfolios.

A Subject-Object-Division of Labour contradiction emerged in the implementation of our key pedagogic strategy of having students develop a small-scale authentic online learning activity. Although the course content and activities were all employed to scaffold this course, individualised coaching remained important for students to succeed. The key challenge here was the extensive investment of time, not to mention exceptional insight into contextual problems and the ability to undertake rapid affordance analysis, required from the lecturers. In order to support more rapid feedback, we encouraged students to invite at least one peer to be a “critical friend” to give them informal feedback, and to make use of departmental interns or other members of the Centre for Educational Technology as individual tutors, depending on the type of technology the students chose to adopt. An associated challenge was helping the students to compose an eportfolio—a writing genre that was completely new to most students. The assistance of colleagues from the Writing Centre to outline writing strategies in portfolios, and the help of interns to prompt with basic readability and comprehensiveness of the students’ developing eportfolios, helped address this tension to an extent. However, given the diversity of languages of the group, explaining and justifying pedagogical choices underpinning an online learning task was a challenge for many of the students. Over the years, our choice of technology for the eportfolio has enabled more and more collaborative opportunities so that our interactions of formative feedback could include both conceptual and linguistic advice.

One way we endeavoured to address some of these contradictions was to provide detailed formative comments during the development of the eportfolios. The challenge we faced was the time-consuming nature of this formative feedback because each student’s online learning activity responded to a particular context and consequently, each reflective eportfolio was unique. In order to maximise the value of the construction of formative feedback, we made use of an open Google Doc collaborative writing space to synthesise “generic” comments and focus students’ attention on the kinds of issues addressed by “students who have done well”. This more positive focus on what could be done, rather than on what students had done incorrectly or inadequately, seemed to prompt some of the students, although not all.

The expansive transformation that seems apparent in this analysis is our learning as lecturers about the efficacy of adopting various pedagogical strategies to assist students to develop learning design thinking. Expansive learning may be viewed as what happens as people perform their work and seek to improve practices that address common problems. This helps in making sense of our observations of the learning design process. Neither the outcomes nor the pathways were known to us prior to developing the course; these had to be designed, discovered, and negotiated collaboratively among ourselves and the students. The course is therefore not a product of a designed policy, although it would “make sense to develop and pursue policies that can make expansive learning less painful and troublesome” (Engeström & Sannino, 2010, p. 18). This in part justifies our interest in writing this paper. The activity system being described is not stable, but rather in a state of change while being mediated and transformed by tools and the actions. Our challenge is to observe how we develop learning design thinking through various tools that include pedagogic strategies and can negotiate with the social and technological environment to solve problems and learn.

Conclusion

This paper set out to reflect on how we, as educational technology educators, develop courses to cultivate students’ learning design thinking. While by no means a comprehensive interrogation, it highlighted a number of useful pedagogic strategies, identified key contradictions, explained resolutions adopted, and ways to improve such a course. The most useful overall pedagogic strategy is authentic learning, which

underpinned the main assessment tasks of developing an online learning activity for an authentic context, and capturing the design decisions in an eportfolio. Other strategies we identified include scaffolding, modelling, coaching, explaining, and reflection.

Key contradictions emerged mostly in relation to our mediational role as lecturers, that is, Subject-Tool-Object tensions. These were particularly noticeable in:

- novice learning design students' inability to notice the modelling of pedagogic strategies while they were engaged in a task
- their conceptual struggles to make sense of the range of learning design traditions that underpin online learning design when presented by peers
- the extensive range of literature that they needed to master to fully understand online learning design
- the need to have a language of description to explain the pedagogic strategies they often implicitly adopted in developing an online learning task and
- the need for individualised and therefore time-consuming conceptual and linguistic feedback on their eportfolios.

On reflection, educational technology educators aiming to cultivate students' learning design thinking need to apply their design thinking to their own practice. This can be surprisingly challenging in identifying aspects of significance. We have drawn on Engeström's (2001) frame in highlighting contradictions that demanded we develop new solutions and practices. The process involves continually interrogating and refining what is understood by learning design thinking, and continually reflecting upon the relevance of the course content, the usefulness of the pedagogic strategies chosen, and the suitability of the activities devised for students—because these all reveal the explicit or implicit learning design thinking that underpins online learning design courses.

References

- Bauer, M.W., (2000). Analytic approaches for text, image and sound. In M.W. Bauer & G. Gaskell (Eds.), *Qualitative researching with text, image and sound* (pp.131–151). Los Angeles, CA: Sage.
- Bernstein, B. (2000). *Pedagogy, symbolic control and identity: theory, research, critique*. (Revised ed.). Oxford: Rowman & Littlefield.
- Bower, M. (2008). Affordance Analysis—matching learning tasks with learning technologies, *Education Media International*, 45(1), 3–15.
- Dabbagh, N. (2003). Scaffolding: An important teacher competency in online learning. *TechTrends*, 47(2), 39–44.
- Dabbagh, N. (2005). Pedagogical models for e-learning: A theory-based design framework. *International Journal of Technology in Teaching and Learning*, 1(1), 25–44.
- Dabbagh, N., & Bannan-Ritland, B. (2005). *Online learning: Concepts, strategies and application*. Upper Saddle River, NJ: Pearson.
- Deacon, A., & Hodgkinson-Williams, C. A. (2013, June). Cultivating learning design thinking with eportfolios in a masters course. In E. Ivala (Ed.), *ICEL Conference Proceedings*.
- Engeström, Y. (2001). Expansive learning at work: Toward an activity theoretical reconceptualization. *Journal of Education and Work*, 14(1), 133–156.

- Engeström, Y., & Sannino, A. (2010). Studies of expansive learning: Foundations, findings and future challenges. *Educational Research Review*, 5, 1–24.
- Ertmer, P. A., Stepich, D. A., York, C. S., Stickman, A., Wu, X., Zurek, S., & Goktas, Y. (2008). How instructional design experts use knowledge and experience to solve ill-structured problems. *Performance Improvement Quarterly*, 21(1), 17–42.
- Fenwick, T., Nerland, M., & Jensen, K. (2012). Sociomaterial approaches to conceptualising professional learning and practice. *Journal of Education and Work*, 25(1), 1–13.
- Gibson, J. (1979). *The ecological approach to human perception*. Boston, MA: Houghton Mifflin.
- Gustafsen K. L., & Branch, R. M. (2007). What is instructional design? In R. A. Reiser & J. V. Dempsey (Eds.), *Trends and issues in instructional design and technology*. (pp. 10–16). Upper Saddle River, NJ: Pearson.
- Horwitz, D., & Hodgkinson-Williams, C. A. (2010, June). *Exploring freeform portfolios for postgraduate teaching*. Presentation at the Sakai Conference, Denver, CO. Retrieved from <http://www.slideshare.net/cherylhw/exploring-freeform-portfolios-for-postgraduate-teaching>
- Huei, C. J. (2012). Design thinking engineers. *Innovation*, 11(1), 42–47.
- Jonassen, D. H. (2000). Toward a design theory of problem solving. *Educational Technology Research and Development*, 48 (4), 63–85.
- Mishra, P., & Koehler, M. J. (2003). Not “what” but “how”: Becoming design-wise about educational technology. In Y. Zhao (Ed.), *What teachers should know about technology: Perspectives and practices* (pp. 99–122). Greenwich, CT: Information Age Publishing.
- Norman, D. (1999). Affordance, Conventions and Design. *Interactions*, 6(3), 28–42.
- Owen C. (2007). Design thinking: Notes on its nature and use. *Design Research Quarterly*, (2), 16–27.
- Panda, S., & Juwah, C. (2007). Professional development of online facilitators in enhancing interactions and engagement: A framework. In C. Juwah (Ed.), *Interactions in online education: Implications for theory and practice*. London: Routledge.
- Razzouk, R., & Shute, V. (2012). What is design thinking and why is it important? *Review of Educational Research*, 82(3), 330–348.
- Stake, R. E. (2005). Qualitative Case Studies. In N. K. Denzin & Y. S. Lincoln (Eds.), *The SAGE handbook of qualitative research* (3rd ed., pp. 443–466). Thousand Oaks, CA: Sage.
- Wakefield, J., Warren, S., & Mills, L. (2012). Traits, skills, & competencies aligned with workplace demands: What today's instructional designers need to master. In P. Resta (Ed.), *Proceedings of Society for Information Technology & Teacher Education International Conference* (pp. 3126–3132). Chesapeake, VA: AACE.

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Exploring Flexible e-Learning Options in a Postgraduate Project Management Course

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Abstract

An e-learning development project has recently been piloted in a taught postgraduate course in the Faculty of Engineering at The University of Auckland, New Zealand. This paper describes the first stage of course design, the collaborative development approach, and early results of the project from the perspectives of the teaching team and the learning designers. We interpret these results using dimensions of “teaching presence” derived from the Community of Inquiry (CoI) framework. This yields a rich portrayal of the educational change processes involved when integrating e-learning in tertiary teaching. The main finding was that the process of innovating, and the introduction of flexible learning opportunities, led to increased student engagement, sometimes in unexpected ways but with positive learning outcomes. These results inform current planning and development of further e-learning initiatives for this and other courses in the Master of Engineering Studies programme. The findings may be generalised to similar postgraduate courses in professional, applied disciplines (such as Business) where flexible or distance learning supports the up-skilling of professionals in industry.

Keywords: Flexible Learning; e-Learning; ICT; Project Management; Postgraduate Engineering Education.

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Introduction

Information and communication technologies (ICTs) that support teaching, learning, and assessment are being integrated into educational settings on an increasing scale world-wide at all levels of educational systems, from pre-school to tertiary and continuing adult education (De Cicco & Kennedy, 2012), 2012). Despite the digital divide that often exists, substantial economic investment is being made in ICTs to support social development and educational reform in many countries (Kozma, 2005). The wider access to low cost communication technologies (e.g., mobile devices, cloud computing, and wireless networks) has

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led to an ever-diversifying range of ICTs being available to educators and students. In tertiary education this increase in availability and diversity of ICTs is changing the expectations of educators and students alike for how degree programmes are taught and how students participate as learners—as is evident in the way social networks, Web 2.0 tools, and open educational resources are being used in open education to offer massive open online courses (MOOCs) to thousands of tertiary students globally (Daniel, 2012).

This paper reports on the experience of adopting an innovative approach to teaching experienced and professional engineers using new ICTs in a postgraduate course on project management. Several studies of ICTs in engineering education have focussed on using ICTs to provide learning opportunities or resources that match students' learning styles (for example, Patterson, 2011; Mohd & Aziah, 2012). However, we explore issues of what ICT innovations best supported, and had the maximum desired impact on, learning outcomes; how we matched pedagogical requirements and technological affordances within a specific educational context; and how selected theoretical frameworks for ICT integration informed a productive interdisciplinary teaching partnership.

The results signal more fundamental implications for change in educational practice and approaches when integrating ICTs in tertiary teaching. These relate to “openness” of access to courses (Conole, 2012; Marshall, 2011), and to academic teachers' willingness to “open” their places and spaces of teaching, to recording and tracking technologies, to bridging inter-disciplinary boundaries, and to adopting iterative approaches to review and redevelop teaching resources and methods in response to student and collegial feedback. As Bates (2005) points out, successful e-learning initiatives in higher education demand organisational and cultural shifts to enable the nature and scale of the changes in teaching practice such as those reported here.

We conclude with outlining future research and development plans for this project and suggest wider implications for educational change, particularly in online teaching and leadership roles, when ICTs are integrated in higher education.

Background

Description of the Masters of Engineering Studies programme

Since its inception the Master of Engineering Studies (MEngSt) programme (Construction Management specialisation) has been offered on campus only. This taught programme attracts students typically with 3–10 years or more of industrial experience who are looking to return to university to undertake advanced level studies as part of their career progression planning. A significant portion of students on the programme are enrolled part-time. A recent review of the programme recommended adding flexible learning options for students who wish to study from a distance or who cannot attend all lectures and labs owing to work commitments. This aligns with two elements of the University of Auckland's current Strategic Plan: one, which advocates increasing the proportion of students enrolled in taught postgraduate programmes, and the second, which calls for innovative and advanced use of ICTs for teaching, learning, and research (University of Auckland, 2012). As a first stage in responding to this recommendation, one of the Project Management courses from the programme was selected to trial the development of more flexible learning options.

This course was seen as successful and vibrant by an independent panel of reviewers because it provided students with in-depth knowledge of the discipline of construction management as it applies to the modern construction industry. It attracted significant numbers of students taking the course as an elective within the department, as well as attracting students from other departments and faculties. Student cohorts of approximately 100 students are typically diverse in terms of background discipline, industry experience,

prior qualifications, maturity, and whether they are full-time or part-time. Ultimately the programme needs to cater for different student cohort profiles: full-time or part-time, and on-campus or distance. Students would benefit from being able to move from one cohort to the other if, for example, they needed to move away for work while enrolled on the programme.

Aim of the Teaching Innovation Project

This project forms part of a larger strategy involving ongoing development of online flexible learning options for a greater proportion of the compulsory and elective courses on the MEngSt programme. There was thus a commitment by the lecturer and course designers to:

- Increase flexibility for part-time and distance students by integrating ICTs into the teaching and course materials
- Use this project as a trial for further ICT and e-learning integration in other postgraduate engineering and business courses
- Adopt a research-based approach using peer review and formative evaluation of specific features of the course in collaboration with colleagues (teachers, engineers, and learning designers) at each stage of development.

The next section expands on each of these aims.

Project Approach

Prompted by the drivers for change as outlined above, the course lecturer (also the programme coordinator) approached learning designers in the University of Auckland's Centre for Learning and Research in Higher Education for advice on best practice in e-learning and flexible course delivery. A number of consultations ensued when objectives were clarified, and other local and international examples of online and blended courses were reviewed that had similar teaching and learning requirements. An initial project brief was drawn up by the course coordinator, which included the ICTs he wished to trial in the initial phase of development.

A design research approach (Reeves, Herrington, & Oliver, 2005) was proposed by the learning designer so that socially responsible methods of inquiry would be used to enhance the quality of the research. Using this approach, rich data is collected during cycles of collaborative planning, design, development, implementation, observation, and reflection on the new teaching strategies and learning tasks. The data is analysed after each cycle in the light of established educational theory. This paper reports the first course design and development cycle within this overarching design research approach.

The e-Learning Project: The First Design and Development Cycle

Brief Description of Project Management Course: delivery and assessment

Prior to this pilot project, the lecturer offered a weekly two-hour lecture, one two-hour tutorial or lab per semester on industry software, and office hours for student consultations on two afternoons per week. The university's Learning Management System (LMS) was used to make course announcements and to provide lecture notes and presentations, assignments, and readings online. Assessment was by means of four discussion papers (essays) and two individual assignments which involved applying principles learned in the work place, or in relation to hypothetical cases. There was no final exam.

The overall objective of the new course design is to provide flexible access and additional online learning opportunities for on-campus, part-time, and, in the future, distance students. This blended approach seeks to “integrate[s] online with traditional face-to-face class activities in a planned, pedagogically valuable manner” (Picciano, 2011, p. 4). Hence, a course website was developed in the first instance as the main component of the design and development cycle. Over a period of four weeks the lecturer developed the course website using CourseBuilder¹. The course website was designed to be used in conjunction with the university’s Learning Management System (LMS), supplementing the LMS functions such as course announcements, grades, assessment, and so forth. The website features were structured according to the course topics using a simple matrix approach, shown in Table 1.

Table 1

Structure and features of the project management (PM) course website according to topics

Provide on the website:	Lecture slides and handout notes	Lecture recording	Weekly case study	Multiple-choice self test	PM templates	Assignment discussion paper	Assignment Question and Answer Forum
Topic 1: Introduction	•	•	•	•	•		
Topic 2:	•	•	•	•	•		
Topic 3:	•	•	•	•	•		
Topic 4: etc	•	•	•	•	•		
Assignments 1 & 2						•	•
Discussion papers 1–4						•	•

The intended student learning outcomes were reviewed at the outset of the pilot and were not changed. The linkages between these learning outcomes and the e-learning approaches adopted for the pilot are presented in Table 2.

¹ CourseBuilder: <http://www.clear.auckland.ac.nz/index.php?p=coursebuilder> is a course website development tool created at the University of Auckland that requires no coding or html knowledge. It is specifically for teachers who wish to develop educational websites and offers a wide range of powerful interactive, collaborative, and multimedia features designed for teaching and learning contexts.

Table 2**Links between intended learning outcomes and e-learning features used in the pilot**

Intended learning outcome	e-Learning features	Linkage between learning outcome and e-learning feature
Understand the fundamentals of project management.	Course website Case studies Multiple-choice self tests Q&A Forum Lecture recordings	Explicit conceptual linkage by providing richer content.
Identify and manage the factors that influence the successful outcomes of projects.	Online case studies with threaded discussion forum	Implicit by providing weekly case studies exploring different success factors. Case studies discussed online and in class.
Be able to analyse and assess the project management needs of organisations.	Website Project management templates	Implicit by demonstrating how templates can be used within an organisational framework.
Understand and apply a range of project management theories, approaches, tools, and techniques.	Website Online case studies Project management templates Lynda.com training videos Lecture recordings	Explicit by introducing a wider range of theories, approaches, tools, and techniques. Students' project management templates were uploaded to supplement those provided by the lecturer.
Undertake the role of the Project Manager.	All: the pilot itself Q&A Forum on assignments	Implicit by presenting the pilot to students as a project.

The introduction of e-learning gave us an opportunity to review and enhance the course assignments. Whilst the means of assessment and the structure of the assignments were unchanged (i.e., two major assignments, four minor assignments, no exam), the ICT technologies opened new options for more imaginative content for the assignments. For example, assignments were designed around further analysis of the online case studies, templates were developed to suit organisational project management needs, and tools and techniques were applied to project management scenarios. We also modified one of the major assignments to a virtual team-based project, and provided an online forum for each team to help facilitate collaboration between students.

Other e-learning features available to students were:

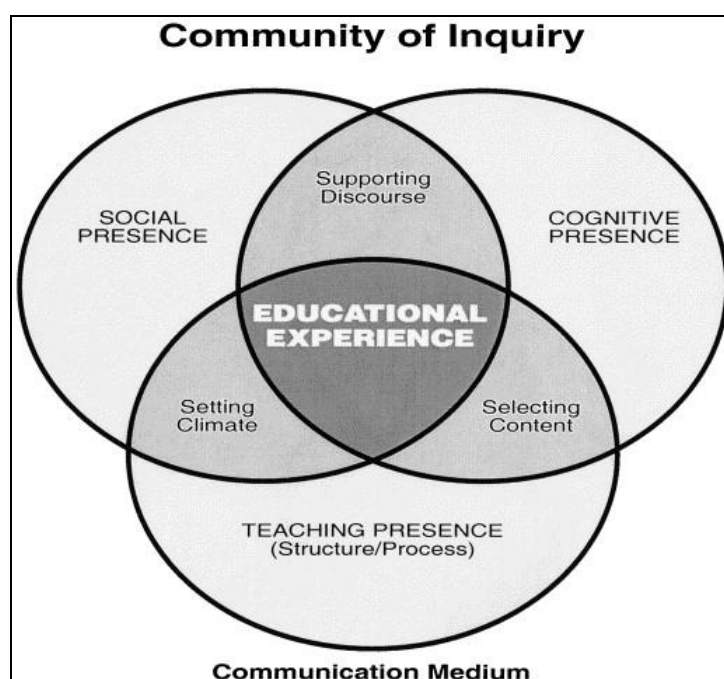
- Online office hours, where students could make appointments for meetings online, with options to hold online meetings via video conferencing (using Skype).
- Lecture recordings, which were made available after each lecture and remained so for the duration of the semester.
- Online training videos on Microsoft Project from Lynda.com. These were used on a trial basis as additional flexible learning resources for students who were unable to attend class tutorials on the software.

The first implementation: Monitoring and managing “teaching presence” of the new blended course

For this first implementation of the blended course, we monitored “teaching presence”, proposed by Garrison, Anderson, and Archer (1999) as one of three elements of the Community of Inquiry (CoI) framework. This framework, illustrated in Figure 1, proposes that teaching presence, social presence, and cognitive presence are critical to sustain a collaborative and worthwhile educational experience in a community of inquiry (Garrison, Anderson & Archer, 2010). While the framework was developed in the context of asynchronous, online, text-based group discussions, it offers a useful way to examine teaching practice in a blended e-learning environment that is not fully online. During the second course design and development cycle, our research focus will expand to include the social and cognitive presences of this framework.

Figure 1.

The Community of Inquiry framework (Garrison et al., 1999, 2010)



Teaching presence is defined as “the design, facilitation and direction of cognitive and social processes for the purposes of realising personally meaningful and educationally worthwhile learning outcomes” (Anderson, Rourke, Garrison, & Archer, 2001, p. 5). We now address these three dimensions of design, facilitation and direction in the following section of this paper. Thereafter we provide reflections, conclusions, and recommendations.

Design as a dimension of teaching presence

It has been suggested that teaching presence is continuous from design to implementation and evaluation when integrating e-learning within a course (Philip & Nicholls, 2007). This was our experience with the project management course.

The design dimension of teaching presence required not only a substantial increase in the number of new ICTs used in the course, but a growing, dynamic understanding of how to best adapt and use these to

support teaching and learning in the context of this course. The new and existing ICTs used during the first implementation of the blended course are listed in Table 3.

Table 3

Comparison of ICTs used before and during the blended project management course

ICT's used in previous years	New ICT's used in the 1 st Design and Development Cycle:	
	Prepared prior to first day of teaching	Adapted and maintained by the lecturer during teaching semester
Learning management system (LMS) for:	Learning management system (LMS) for:	Learning management system (LMS) for:
<ul style="list-style-type: none"> • Announcements • Grades • Lecture notes • Slide presentations • Assignments • Readings online 	<ul style="list-style-type: none"> • Lecture notes • Slide presentations • Assignments • Readings online 	<ul style="list-style-type: none"> • Announcements • Grades
Microsoft Project	Microsoft Project	
Microsoft PowerPoint presentations	Microsoft PowerPoint presentations	
	New course website developed and populated with:	Course website regularly updated to include or update:
	<ul style="list-style-type: none"> • Case studies • Project management templates • Self-test multiple-choice questions and answers on each topic 	<ul style="list-style-type: none"> • Lecture theatre recordings • The Q&A Forum • Project management templates • Weekly online competition for best contribution from students
	Lynda.com training videos	Online office hours with videoconferencing (using Skype)

Each new ICT, with its own educational affordances, was used to support student learning differently; mapping affordances to learning requirements (Conole, Dyke, Oliver, & Seale, 2004). Sometimes this involved preparing resources ahead of the course which remained largely unchanged while teaching (e.g., readings, case studies, assignments, slide presentations), while other tools and resources were updated and maintained continuously (e.g., forums, templates, lecture recordings). This required a reflective and proactive approach open to taking risks and accepting critique from students and colleagues.

There were other potential risks inherent in taking an innovative teaching approach that involved integrating new ICTs: risks of using relatively unfamiliar software to deliver core teaching material; risks of unexpected student responses to using new software and user-interfaces; risks of negative student evaluations; risks of lowered student attendance at lectures due to the availability of lecture recordings; risks of unforeseen technical failure, or incompatibilities; and risks of peer criticism from colleagues in the teaching department. While these risks were real, we actively mitigated them by: consulting with experienced learning designers; learning from examining other online courses (case studies); being responsive to students and making a concerted effort to obtain large amounts of informal feedback; undertaking training in the new ICT systems; having a sense of fun and not taking self too seriously when technical glitches occurred; and accepting constructive criticism from colleagues as part of the ongoing process of improvement.

Facilitation as a dimension of teaching presence

While the design emphasis is on course and resource presentation and structure, and mapping ICT affordances to learning requirements, facilitation focuses our attention on the learning experience as a process of inquiry; guiding student learning from perception to conception, between theory and practice,

through deliberation and application of the course concepts (Garrison et al., 1999). Facilitation as teaching presence in this course involved maintaining an online presence through making regular updates to the course website before and during the teaching semester, moderating the Question and Answer (Q&A) Forum, and incorporating student contributions to the course content. We anticipated that the ongoing development of the website would become one of the features of the course, enabling the lecturer to interact with students in more meaningful ways than a static website would allow.

We monitored student participation in the new course website on a daily basis, particularly the Q&A Forum for answering student queries. It was important that questions were answered within 24 hours with a considered response. This proved to be a successful strategy; whilst it demanded some rigour to set time aside every day, it helped reduce the number of students coming to the office asking similar questions (See Table 4). The lecturer still maintained office hours, with an online booking system for half-hour slots. However these slots for office appointments were not used for routine queries as most of the straightforward questions were dealt with via the Q&A Forum, freeing time for more purposeful teaching activities and increasing the productivity of staff and students.

Table 4

Usage of the online Question and Answer (Q&A) Forum in relation to assignment deadlines

Assignment	Percentage of the course assessment	Deadline	Number of queries posted via the Forum
1	5	Week 4	11
2	5	Week 4	5
3	40	Week 6	51
4	5	Week 9	21
5	5	Week 9	2
6	40	Week 12	6

Incorporating students' contributions to the content of the course was the third component of facilitation as teaching presence. As noted earlier, many of the students were professional engineers with years of industry experience; they had valuable experience and practical examples to contribute. Experimenting with principles of the "contributing student pedagogy" described by Hamer et al. (2008), we invited students to share their experiences wherever possible in the application of project management theory to practice. Examples included addition of resources to the course website, addition of quotations on project management sourced by students, and posting of templates and other materials that students developed.

Direction as a dimension of teaching presence

Direction in Garrison et al.'s (1999) Col framework refers to direct instruction and how this engages social and cognitive presence by learning communities in online asynchronous forums. In the context of the project management blended course, this dimension of the lecturer's teaching presence focuses our analysis on the influence of lecture recordings for the first time in this course. Research on the impact of lecture recordings on teaching and student learning shows that, contrary to expectations, the availability of lecture recordings encourages students to attend lectures rather than miss the lectures and use the recordings as a replacement (Gosper et al., 2008).

At the outset we anticipated that lecture recordings would be more useful for some student cohorts than others, particularly for those working part-time who may not have been able to attend all lectures, or students studying via distance learning. Whilst we wished to enhance the flexibility of the course via the use of lecture recordings, we also took the view that the quality of the lectures was paramount, and that the use of recordings should not detract from the experience in class. The University of Auckland guidelines for staff on using lecture recordings advises that recordings are useful when:

- The lecture is delivered in a traditional format based on one-way communication
- Class sizes are large and tend to be impersonal
- There are little or no interactive elements where students communicate or collaborate with others.

These features are contrary to our preferred style of conducting lectures where class discussions, facilitated interactions, and group work are regular features. We therefore split the two-hour lecture in two with a formal presentation in the first hour, and student interaction and participation in the second. We recorded the first hour of the lectures, and arranged for the recordings to be posted on the website within 24 hours.

Overall, the approach appears to work well for this particular course. It took two or three lectures to become comfortable with being recorded, but thereafter the recording process did not affect the lecture. Students in the project management course were very positive about the lecture recordings and reported that they were useful for revision and clarification and, in some cases, for catching up when they had missed a lecture. Although we didn't count class attendance, there was no noticeable reduction in the number of students attending classes compared to previous years—indicating that the lecture recording supplemented the course rather than replaced traditional lectures. Whilst our findings on this are rather subjective, we plan to collect more objective feedback and data in future years. We outline our research design for the next iteration later in this paper.

Reflections on the First Design and Development Implementation Cycle

Most of our reflections on this first cycle are qualitative, based on observations, critical self-assessment, and informal feedback from students. We also reviewed student satisfaction scores available for the course at the end of the teaching semester, and website usage data.

Student satisfaction results

The University of Auckland collects feedback from students as a routine part of quality assurance procedures. Results of student satisfaction surveys for the past three years are summarised in Table 5.

Table 5

Student Satisfaction Results

Course Title	Feedback Score (Grading scale 0–10)		
	Year 1	Year 2	Year 3 (when the blended course was first piloted)
Project Management	7.2	7.9	8.4

Note: Students rate positively-worded statements on a scale of 0–10 (0 = strongly disagree, 10 = strongly agree).

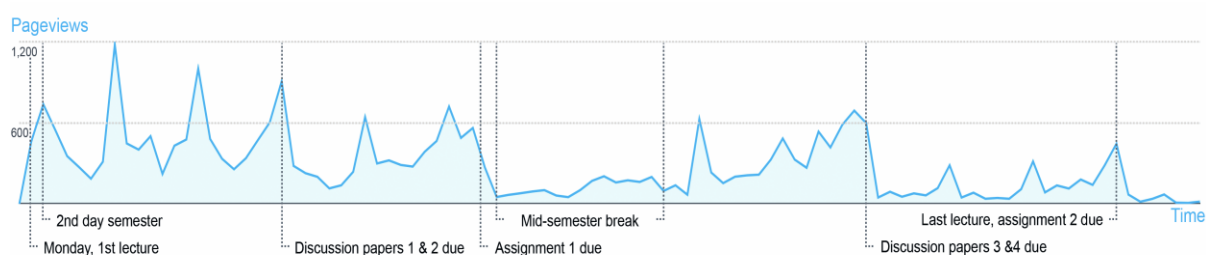
The target was to obtain a feedback score of 9 or better. Whilst this was not achieved there was an improvement compared to previous years. We acknowledge that these results only provide indicative feedback because there are numerous other factors that account for the improvement in satisfaction results, and there is insufficient data to draw any statistical relevance.

Website usage data

During this first implementation of the blended course we monitored usage data for the new website using Google Analytics. Figure 2 shows that in the first half of the semester website use was high, with weekly peaks. These peaks correspond broadly with the weekly lectures, indicating that students were using the website to prepare for the lectures. During the mid-semester break there was a noticeable drop-off of page views. The small amount of usage suggests that some students used the website to catch up or to progress with their assignments. In the second half of the semester the graph shows a less distinct pattern, but with a spike leading up to the deadline for Discussion Papers 3 and 4. In the next iteration of the course we will monitor students' use of particular pages and elements of the website.

Figure 2

Google analytics data on use of the new course website



Online teaching competencies

In addition to the skills and experience required to teach a postgraduate course at university level, additional competencies are required for online teaching (Oliver & Herrington, 2001). The range of online teaching roles and associated competencies proposed more than a decade ago by Goodyear, Salmon, Spector, Steeples, and Tickner (2001), still hold true with current e-learning implementations. We offer our reflections based on a selection of these roles that were relevant to this blended course: the roles of process facilitator, content facilitator, technologist, manager and administrator, assessor, and researcher.

Process Facilitator

Goodyear et al. (2001) propose that the process facilitator is concerned with facilitating a range of activities that are supportive of student learning. Initially we gave too little attention to this role in the online domain because it is easier to welcome students, establish ground rules, create community, manage communication, and model social behaviour in face-to-face teaching. However, these components are equally important for successful online learning experiences, but require innovative and pro-active approaches. For example, encouraging initial participation and making contributions; we found that while some students were happy to contribute (e.g., in online case studies, assignment Q&A's) others were not participating. We therefore went to some lengths to encourage all students to make at least one contribution to one online case study discussion forum, specifically, to help students become comfortable in expressing a view online.

Having acknowledged that these process competencies are equally important online as in traditional settings, the specific means of achieving successful outcomes is somewhat different in our view. A specific problem is that in an era of information overload (Edmunds & Morris, 2000), the online setting is a particular challenge because most people do not want to be bombarded with emails and other e-communications. Establishing a learning community online using online dialogue runs the risk of becoming unwanted “noise” and spam. This may mean posting fewer high quality communications rather than sending many messages. Also, the facilitating process is likely, in our view, to require an ongoing mixture of face-to-face and online efforts. For example, demonstrating good etiquette in online discussions is something that can be discussed in class and then simply demonstrated by staff in online discussions.

In our experience, the partnership between lecturer and learning designers allowed for some peer observation of teaching and gathering of informal feedback from students. From these observations particular points on facilitating student learning were noted:

- The majority of students preferred doing the case studies in class, because they preferred discussing the answers in that forum.
- Where case studies had been discussed online, students expressed a desire to have some model answers from the lecturer and a follow-on discussion in class in which the online contributions were further considered (i.e., to receive further feedback). This suggests that the quality of the discussion and tutor feedback received via the online domain was not sufficiently deep.
- Students were more likely to participate online if a task was graded. If not, other priorities prevailed.
- The provision of the online Q&A Forum was viewed by students as very useful. It was noted that having a robust structure to the Q&A Forum was important. Initially, our technology within CourseBuilder didn’t allow for provision of comments structured by topic, but this feature has subsequently been incorporated.

While a large number of students did not initially participate in the online forums (case studies and Q&A), the vast majority did read them. This suggests that the online discussions may be useful to more students than the number of participants in the actual forum. Such “active lurking” may be a positive learning experience for students.

On reflection, the process facilitator role is probably the hardest part to integrate into a blended learning environment, but possibly the most critical. In hindsight we didn’t give this aspect sufficient attention in our first cycle, and will need to be more pro-active and imaginative in the next iteration. One positive outcome was that the process itself of creating the website and innovating with features such as online case studies, the Q&A Forum, and so forth, contributed to positive engagement with the students. Informal feedback was very positive, with students commenting favourably on the innovations (i.e., there was a positive appreciation that we were making efforts to innovate).

Content Facilitator

In contrast to the process facilitator, the content facilitator is concerned directly with growing the understanding of the course content. During the implementation of the first cycle it became increasingly apparent that use of ICT opens new opportunities to incorporate a wide range of rich content that is already available, for example, by providing links to other materials, incorporating Lynda.com training materials, and embedding relevant videos to illustrate key points.

Moreover (and excitingly in our view), it opens more opportunities to draw on the rich experiences of students. This was something that became increasingly apparent during the implementation of the first development cycle. Towards the end of the semester we encouraged students to use some of the templates provided on the course website, but also to offer their own templates for others to use. In future course iterations we will invite students to draw on their industry knowledge by contributing examples from their own experience in relation to the week's topic. They will be able to post these online and have them peer assessed.

The trial use of the supplementary online training videos in Lynda.com was also popular. Informal feedback from students on access to these additional materials was positive, particularly in relation to the online tutorials on project management software.

Another feature that was positively received by students was that the entire content of the course, including all assignments, was available at an early stage. Although the website was slightly restricted during the first two weeks of the semester (while students were still finalising the course selections and enrolments), thereafter the website was opened for all future weeks' topics. We deliberately took this approach rather than releasing content on a week-by-week basis in order to give maximum flexibility for students. For example, students working part-time could, if they so wished, commence assignments early in order to manage their studies round their employed workload. Although there was very moderate evidence of students progressing in advance of the weekly topics, the advance visibility gave students a sense of a well-structured and organised course. In informal feedback students were positive, saying that the website was useful in the way that it supported the course, and they appreciated the clearly structured website materials.

During the semester some students asked for more examples (such as industry case studies) to be added to the website as additional reading. Although the core text book and other referenced text books provided numerous case studies, it appeared that some students were looking to the website as providing the core content. The flexibility of the CourseBuilder software makes it easy for us to expand the content to incorporate such additional materials. However, it does introduce a dilemma: to what extent do we expand the content on the website as replacing core content that might typically be provided in textbooks? We don't envisage the website as ever being as comprehensive as a good text on the subject matter, but we do see a blurring between website, e-books, and traditional textbooks. One advantage of using the website is that it gives the lecturer a tool to update materials quickly, which provides a more interactive environment. However, this imposes a requirement on the lecturer to manage the content and ensure clarity of structure.

Technologist

According to Goodyear et al. (2001), the technologist role is concerned with making or helping to make technological choices that improve the environment available to learners. This is a specialist role, however, it does not have to be a barrier for the technophobe in using e-learning. Embarking on the first cycle of design and implementation, the course lecturer had no previous experience in developing websites, nor in making lecture recordings. The lecturer can be described as "technology aware", probably of average computer proficiency for an academic, but able to appreciate the implications of using technology in teaching. The learning designer was a specialist in the field, with experience in advising academics on implementation issues, and able to draw on the support of other specialists such as the CourseBuilder developer. Hence, the lecturer was able to draw on the necessary support to help with implementation, which was important for the successful deployment of the new technologies. There were only a small number of technology glitches which were quickly rectified. Students were surprisingly tolerant of such glitches.

Manager / Administrator

The use of e-learning technologies does offer opportunities to enhance the management and administration of the course. Advance effort is required to set up the technology systems to ensure they work effectively, but once established, provides benefits for lecturer and students alike. These benefits include better organisation, fewer errors, improved efficiency and ultimately, better quality of administration. In our case particular examples were:

- The use of an online booking system for office appointments between staff and students. Students were able to self-book appointments.
- The use of the online Q&A Forum. Whilst the online Q&A had benefits in the process role as previously outlined, it also helped significantly in reducing the number of requests from students for an office appointment to answer simple, repeated questions. It reduced too, the number of emails received (compared to previous years in running the course).
- Online booking for access to additional materials (Lynda.com).
- Use of an online system for nominating teams for one of the assignments.

Monitoring the course website required additional administration which was primarily related to ensuring questions posted by students were answered in a timely manner. We set a target of answering queries within 24 hours during the week, or first thing Monday morning for queries raised over a weekend. The majority of queries were posted at night and could be answered the following morning. Overall, the reduction in administrative input, in turn, gave the lecturer more time to devote to other value-adding work such as research, and improving teaching content. Also, the website is now available for future years, making it easier to prepare the course each year.

Assessor

This course was mainly assessed using assignments, and this remained unchanged from previous years. One new feature was the use of multiple-choice, self-test questions and answers on each week's topic which were designed to offer students an option to test their knowledge. These tests were not included in the formal assessment in the first year, partially due to the trial nature of the course website development (i.e., risk mitigation) and also, because we were not convinced that multiple-choice questions were suitable for assessing an advanced topic. Not many students used the multiple-choice tests, and some students asked for more feedback to supplement the automated answers which we will provide in future. Also, we will consider using peer assessment in future years for students' contributions, as well as to assess one of the major team-based assignments.

Researcher

Developing and implementing this blended course provided numerous opportunities for research; on our own teaching practice as well as on how these technologies supported students' learning experiences. As mentioned earlier, the purpose of this pilot project was to trial new e-learning approaches before adopting them more widely in the MEngSt programme. The design research approach gave us a research framework that these and future findings contribute to. We have developed a research strategy for the second cycle of development and implementation, to explore in more detail how students source their information, and to collect more detailed quantitative qualitative data sets. We outline the research design for the next phase later in this paper.

Putting the roles together: Requirement for leadership

Each of these six roles proposed by Goodyear et al. (2001), namely, the process facilitator, content facilitator, technologist, manager and administrator, assessor, and researcher are facets of the course coordinator's role in a study programme such as the MEngSt. These roles can be undertaken by an individual (i.e., single lecturer) or by a small team (in our case two individuals with specialist support from other colleagues). In addition, we propose that there is one role missing from the Goodyear et al. model, namely, a leadership role.

This is not the place to review leadership theories or models here. Suffice to say there is a considerable body of knowledge and literature on leadership (e.g., Bennis & Nanus, 2007). The leadership role is critically important in developing and delivering a successful e-learning course (Marshall, 2011). The leader is primarily concerned with setting the objectives, sharing the vision, and influencing others to achieve these objectives. Without exercising some leadership for a high-level long-term goal, e-learning initiatives are unlikely to deliver excellence.

Whilst we are not so bold as to claim that we have delivered excellence yet, we started with an overall objective, and have embarked on a continuous improvement cycle seeking to achieve excellence. In this sense we borrowed from some of the organisational excellence models such as Lean Thinking (Womack & Jones, 1996). This provided the initial impetus for embarking on the project, and provided us with ongoing sustenance when effort was required.

We also believe that a move from traditional delivery to a successful blended approach with e-learning is something that is better undertaken on an incremental basis, rather than a single "big bang" technology change (Quinsee & Sumner, 2005). This has the advantage of making incremental changes based on feedback from students and other stakeholders. As such, a sustained vision is needed, which is unlikely to be provided by the eight roles of online teaching proposed by Goodyear et al. (2001). Just as these authors identify competencies associated with the roles for online teaching, so we propose competencies for the role of leadership in e-learning integration as:

- Set an overall objective for e-learning implementation in a course
- Share the objective with others, and communicate and influence others to help achieve the objectives in an ongoing sustained manner
- Understand the possible advantages and associated risks in using e-learning technologies, and establish suitable approaches for managing threats
- Show enthusiasm and demonstrate commitment through personal actions
- Strive for excellence.

Summary: Roles for online teaching and possible future improvements

We have provided a qualitative description of our reflections on six (of the eight) roles for online teachers proposed by Goodyear et al. (2001). These are summarised in Table 6 with improvements we have formulated based on the first implementation of the blended course.

Table 6

Summary: Online teaching roles and suggestions for future improvements

Role	Summary of key findings	Suggested improvements for our pilot
Process facilitator	Requires pro-active effort to make online delivery successful Multiple communication channels need to be coordinated with a central authoritative hub (i.e., all communications duplicated on the website) Students are more likely to engage in online learning activities if they are assessed Some students are likely to engage in “active lurking” which is not necessarily a negative thing	Increased effort on process elements Post all information on the website and make announcements in form of summary with link to the website as a hub Incorporate aspects of assessment of different e-learning approaches used during course delivery Design hooks to engage active lurkers and encourage them to participate more openly
Content facilitator	The use of ICT expands the horizons of course content e-Learning approaches open options to draw on the rich experiences of students to contribute to course content Making course content transparent via a website helps students understand overall course structure Making content available via a website allows for asynchronous learning options The flexibility offered by some ICT applications allows for rapid updating of course content, taking advantage of learning opportunities, and responding to student needs	Expand options for contributions from students, e.g., case studies, presentations, discussion papers Students could contribute content such as templates on the course website using student pages or a wiki
Technologist	A willingness to experiment is required The course lecturer does not have to be a technology expert, provided support from other experts is available when needed Some technology glitches are to be expected but student tolerance is good provided problems are addressed quickly	Options to use other technologies to support learning objectives, such as project management simulations and social annotation tools
Designer	There should be clear linkage between course objectives, learning outcomes, and e-learning design Design can be incremental; some ICTs need to be designed prior to commencement of the course, others must be moderated throughout the teaching semester Ongoing online updates help ensure the course is dynamic	Use findings from the pilot to inform course design for future
Manager / Administrator	Use of ICT requires up-front administrative effort, but early planning helps with management of the course, which ultimately helps improve efficiency and effectiveness Use of an online Q&A forum necessitates a commitment to respond in a timely manner (24 hours in our case)	Continue to upgrade the course website supplemented by other ICT applications to assist with administration
Assessor	Self-test multiple-choice tests were only moderately successful and require more feedback	Include aspects of peer assessment
Researcher	Embarking on a design research approach when introducing e-learning options in a course opens options over a number of cycles to undertake meaningful research	Undertake a research project for the second cycle of development
Leader	Sustained leadership is necessary	Share the vision with students and other stakeholders

Research Design for Second Iteration

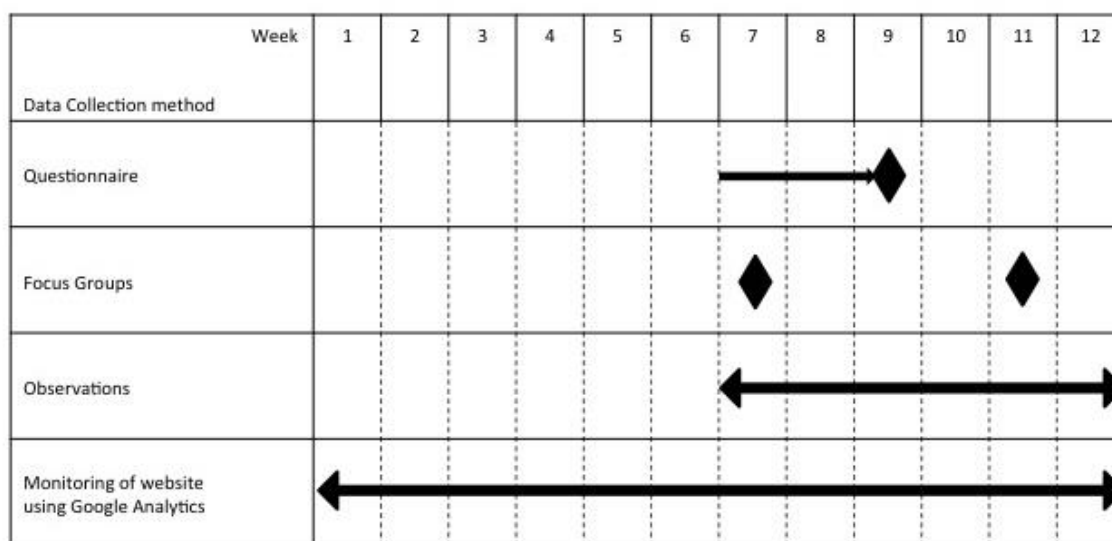
During the second iteration of the blended course our research focus will shift to address a particular research problem that we identified in the modern tertiary education environment, where students have access to a vast array of knowledge resources which are accessible via numerous communications channels. Many of these channels are partially or completely accessed via modern ICT systems. For example, traditional face-to-face lectures are now supplemented with lecture recordings. We have received

ethics approval to investigate information flow patterns and issues in the postgraduate project management course in order to identify possible means of improving teaching methods and e-learning technologies that support student learning.

Two new innovations will be introduced into the course: project simulation software, and an online social annotation tool for collaborative student note-taking during lectures. In order to gain a better understanding of the effectiveness of these two innovations, research is planned that will enable the researchers to gain more in-depth data on how students access information for decision making when undertaking assignments in the course. The planned research methods are shown in Figure 3.

Figure 3

Research methods for the second design and implementation of the blended course



We will collect data on how students source information. We will use a matrix that seeks to link human and documentary sources of information with forms of communication and means of access. In this way we seek to gain insight into student preferences for information sourcing, which will inform our design for future interactions.

Conclusions

This innovative approach to designing and implementing a blended course has resulted in a number of benefits, including:

- Increased student satisfaction: the departmental surveys of student satisfaction showed an increase in student satisfaction for this course.
- Improved productivity during the delivery of the course. This repaid the initial investment in time by the lecturer in developing the course website and adopting new technologies. In particular, the lecture recordings and online Question and Answer Forum streamlined queries relating to assignments, and ensured that all students received the same information. This was a popular feature of the online course components.

- Increased flexibility for student learning. Whilst traditional teaching via face-to-face lectures, tutorials, and meetings was not replaced with online learning, interaction via the course website, lecture recordings, online case studies and so on, offered students multiple learning strategies. Flexibility, not only of pace, time and place of study, but also of learning style and learning opportunities, was made possible by these innovative online technologies (Collis & Moonen, 2002).

Considering the benefits of the e-learning innovations used in this trial, we conclude that the benefits are real and significant, and therefore we will apply lessons learned from the pilot study to other courses in the MEngSt programme. However, we also feel that it would be a mistake to move to a distance learning model at this stage; rather that the e-learning approaches supplement (not replace) the more traditional teaching approaches by further developing a blended course. This is a pragmatic decision given that all other Masters courses in the Masters programme are currently delivered face-to-face, and that this pilot project is a first attempt at using a blended approach within this programme. Adopting a blended approach covers the various needs of our current students, and makes an incremental change rather than a radical departure from the norm.

The continuous teaching presence of the lecturer, from design through to implementation of the course, was monitored during the pilot and analysed with reference to Garrison, Anderson, and Archer's (1999) Community of Inquiry framework. This approach meant that we were able to engage with students and colleagues in a) checking assumptions upon which the course was designed, and b) seeking continuous improvement in the delivery of the course, which was well received. The particular innovations used thus far, are in our view, less important than adopting an innovative, scholarly approach to teaching. Using such collaborative and participatory methods to trial flexible e-learning options for substantial change to teaching postgraduate engineering courses extends the potential for student access beyond this institution both nationally and internationally. This has significant implications for up-skilling professionals in a wide range of engineering and business industries.

References

- Anderson, T., Rourke, L., Garrison, D., & Archer, W. (2001). Assessing teaching presence in a computer conferencing context. *Journal of Asynchronous Learning Networks*, 5(2), 1–17.
- Bates, A. (2005). Charting the evolution of lifelong learning and distance higher education: The role of research. In C. McIntosh (Ed.), *Perspectives on Distance Education: Lifelong Learning and Distance Higher Education* (pp. 133-150). Paris, France: UNESCO/Commonwealth of Learning.
- Bennis, W.G., & Nanus, B. (2007). *Leaders: The strategies for taking charge*. (2nd ed.). New York: HarperCollins.
- Collis, B., & Moonen, J. (2002). Flexible learning in a digital world. *Open Learning: The Journal of Open, Distance and e-Learning*, 17(3), 217–230. Retrieved from <http://www.tandfonline.com/doi/abs/10.1080/0268051022000048228>
- Conole, G., Dyke, M., Oliver, M., & Seale, J. (2004). Mapping pedagogy and tools for effective learning design. *Computers & Education*, 43(1–2), 17–33. Retrieved from <http://www.sciencedirect.com/science/article/pii/S0360131503001404>
- Conole, G. (2012). *Designing for learning in an open world*. New York: Springer.
- Daniel, J. (2012). Making sense of MOOCs: Musings in a maze of myth, paradox and possibility. *Journal of Interactive Media in Education*, 18. Retrieved from <http://www-jime.open.ac.uk/jime/article/viewArticle/2012-18/html>

- De Cicco, E., & Kennedy, S. (2012). *Learning in a digital age: Extending higher education opportunities for lifelong learning*. Retrieved from <http://www.jisc.ac.uk/publications/programmerelated/2012/learning-in-a-digital-age.aspx>
- Edmunds, A., & Morris, A. (2000). Problem of information overload in business organizations: A review of the literature. *International Journal of Information Management*, 20, 17–28.
- Garrison, D., Anderson, T., & Archer, W. (1999). Critical thinking in text-based environments: Computer conferencing in higher education. *The Internet and Higher Education*, 2(2), 87–105. Retrieved from <http://www.sciencedirect.com/science/article/pii/S1096751600000166>
- Garrison, D., Anderson, T., & Archer, W. (2010). The first decade of the community of inquiry framework: A retrospective. *The Internet and Higher Education*, 13, 5–9.
- Gosper, M., Green, D., McNeill, M., Phillips, R., Preston, G., & Woo, K. (2008). *The impact of web-based lecture technologies on current and future practices in learning and teaching*. Strawberry Hills, Australia: Australian Learning and Teaching Council.
- Goodyear, P., Salmon, G., Spector, J., Steeples, C., & Tickner, S. (2001). Competencies for online teaching: A special report. *Education Technology Research and Development*, 49(1), 65–72.
- Hamer, J., Cutts, Q., Jackova, J., Luxton-Reilly, A., McCartney, R., Purchase, H., . . . Sheard, J. (2008). Contributing student pedagogy. *ACM SIGCSE Bulletin*, 40(4), 194–212.
- Kozma, R. (2005). National policies that connect ICT-based education reform to economic and social development. *Human Technology: An Interdisciplinary Journal on Humans in ICT Environments*, 1(2), 117–156. Retrieved from <http://www.humantechnology.jyu.fi>
- Marshall, S. (2011). Change, technology and higher education: Are universities capable of organizational change? *Journal of Asynchronous Learning Networks*, 15(4), 22–34.
- Mohd, S., & Aziah, I. (2012). Learning styles and perception of Engineering students towards online learning. *Procedia - Social and Behavioral Sciences*, 69, 669–674. Retrieved from <http://www.sciencedirect.com/science/journal/18770428/69>
- Oliver, R., & Herrington, J. (2001). *Teaching and learning online: A beginner's guide to e-learning and e-teaching in higher education*. Mt Lawley, Australia: Edith Cowan University. Centre for Research in Information Technology and Communications.
- Philip, R., & Nicholls, J. (2007). Theatre online: The design and drama of e-learning. *Distance Education*, 28(3), 261–279. doi: 10.1080/01587910701611310
- Picciano, A. (2011). Introduction to the special issue on transitioning to blended learning. *Journal of Asynchronous Learning Networks*, 15(1), 1–5. Retrieved from <http://jaln.sloanconsortium.org/index.php/jaln/issue/view/23/showToc>
- Quinsee, S., & Sumner, S. (2005). How to manage the big bang: Evolution or revolution in the introduction of an MLE? *Aslib Proceedings: New Information Perspectives*, 57(2), 146–156.
- Patterson, D. (2011). Impact of a multimedia laboratory manual: Investigating the influence of student learning styles on laboratory preparation and performance over one semester. *Education for Chemical Engineers*, 6(1), 10–30.
- Reeves, T., Herrington, J., & Oliver, R. (2005). Design research: A socially responsible approach to instructional technology research in higher education. *Journal of Computing in Higher Education*, 16(2), 96–115. Retrieved from <http://link.springer.com/article/10.1007%2FBF02961476?LI=true>
- University of Auckland. (2012). *The University of Auckland Strategic Plan 2013–2020*. Auckland. Retrieved from <http://www.auckland.ac.nz/uoa/home/about/the-university/official-publications/draft-strategic-plan-2013-2020>

Womack, J. P., & Jones, D. T. (1996). *Lean thinking: Banish waste and create wealth in your corporation*. New York: Simon & Schuster.

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How Physics Teaching is Presented on YouTube Videos

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Abstract

One hundred and twenty videos on YouTube were selected and investigated in terms of content relating to physics and science teaching. This video material was used to generate categories that were then applied to three investigations: physics as taught in upper secondary school and in the introductory level at university, physics projects in upper secondary school, and science in preschool. The results revealed different practices for the use of YouTube in physics and science teaching. One practice, in upper secondary school and at the introductory level at university, was to display physics based on traditional lectures that were video recorded. Another practice was the presenting of students' projects, and a third was support for preschool teachers as a means of promoting science material for their teaching needs.

Keywords: YouTube; Video; Physics Teaching; Educational Tool; Innovation

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Introduction

Innovations can change the conditions for teaching and education by providing new educational tools. Examples from the past are tools such as the printed book and the black or white board. Other innovations are tape recorders and movies and, nowadays, the Internet has become yet another tool.

Today, many users have access to the Internet through different devices that include pocket devices such as the smart phone. Using these devices to access multimedia is natural for today's youth, or the Net Generation (Berk, 2009) as they also are called. They therefore possess experience suitable for multimodal learning. Easy access to the world and the flow of information in our digital age also gives the Net Generation better potential to learn through connectivism (Siemens, 2005). Connectivism describes how the personal network connects to other users, organisations, and institutions; a process that is free in time and space and not limited to traditional learning institutions such as schools and universities. Future students will probably envisage learning activities based on student control, responsibility, and freedom

and thus can be assumed to be yet more diverse learners than current students are. As teachers, we have to relate to these developments.

One potential new educational tool on the Internet is YouTube. This website was opened in February 2005 and it enables users to share video clips through uploading and viewing. The only obligation a user has in order to be able to upload movie clips, is to register—which is free of charge. YouTube is considered a social network because the uploaded clips which are user produced, can be commented on by viewers, thereby giving the producer feedback. Viewer comments can also be commented on by other users.

Of course, it can be questioned whether technical developments are useful as pedagogical tools. An important benchmark for education politics in many countries has been the Programme for International Student Assessment (PISA) conducted under the auspices of the Organisation for Economic Co-operation and Development (OECD). Because PISA has to be free of cultural bias, it is very narrow in its selection of tested areas as well as in methods for the tests. This narrowness promotes teaching methods that can be seen as rather traditional, which induces politicians to draw generalised conclusions which the test results not support regarding, for example, educational resources and class size (Sjøberg, 2012).

In contrast to this point of view, educational research continuously results in new pedagogical tools and methods that map out new ways for learning. For the purpose of identifying and understanding those new ways, it is of interest to study how each new technological tool can be helpful in teaching and learning practice. For example, as a tool for learning and as part of courses, can we as teachers guide students to produce and upload videos to YouTube and also, to view each other's productions and comment on them?

It has been documented how the use of videos, especially in introductory courses and for introducing complex topics (Berk, 2009), can support learning and enhance learning outcomes and be of value for learners who are helped through visual experiences. A review of previous research identifies how teachers promote the use of YouTube as a teaching tool and, better still, how the teachers actually use it. In the journal, *The Physics Teacher*, there is a monthly column with readers' tips of how to use YouTube, and articles on the subject too. An obvious use for YouTube is to deliver lectures (Haase, 2009), but it also has value as attention grabber, focus concentrator, and for distributing instructions (Berk, 2009; Jones & Cuthrell, 2011). Several examples of these YouTube applications can be found (Riendeau, 2010a, 2011). There are also reports of computer-based laboratory work in, for example, mechanics, which use YouTube for video analysis (Riendeau, 2010b; Ruiz, 2009).

Other than these examples of a dedicated and obvious use of YouTube, few investigations have been done to investigate how video clips on YouTube present physics teaching and, in relation to this, how teachers and students are using this technology. Knowledge of physics education content on YouTube is important for a pedagogical practice to develop, and to direct teaching and learning for future use.

The ability to describe physics concepts and laws in context, particularly everyday contexts, is of importance in science education. The importance of context for learning and recalling was established early (Godden & Babbeley, 1975), and its value has been shown in relation to studies in physics too (Rennie & Parker, 1993). Tasks connected to a context have also been found to be more tempting to solve but in order for the student to understand the tasks, the context has to be familiar and relevant; and a context suitable for one student is not necessarily of interest to others (Park & Lee, 2004; Rennie & Parker, 1993, 1996; Whitelegg & Parry, 1999). Therefore, a variation of contexts in the presentation is necessary. When using videos in teaching, various aspects of context could probably be included easily through the selection of the materials used.

It is also interesting to identify whether the on-going discussion of physics as a male domain is reflected in YouTube videos. For example, the choice of context for activities is of importance in making the subject relevant for women (McCullough, 2011; Rennie & Parker, 1993; Rennie & Parker, 1998; Staberg, 1994).

This article, based on an unpublished conference proceeding (Gustafsson 2012), has the objective of conducting a preliminary study to obtain information on what material, related to physics education, is uploaded on YouTube and also of investigating possible uses of video clips for teaching physics at different stages of school and university.

Research questions

Besides the objective of mapping out physics-related video clips on YouTube, it is also of value to connect to discussions of physics as a male dominated domain and a subject that appears dull to women. Furthermore, it is of interest to study how the context in which the subject is placed, matters (McCullough, 2011). The following research questions are therefore formulated:

- How can YouTube clips related to physics teaching, be described?
- In respect to physics education, what kind of usage can be found for these video clips?
- What representations of gender and context can be found?

Methodology

This study falls within the area of interpretive research (Walsham, 2006). The material investigated is primarily video clips on YouTube, as well as the titles and descriptions of the clips to identify the level of education presented in the clip. This is information that the producer of the video clip has submitted. The comments written by viewers of the clips have also, to some extent, been read to obtain further information for the study.

Sample selection

Because there is a huge quantity of video clips on YouTube related to physics, a limitation to the sample was needed. For this purpose, the search engine at the website was used. It was used for three investigations using three different sets of search words. Most of the searching and sampling was performed during February 2012 when 80 of the videos were sampled, and then extended with a search during November 2012 when 40 additional videos were sampled.

In the first investigation, the aim was to map out how different areas within classical physics were presented in YouTube clips. For this, four selected concepts were chosen: *physics + mechanics*, *physics + thermodynamics*, *physics + electromagnetism*, and *physics + waves*. Even though mechanics, thermodynamics, electromagnetism, and waves constitute fundamental areas in classical physics and, in that respect, are valid search categories, they can also be valid in everyday contexts that include phenomena that cannot easily be related to a subject discourse of physics. Therefore, many video clips, irrelevant for this study, were presented as result of such an open search. This is the reason why the word *physics* was also added to the search string. It gave a sharper focus to the result list.

In a second investigation, the search words used were *physics + projects*. The thought was that this would present video clips containing students' projects. In the third investigation, the intention was to find relevant videos for preschool. The search words were originally *physics + preschool* but this combination resulted in very few hits—only 163—therefore it was changed to *science + preschool*.

To limit searches and sort the results, filters can be applied to YouTube. In this investigation all filters were open but one. That was the filter that limits the search to videos. In the first investigation the combination of *physics + mechanics* resulted in over 24,000 hits, also the highest number in the whole study. In the first investigation the lowest number of hits was for *physics + electromagnetism* with 2,200 hits.

A second investigation with *physics + projects* as search words resulted in nearly 5,000 hits. The investigation on *science + preschool* resulted in just below 1,900 hits in the search performed in February 2012. However, this was well over the original 163 hits for the search combination of *physics + preschool*. The search in November 2012 for *science + preschool* resulted in 4,170 hits. This was an increase of 120% in just nine months, indicating a growing interest in using YouTube to promote ideas and material.

Because it was not viable to investigate 24,000 video clips nor even 1,900, the lowest hit result, a selection was required. A grading or rating of hits is always done by YouTube for the result presented in relation to a chosen indicator. The alternatives for this indicator are predefined by YouTube. For these investigations, *relevance* was prioritised at the expense of *published date* and *number of displays* because neither of the two latter indicators had any apparent meaning for this study. The algorithm for sorting by relevance function, however, cannot be tracked. In March 2012 YouTube also added *ranking* as a sorting parameter but that was not used in this study since most of the data was collected before that month. As a sample for further investigation, the top 10 results from *relevance* for each search were taken.

A total of 60 videos in the four traditional physics areas were used in the first investigation. Of these 60 videos, 30 were by identified using the search word combination *physics + mechanics*. In an earlier investigation of the material, the effects of language choice were studied (Gustafsson, 2012) to see if there was an Anglo-American bias. Therefore a German and a Swedish/Danish (the words for physics and mechanics are identical in these two languages) translation of *physics + mechanics* sample of 20 videos was included in the material. However, the teaching language was not found to have any effect. A chi-square test on the English versus the non-English material showed that there was no language bias regarding setting or gender (Gustafsson, 2012). A conclusion from that result could be that the teaching of physics approach was not bound to language barriers, at least not in the video material studied.

Sixty videos of the total 120 videos were used for the two other investigations with 30 videos for each investigation. Originally 20 videos, 10 for each investigation, were sampled in February 2012. These two samples were later extended in the November 2012 search with 40 more videos for the second and third investigations. Here the 20 top videos were used for each investigation and the results added to earlier findings. If a video in the November 2012 search was identical to one found in February 2012, it was excluded in order not to duplicate the data, and the next hit was used instead so as to secure new material for the investigation.

Data analysis

For analysis of the videos, a methodology in line with grounded theory (Glaser & Strauss, 1967) was chosen. A data set was then generated by studying the videos and describing the content in them with key words derived from observations made by the researcher. The key words were chosen to form a descriptive observation within several dimensions of the social situation that the videos presented (Spradley, 1980) and with focus on space, actor, activity, and object. These key words were then used to generate main categories with descriptive subcategories related to the research questions, but also to other features that were apparent in the material such as producer, organisation, or similar if identifiable.

This process resulted in three main categories with three to four subcategories each. A main category appeared, being *settings* for the recording. Associated with this category were the underlying categories

live lecture and *studio lecture* for a lecture with pedagogical content but with no audience, *demonstration* and *other*. The *gender* of the actors and type of *producer* (commercial, organisation, or private) were also generated as main categories. That *producer* would be a category was not directly apparent from the research question. But in relation to formulating an answer to the question, “In respect to physics education, what kind of usage can be found for these video clips?” the producer turned out to be a revealing category. See Table 1 for the structure and indicators of these categories. The same categories were used for all three investigations. For the second investigation, the category *demonstration* also included presentations of projects.

On YouTube, viewers can write comments on the videos. These were read to some extent because they gave an indication of viewers’ opinions of the videos. The headings of the videos were read because they sometimes gave information regarding age or school level.

Table 1

The categories and indicators generated and used

Main category	Subcategory	Indicators
Setting	Live lecture	A recording in a live situation with both teacher and students/children present and active.
	Studio lecture	Only a teacher present and giving a presentation/lecture that could have been given in class.
	Demonstration	A demonstration of material, phenomena, or equipment for students or children. Presentation of the activities and results of a student project.
	Other	No education-related activity.
Gender	Female	Female gender as active person/persons. That is for an adult in a teaching situation. If no adult is present, female gender of student or children.
	Male	As above but male gender.
	Mixed	As above. Mixed gender active.
Producer	Commercial	If the main purpose of the video is to promote a product or service for sale.
	Organisation	If a URL or organisation name is shown, but the main purpose is not to promote selling, but to inform.
	Private	No organisation is visible as producer.

Authenticity, limitations, and plausibility

For interpretive research methods, the authenticity and plausibility of the data must be considered as well as the pre-understandings of both the researcher and readers of the study (Walsham 2006). For this study there was no indication or reason to believe that the videos were not genuine or were placed for a manipulative purpose on YouTube.

The limited number of search words produced a sample of videos that only reflected part of all physics-related videos on YouTube. But this was also the objective of the study; through a preliminary study, present a sample of what could be found on this website related to physics teaching.

It is possible to raise questions about the selection of a sample on the basis of search words. For the present study, the top 10 or 20 video clips in terms of relevance were chosen. Other forms of selection might have given other results. For this study the procedure for selection of sample is openly presented and motivated, given that the results can be compared to results from other methods of selection.

Regarding the pre-understanding of the researcher, the key words were generated and the studied video situations were observed on the basis of the researcher's knowledge and experience as a member of what could be called a physics subculture. Therefore, to make the results plausible and consequently reliable, key words had to be found that could be understood by the general public, and not necessarily be related to the subject of physics. The video material on YouTube is also open for all to investigate so other researchers can perform studies to investigate the reproducibility of the results.

Results

The first investigation

When searching on traditional physics areas, the samples of videos were dominated by clips produced in a studio with a teacher giving a lecture on some well-defined concept or phenomenon, on a board or as a Power Point presentation. There was no audience and the clips were between three and 11 minutes long.

Of the 60 videos, 48 were in this category—*studio lecture*. For the searches on thermodynamics and electromagnetism, this was the only category present in the sample and for the mechanics and wave searches, this category was found in 22 of 30 videos, and in six of 10 respectively.

Of the 48 videos recorded in a studio, 29 were produced under a specific producer name, here labelled as an organisation. The remaining 19, and those five categorised as live lectures and demonstrations, could be defined as private productions since no name of any organisation was identified.

The second most frequent type of video for the mechanics and wave searches was the *live lecture* with a class of students present. Here, some classic American universities were included with contributions from Berkeley, Massachusetts Institute of Technology (MIT), and Stanford that had four videos between them. These videos showed full lectures of lengths between 38 and 70 minutes. The lectures included a professor talking, writing on the board, showing pictures, and giving demonstrations, sometimes with the assistance of a student.

Video recordings just of demonstrations were found in three of the sampled videos namely, a gyro, a pendulum, and an air track with several male and female physics teachers demonstrating movement. The remaining five videos were categorised as *other* and included an interview, synthesizer sound, two videos with a singing man, and one video documenting an inventory of laboratory equipment.

The quality of all videos was of good standard and it was easy to hear the lecturers and see the writings on the boards. The videos presented first-rate teachers who appeared to have long experience. The viewer comments on the videos were almost without exception very positive: "I love this, Great lesson, I am really amazed . . . very basic but really good explanation . . . wow . . ."

Of the 52 videos in the sample where live lectures or studio lectures were presented, 47 of the lectures were given by a male teacher. The videos that presented a woman as teacher all came from the same producer. In one of those, a male voice was used occasionally to comment on some of the demonstrations included in the video. For a summary of all results, in numbers, see Table 2.

Table 2

A summary of the results for the three main investigations is presented. On top (the table turned) the different generated categories are given. The number gives observed occurrence within each set of ten videos

Investigation:	Search words:	Number of videos	Setting				Gender			Producer		
			Live lecture	Studio lecture	Demo	Other	Female	Male	Mixed	Commercial	Organisation	Private
	<i>Physics + mechanics</i>	30	3	22	2	3		27	2		5	22
First, four physics areas	<i>Physics + Thermodynamics</i>	10		10			1	9			8	2
	<i>Physics + electro-magnetism</i>	10		10			4	6			10	
	<i>Physics + waves</i>	10	1	6	1	2		6	1		6	3
		60	4	48	3	5	5	48	3		29	27
First, in total					30		7	19	3			30
Second	<i>Physics + projects</i>	30										
Third	<i>Science + preschool</i>	30			5	5	24	1	1	11	7	12

The second investigation

For the investigation of projects, all but two of 30 videos showed student projects conducted mostly in upper secondary school. Upper secondary school is used here as a synonym for senior high school. The school level was determined both from the visual expression in the videos and from titles and descriptions of the uploaded videos. A couple of the videos showed teachers conducting projects and therefore, had the characteristics of demonstrations. Due to the electromagnetic content in these demonstrations, it is possible that the videos could also have appeared in the first investigation had a larger sample been taken there. The projects were all relevant physics projects presented with care and seriousness on the part of the students and teachers.

Nineteen videos were presentations by men, seven by women, and three were by mixed genders. In one video, no person was shown and therefore no gender could be identified. The environments where the videos were recorded varied. Some of the projects were placed indoors in a classroom or at a student's home. Other projects were conducted outside in a schoolyard or in the backyard of a home. The videos were between 15 seconds—a small trebuchet built for a physics project in Grade 12, according to the information at the video clip—and 14:05 minutes—students in their senior year of upper secondary school performing a project in physics class that closely replicated the Discovery Channel show, *Mythbusters*. Three of the presented projects were Rube Goldberg machines (Rube Goldberg, n.d.), probably participating in the yearly contest, and these seemed to be a lot of fun for the students.

The third investigation

The sample of 30 videos from the investigation for preschool videos contained 18 commercial videos promoting different preschool organisations, and learning materials for science in preschool. Many of them had the purpose of selling such learning materials and YouTube functioned as a commercial area for them. Sometimes a teaser from the material was presented—for example, a fun experiment.

In addition to the commercial videos, there were seven videos that presented organisations but selling was not their main purpose. The remaining 12 videos were categorised as private productions. These video productions were made to show how science could be done with younger children.

The content in the videos categorised as *organisation* or *private* included different science-related activities such as growing plants, producing carbon dioxide from common household items, making a paper clip float on water, and taking a walk in a natural environment. One clip presented science planning for preschool and another clip presented mathematical exercises with numbers. Their lengths ranged from 59 seconds to almost 10 minutes.

In 25 of the videos, women were present or speaking, often together with children. In two videos, a man was doing activities together with children. In one of these videos, women were also present. In 10 of the videos, children were present and in two of them, there were only children acting. Two videos could not be gender coded.

Discussion

Several interesting observations can be made about the collected material. Even though all videos were sampled from the same source, YouTube, and all sampling contained *physics* or *science* as search word, clear difference in content was observed. These differences are obviously related to the choice of additional search words.

Male dominated and traditional lectures

For the first investigation, conducted with the search word *physics* plus one of four physics areas, most of the videos featured men presenting physics in a studio setting. When *live lecture* was added to the search, in 52 out of 60 video clips or 87%, physics was presented in the form of a lecture for an audience present, or watching the video.

The target groups for the videos were upper secondary school, college, and the introductory level at university. This conclusion was drawn from the content of the lectures and the ages of the students in the live lectures and gives a rather narrow age span for the expected viewers. Of course, the selected search words could have contributed to this effect, since the selected search words represent different areas in physics that are presented and elaborated at this level of education in most school systems.

Physics as a subject was presented very traditionally in the videos. They displayed how physics is commonly taught throughout the world namely, as a presentation on a board, or as a collection of concepts and laws. The live lectures presented physics as an indoor, basically theoretical experience for the students even when demonstrations and some real-life examples were included. The fact that the video content showed reproductions of how physics is generally taught indicates that this educational tradition has not altered with the introduction of new technology.

In the present study, it is also once again demonstrated that physics is a male domain with only a few women involved in the presentations. The videos with female lecturers all came from the same organisation and it can be assumed that there was a conscious choice of gender for those presentations. If some producers showed awareness and could make such decisions regarding gender, it was surprising that no example was found where physics concepts and ideas were presented and demonstrated in more innovative ways when using video as media. It is easy to move outdoors and present physics in real life contexts.

Even when viewer comments were positive or even very positive, it must be remembered that these comments were probably posted by viewers who had found what they were looking for, that is explanations and presentations of unsolved questions regarding physics concepts. One can assume that the viewers posting positive comments were students who had been struggling with the understanding of concepts and physical models. Because attending classes in school had not helped these students to grasp the content, do the homework, complete the assignment, and perform well on tests and examinations, they considered YouTube for assistance.

Alternative views and uses

A contrast to this positive picture of traditional physics teaching is given by Slisko and Dykstra Jr. (2011) who reported on a YouTube clip illustrating a practical solution for a textbook problem that was supposed to be fun. The video, however, showed how bizarre the problem was and it had had nearly a half a million views by 2013 with comments such as: “I knew there was a reason why I hated physics!!!” and “LOL wonderful! God, I hate physics.” These could actually be the same, or similar, students who made positive comments on the YouTube clips selected for this study and who described their frustrations in the physics classroom. The attitude is also manifest as a more general attitude towards science studies (Osborne, Simon, & Collins, 2003), and presumably related to a low interest in studying science. This observation is especially valid for women in European countries and Japan (Sjøberg & Schreiner, 2010).

A partial explanation for the attitude that physics is frustrating, not connected to the real world, and only a profession for men is in line with what was evident in the first part of this study—the reported male

dominance among the lecturers, indicating that physics is not a subject or career option including or involving women. This is also in line with earlier findings (Benckert & Staberg, 2001; Staberg, 1994; Tobias, 1990). For the learner who has to enter a new community of practice, two processes start. One process is acquisition of knowledge, and the other is participation in the knowledge community (Sfard, 1998). If the community more, or less, consciously presents the knowledge that must be acquired to participate in the community as intellectually complicated and hard to grasp, and if the community is both competitive and dominated by one gender the way physics is, there could be a reluctance to participate in the community, especially from women (Carlone, 2004).

Therefore, it is regrettable that no more innovative material was found among the studied videos. Using the YouTube site, there is the potential to produce and present physics in real-life contexts with both genders as participators on equal terms. Berk (2009) has presented a list of 20 possible learning outcomes of using videos for teaching. If this list can be viewed as criteria for using and selecting videos for teaching, it can also be regarded as a list of objectives when producing a video. These objectives could be to catch the viewer's attention, generate interest, foster creativity, provide inspiration and motivation, and make learning fun. With such an agenda for producing videos or searching for YouTube clips to use in science class, a change in attitudes from physics as a subject only for a few and not connected to everyday life, could start.

YouTube could also be a resource for other activities in line with Berk's (2009) list of learning outcomes. Jones and Cuthrell (2011) suggest reference videos in connection with elementary instructions and as springboards for classroom activities. To find appropriate videos as resources within the subject of physics, it is obvious that search words other than those used in this investigation have to be used.

The example from Slisko and Dykstra Jr. (2011) also demonstrates the possibility of using YouTube for evaluation. For example, as teacher you can let the students post comments on the YouTube site for videos used in teaching.

In other examples it has been demonstrated how to use easily accessible YouTube videos for computer-based laboratory work (Riendeau, 2010b; Ruiz, 2009). Here one can select materials actively and reject the traditional and male dominated views of physics.

Active students

A more untraditional picture of physics was evident when considering the second investigation, physics projects. The physics presented here was also related to what is usually taught in upper secondary school and at college level in terms of content, as in the first investigation. But they featured active students showing the results of projects and demonstrations. There are also female students participating. Even if these were a result of mandatory courses for both genders, they demonstrated willingness among all students to upload their videos. It is plausible that the students were instructed by their teachers to do these video recordings as a part of assignments in a course and then to upload the clips. It could even be so that the teacher watched the clips as part of the assessment of the students.

Videos of this kind could be used to inspire pupils and students before starting a project. In addition, they could provide ideas for possible projects, as well as ideas for how to realize them and how to present them. The students would not necessarily be expected to copy what they have seen on YouTube, but they might get an idea of what to do or what to avoid (everything uploaded on YouTube is not good) or just an eye-opener.

Preschool as a market

A not unexpected but still interesting gender shift was obvious when considering the third investigation, science and preschool. In these YouTube clips, women were in clear majority as among preschool teachers. There was also a more apparent commercial purpose to videos in this investigation. Approximately half of the videos were advertisements related to science in preschool while the rest showed more regular preschool activities. The result indicated the existence of a market for presenting and selling teaching material for doing science in preschool. Therefore, a shift from knowledge and competence sharing through YouTube to a market using YouTube was observed. This market contained products to help preschool teachers compensate for a lack in competence, with ready-made solutions. An extension of the teaching of these subjects appeared to be needed. It also promoted services to a target audience of education officers. A result is that these YouTube videos unintentionally send a signal to preschool teacher educators, that it might be a good idea to revise the curriculum regarding the science and technology content.

Conclusions

When searching on YouTube with traditional physical concepts as search words, a traditional picture of physics teaching for upper secondary school and college and also for science in preschool is obtained. This is not, perhaps, such a surprising finding but still a bit disappointing. Even though movies and videos have been around for years and the Internet has helped introduce new social media, the use of these as pedagogical tools has not meant a change in the teaching of physics as displayed in the reviewed videos. The lectures found on YouTube were of a good pedagogical standard and appreciated by the viewers but videos on YouTube could also lead to a change in teaching. With a sensible choice of videos, or by producing their own videos, teachers could probably help diminish the view of physics as a dull and uninteresting subject and hopefully influence the gender identity of the subject to not to be so male dominated in the future.

Videos could also be used by teachers in many ways. For example, a search on YouTube with the phrase, *physics lesson planning* gives several interesting results. There is also the possibility that teachers use YouTube as suggested by, for example, Berk (2009) and Jones and Cuthrell (2011) as a pedagogical element in teaching. To find out if this is happening, a more extended investigation must be conducted, with visits to classrooms or interviews with teachers.

For displaying student work and for active use in teaching, YouTube offers various possibilities for the prepared and interested teacher. The second investigation demonstrated that if students themselves produced material, multiple skills were involved such as physics knowledge, planning and conducting projects, working in teams, and technical control in making and uploading the videos. No gender barrier appeared to affect this.

For preschool, perhaps what is needed is not more videos for young children but instead, inspiration and knowledge for preschool teachers which may motivate them to include science in daily activities for the children. For this purpose channels such as YouTube, with more genuine uploaded clips, could be an inspirational source. It is apparent that knowledge of good science teaching and practices involving YouTube exists among teachers even if it is not widespread. This also provides the potential for teachers to reclaim the arena of teaching science that now, unfortunately, is increasingly dominated by the market.

References

- Benckert, S., & Staberg, E. (2001). Women in science: Can they be disturbing elements? *NORA*, 9(3), 162–171.

- Berk, R. A. (2009). Multimedia teaching with video clips: TV, movies, YouTube, and mtvU in the college classroom. *International Journal of Technology in Teaching and Learning*, 5(1), 1–21.
- Carlone, H. B. (2004). The cultural production of science in reform-based physics: Girls' access, participation, and resistance. *Journal of Research in Science Teaching*, 41(4), 392–414.
- Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago: Adline.
- Godden, D. R., & Babbeley, A. D. (1975). Context-dependent memory in two natural environments: On land and underwater. *British Journal of Psychology*, 66(3), 325–331.
- Gustafsson, P. (2012, October/November). *YouTube as an educational tool in physics teaching*. Paper presented at the IOSTE XV International symposium on Science & Technology Education for Development, Citizenship and Social Justice, Hammamet, Tunisia.,
- Haase, D. G. (2009). The YouTube makeup class. *The Physics Teacher*, 47, 272–273.
- Jones, T., & Cuthrell, K. (2011). YouTube: Educational potentials and pitfalls. *Computers in the Schools*, 28, 75–85.
- McCullough, L. (2011, July). *Gender differences in student responses top physics conceptual questions based on question context*. Paper presented at the ASQ Advancing the STEM Agenda in Education, the Workplace, and Society Conference at the University of Wisconsin–Stout, Menomonie Wisconsin.
- Osborne, J., Simon, S., & Collins, S. (2003). Attitudes towards science: A review of the literature and its implications. *International Journal of Science Education*, 25(9), 1049–1079.
- Park, J., & Lee, L. (2004). Analysing cognitive or non-cognitive factors involved in the process of physics problem-solving in an everyday context. *International Journal of Science Education*, 26(13), 1577–1595.
- Rennie, L., & Parker, L. (1993). Assessment in physics: Further exploration of the implications of item context. *The Australian Science Teachers Journal*, 39(4), 28–32.
- Rennie, L., & Parker, L. (1996). Placing physics problems in real-life context: Students' reactions and performance. *The Australian Science Teachers Journal*, 42(1), 55–59.
- Rennie, L., & Parker, L. (1998). Equitable measurement of achievement in physics: High school students' responses to assessment tasks in different formats and contexts. *Journal of Women and Minorities in Science and Engineering*, 4(2), 113–127.
- Riendeau, D. (2010a). YouTube physics. *The Physics Teacher*, 48, 489.
- Riendeau, D. (2010b). YouTube physics. *The Physics Teacher*, 48, 268.
- Riendeau, D. (2011). YouTube physics. *The Physics Teacher*, 49, 186.
- Rube Goldberg. (n.d.). Retrieved January 2, 2013 from <http://www.rubegoldberg.com/home>
- Ruiz, M. J. (2009). Kinematic measurements from YouTube videos. *The Physics Teacher*, 47, 200–203.
- Sfard, A. (1998). On two metaphors for learning and the dangers of choosing just one. *Educational Research*, 27(2), 4–13.
- Siemens, G. (2005). Connectivism: A learning theory for the digital age. *International Journal of Instructional Technology & Distance Learning*, 2(1), 3–11.
- Sjøberg, S. (2012, October/November). *The PISA project: "Mission impossible"? The politics, the unrealistic ambitions and the intriguing results*. Paper presented at the IOSTE XV International symposium on Science & Technology Education for Development, Citizenship and Social Justice, Hammamet, Tunisia.
- Sjøberg, S., & Schreiner, C. (2010). *The ROSE project. An overview and key findings*. Oslo: University of Oslo.

- Slisko, J., & Dykstra Jr., D. (2011). Unfortunate outcomes of a “funny” physics problem: Some eye-opening YouTube comments. *The Physics Teacher*, 49(2), 72.
- Spradley, J. P. (1980). *Participant observation*. Belmont, CA: Wadsworth-Thomson Learning.
- Staberg, E. (1994). Gender and science in the Swedish compulsory school. *Gender & Education*, 6(1), 35.
- Tobias, S. (1990). *They're not dumb, they're different: Stalking the second tier*. Tucson, Arizona: Research Coperation.
- Walsham, G. (2006). Doing interpretive research. *European Journal of Information Systems*, 15, 320–330.
- Whitelegg, E., & Parry, M. (1999). Real-life contexts for learning physics: Meanings, issues and practice. *Physics Education*, 34(2), 68.

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REPORT

Annual ASCILITE Conference, 2012

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The Australasian Society for Computers in Learning in Tertiary Education (ASCILITE) hosted its annual conference in Wellington, New Zealand, at the Te Papa Tongarewa National Museum (25–28 November, 2012). This society was formed in 1985 and, with its focus on the application of technology to enhance teaching and learning in higher education, continues to attract a professional community of innovators, leaders, and scholars. The following is quoted directly from their website (<http://www.ascilite.org.au/>) in order to provide an overview of the organization:

The strategic aim of ASCILITE is to be a sustainable and vibrant society that encourages and supports quality research into, and exemplary use of technologies for teaching and learning in tertiary education throughout Australasia. This strategic aim is realised through ASCILITE initiatives including:

- Annual conference. Delegates attend workshops, peer reviewed paper presentations and poster sessions. The conference is also a time for members to network and socialise.
- Community Mentoring Programme. Individuals seeking to develop an area of expertise are matched with an experienced mentor. Over the course of a year the mentor and mentee work together to realise mutually agreed goals.
- ASCILITE awards. ASCILITE recognises the outstanding contributions of members to the exemplary use of technologies for teaching and learning in tertiary education.
- Community of Practice. ASCILITE provides a community hub for members. The community hub is the portal for community engagement.
- ASCILITE Representatives. ASCILITE Reps are self-appointed ASCILITE members who actively promote ASCILITE aims and objectives within and across institutions.
- Fortnightly Bulletin. The fortnightly bulletin provides information and updates about the activities and initiatives of the society. It is also a forum for members to share information and opinions and find out about technology related positions vacant in tertiary institutions globally.
- Professional Development. Services to members include webinars and regional events focused on topical elearning issues.
- Professional Accreditation. CMALT Australasia is a professional accreditation scheme offered in partnership with the Association for Learning Technology (ALT). It enables people whose work involves learning technology to have their experience and capabilities certified by peers, and demonstrate that they are taking a committed approach to their professional development.

Educational Research for Social Change, April 2013, 2 (1)

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- Australasian Journal of Educational Technology (AJET). AJET is published by ASCILITE. AJET is a refereed academic journal publishing research and review articles in educational technology, information and communications technologies for education, online and e-learning, educational design, multimedia, computer assisted learning, and related areas.

The focus of ASCILITE 2012 was education, which is currently facing a tremendous amount of challenges on various fronts. Technology is developing at a rapid pace, and questions that require serious thinking relate to the impact of technology on teaching and learning, and to the sustainability of current tertiary models. Consequently, the sub-themes of the conference were:

- Learning for the future
- Teachers as future-makers
- Leading in a climate of change.

The conference provided food for thought through the three keynote addresses as well as from the conference presentations. The first keynote speaker, Neil Selwyn from Monash University in Australia, stated at the outset that he wanted to create uneasiness among the attendees because he wanted them to question their assumptions about technology. His presentation, “The Future is New? The Future is Now!” focused on our so-called hype and hope for educational technology to solve educational problems as well as on our quests to find the “new”. He cautioned the audience against several promises that technology may offer—for example, change in the social, political, and economic realms. The problem, according to Selwyn, is that we continue to hope for a better future because the argument is that although technology is not working well now to serve our needs, it will in the future. However, he argues that the future is “now” and that we have to move away from the “what if” questions. The future cannot be predicted and technology may well provide future opportunities, but we are not harnessing its possibilities right now. We need to tell the stories of how technology benefits learning now; not how it will be assisting with learning in the future. We should be focusing on what is possible with technology now, and at the same time be trying to do things differently with technology—not using technology just to do old things differently or in better ways. More about Neil Selwyn and his research and writings can be perused here: <http://newmediaresearch.educ.monash.edu.au/lnmrg/selwyn>

Dale Stephens, founder of the UnCollege, was even more contentious and asked whether technology development does not entail, as the title of his address asserted, “The End of the University”. According to him, technology has opened new doors for people, allowing us to become much more responsible for our own learning. Stephens is an USA-born entrepreneur, speaker, and author who received a Thiel Fellowship which provides \$100,000 grants for fellows to pursue their goals and passion for two years before attending college (university). He gave an overview of his unschooled experiences (not home schooling) and how he had been disappointed when he attended college. Stephens argued that college costs students a fortune and asked whether it really offers a better life to those who complete their studies. His new book, *Hacking your education: Ditch the lectures, save tens of thousands, and learn more than your peers ever will*, makes the case that a large number of people have been successful without attending tertiary institutions. He also asked why one would attend an expensive university if one could, in fact, enroll for an online degree from a university for free. Read more about Dale Stephens and UnCollege here: <http://www.uncollege.org/team/>

The third and final keynote address, “An Unexpected Journey: Changing Hearts and Minds in the Cloud”, was by Beverley Oliver. Oliver asked several questions that not only universities, but schools too, should reflect upon for example, how we organize and “present” learning as well as assessment. She also seemed

to be hinting at whether there is a mismatch between what the university requires from students and the real world workplace. She also made the point that education should foster change on all spheres and that we have a social responsibility to prepare graduates for a continually changing world. Beverley Oliver's personal website, <http://boliver.ning.com/page/recent-publications-oliver>, provides various interesting articles on assessment and the future graduate. One has to join her network in order to access these articles.

Another highlight of the conference was the Massive Open Online Course (MOOC) debate entitled, "The Great Debate: That MOOCs are a real game changer which seriously challenges traditional models of Tertiary Education". Evidently, the proponents of MOOCs lost the debate to a locally hosted team who argued against the case.

A wide range of papers regarding technology and learning were presented, and they are all available online here:

http://www.ascilite.org.au/conferences/wellington12/2012/images/custom/asclite2012_proceedings.pdf

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BOOK REVIEW

Your guide to case study research

by Peter Rule and Vaughn John, Pretoria: Van Schaik, 2011. 144 pp.

ISBN: 978 0 627 02789 5 paperback

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Case study research is a popular research approach in social science inquiry (Yin, 2012). Given its popularity, one would expect a plethora of methodologically specific scholarly works to have been produced around case study research. However, this seems not to be the case. Yin (2012, p. xix–xx) declares:

Despite its widespread use, case study research has received perhaps the least attention and guidance among nearly all social science research methods. The methodological literature covers the topic in little depth. . . .

Moreover, the most common textbooks on social methods in general, and on evaluation research methods in particular, still give only secondary attention to the case study method.

In the light of Yin's comments, Rule and John's (2011) book should be seen as a welcome contribution to the corpus of literature on case study research. As a methodological approach, case study research has broad applicability (see Yin, 2004). Given this, it has the potential to contribute to social change. Cohen, Manion, and Morrison (2011, p. 292) explain:

Case studies are 'a step to action'. They begin in a world of action and contribute to it. Their insights may be directly interpreted and put to use; for staff or individual self-development, for within-institutional feedback; for formative evaluation; and in educational policy making.

Throughout their book, Rule and John demonstrate how case studies can contribute to social change either as a stand-alone approach or in combination with other approaches.

The book itself goes beyond a readership with just an academic interest in case studies to those who want to apply it as a research approach. The title of the book suggests that it is a *guide*. A guide is a "book with essential information on a subject" (Concise Oxford Dictionary of Current English, 1990). This is exactly what the book contains—indispensable knowledge and skills on case study research. There is a wealth of information on case selection, generating case data, interpreting the case, theorising the case, quality processes in case study research, and organising and presenting the case. The book does not require readers to possess in-depth knowledge about research in order to engage with it. Rather, it is a step-by-step guide which allows its users to navigate through the process of conceptualising, designing and executing case study research. I therefore consider this concise, but very comprehensive book, written in

very simple language, to be a valuable resource for postgraduate students and researchers embarking on case study research.

From my experience as a South African researcher, supervisor, and examiner of postgraduate work, the dearth of local literature on case study research has meant that local students and researchers have had to rely on works produced outside the continent of Africa. This gap in the local market was seized by the authors and formed the rationale for their publication. They contend that “there have been some excellent case studies researched and written in the South African context”, however, “there are no local specialist texts that focus specifically on how to do case study” (p. vi). Hence, this book which takes into account South African researchers and their contexts in particular, and African contexts in general.

The book itself is very user friendly and presented in way that takes the reader through “the process of case study research, from its inception to its conclusion” (p. viii). It comprises 10 chapters. Chapters 1 to 4 deal with the groundwork for case study research and engage with issues such as understanding the case, identifying and selecting the case, questioning the case, and situating the case. In these chapters, the terminology associated with case study research is unpacked; the compatibility of case study research with other research approaches is presented together with an incisive account of how key research questions, field questions, and self-reflection questions cohere in conceptualising case study research. The importance of context in case study research is addressed here too.

Chapters 5 and 6 deal with generating data and analysing data respectively. In addition to some conventional methods of producing data in case study research such as interviews, storytelling, observation, and document analysis, the authors present some innovative participatory methods such as transect walks, mapping, drawings, and photo-voice as methods of data generation in case study research. Several methods of data analysis are presented and supported by relevant examples. Chapter 7 interrogates the relationship between theory and case study and aptly demonstrates how the two “speak” to each other, and Chapter 8 focuses on issues of quality in case study research by drawing attention to, *inter alia*, issues of trustworthiness. Chapter 9, centres on writing up case study research and examines some creative ways of organising and presenting case studies. Chapter 10, the last chapter, examines the concluding of a case study as well as its opportunities for reflection and application.

In all the chapters, numerous examples and exemplars (drawn largely from South Africa and the African continent) are furnished to facilitate understanding. They are presented in a manner that has the potential to provide students and researchers with ideas so that they may be better able to employ case study research techniques and principles in their own research. Furthermore, throughout the book, there are thought-provoking activities and self-reflective questions for the reader to engage with. This helps readers to focus on, and synthesise, the key units of information within the chapter.

A similar publication to Rule and John’s titled *How to do your case study. A guide for students and researchers* (Thomas, 2011), was published in the same year. There seems to be much similarity in the two books in terms of the content covered. This notwithstanding, I am of the opinion that Rule and John’s work complements the work of Thomas by drawing on rich South African and African examples and cases. This said, Rule and John’s book could have been enriched by providing references for further reading at the end of each chapter, as Thomas does, for students and researchers to consult should they want to extend their knowledge on particular aspects of case study research.

In order to determine how user-friendly the book is I asked a colleague, Siphwe Mthiyane who supervises postgraduate students involved in case study research and who himself is engaged in case study research

for his PhD, for his candid views on the book. Many of Sipiwe's comments corroborate my views of the book. He indicated:

This book is a welcome addition to what has been written on Case Study research in this country. As a budding academic and PhD student myself, I find it very useful for ease of reference for both my postgraduate students and myself. The language used is easy to read and understand. It draws on examples from the South African context, is lucid, to the point and very appropriate for both novice and experienced researchers. Further, it provides a fresh, up-to-date step-by step guide to doing case study research. If you are involved in research, either as a student or as an academic, this is one of the 'must-have' research methods books in your collection/library.

Overall, the book is well conceived and the authors have managed to use their expertise in case study research to good effect. I have no doubt that this book will be widely used by both students and researchers to craft their case studies.

References

- Cohen, L., Manion, L., & Morrison, K. (2011). *Research methods in education* (7th ed.). London: Routledge.
- Guide. (1990). In H. W. Fowler, F. G. Fowler, & R. E. Allen (Eds.), *The Concise Oxford Dictionary of Current English* (8th ed.). Oxford: Clarendon Press.
- Thomas, G. (2011). *How to do your case study: A guide for students and researchers*. London: SAGE.
- Yin, R. K. (2004). *The case study anthology*. Thousand Oaks, CA: SAGE.
- Yin, R. K. (2012). *Applications of case study research*. Thousand Oaks, CA: SAGE.