New technologies, new pedagogies: Mobile learning in higher education

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Preface

While mobile technologies such as mobile phones, personal digital assistants (PDAs) and digital music players (mp3 players) have permeated popular culture, they have not found widespread acceptance as pedagogical tools in higher education.

The purpose of this e-book is to explore the use of mobile devices in learning in higher education, and to provide examples of good pedagogy. We are sure that the rich variety of examples of mobile learning found in this book will provide the reader with the inspiration to teach their own subjects and courses in ways that employ mobile devices in authentic and creative ways. This book is made up of a collection of double blind peer-reviewed chapters written by participants in the project *New technologies, new pedagogies: Using mobile technologies to develop new ways of teaching and learning*.

The book begins with an introductory chapter that describes the overall project, its aims and methods. The second chapter describes the professional development process that was used for the teacher-participants involved in the project. This is followed by 10 chapters, each describing a mobile learning pedagogy that was employed in the context of a subject area within a Faculty of Education. The final chapter presents guidelines or design principles for the use of mobile learning in higher education learning environments.

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CHAPTER 1

Using mobile technologies to develop new ways of teaching and learning

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Abstract:
The chapters of this e-book comprise the pedagogical and research endeavours of a team of academics in higher education who worked with mobile learning devices over two years on a project entitled New Technologies: New Pedagogies project: Using mobile technologies to develop new ways of teaching and learning. The project endeavoured to take an innovative approach not only in the creation of new, authentic pedagogies for mobile devices but also in the action learning approach adopted for the professional development of participants. The project involved 15 people including teachers, IT and PD personnel. It was a large and ambitious project that resulted not only in a range of innovative pedagogies, but in the creation of more knowledgeable and confident users of mobile technologies among teachers and students.

The pedagogical uses of mobile technologies

The use of mobile devices—such as mobile phones and mp3 players—has grown to such an extent over recent years that they now overtake the proliferation of personal computers in modern professional and social contexts (Attewell, 2005). The ready availability and uptake of these devices has permeated the means of human communication, socializing and entertainment to such an extent that is it rare to find a person in western society who does not own at least one such device. However, it appears that little use has been made of these convenient tools in learning contexts, and that there is little theoretical foundation to the learning environments that do use them. While the so-called 'early adopters' are willing to use new technologies for pedagogical purposes, it is not yet clear that there are sound theoretical reasons for the use of mobile devices in learning.

In this project, we endeavoured to demonstrate that the advances in philosophical and practical developments in education have created justifiable conditions for the pedagogical use of mobile technologies based on authentic learning.

m-Learning in education

In general, mobile learning—or *m-learning*—can be viewed as any form of learning that happens when mediated through a mobile device, and a form of learning that has established the legitimacy of 'nomadic' learners (Alexander, 2004). While it has been described as 'an emergent paradigm in a state of intense development' (O'Malley, Vavoula, Glew, Taylor, Sharples, & Lefrere, 2005) few universities have adopted widespread m-learning technologies, and in those that have, it is not clear that they are being used in pedagogically appropriate ways. Many research studies and projects have examined mobile learning from an identified theoretical perspective (cf. O'Malley, et al., 2005; Naismith, Lonsdale, Vavoula, & Sharples, 2004; BECTA, 2006; Thornton & Houser, 2004; Wood, 2004; Cortez, et al., 2004; Chesterman, nd; Rogers et al. 2002; Proctor & Burton, 2003; Perry, 2003). For example, teachers in higher education in the

UK have made use of SMS (short messaging service) as prompts for course requirements, polling classes and pop quizzes with some universities experimenting with phone exams where the user's voice print identifies them as the test taker (NMC and Educause, 2006). There is evidence that some young people resent this 'usurping' of their favoured technologies for such prosaic and teacher-centred activities (Geser, 2004). Kim, Mims, and Holmes (2006) reviewed the way universities use personal digital assistants (PDAs), and found that storage and retrieval of information such as e-books, courseware, and timetables are the general uses. Similarly, digital audio players such as Apple's iPod have primarily been used in higher education to 'deliver' lectures that are recorded and subsequently podcast as RSS feeds to students' computers to be downloaded to iPods (Belanger, 2005). This transmission of information is a common feature of many research findings, where the teacher creates the content and the students receive it (for example, McCombs & Liu, 2006; Pownell, 2006; Scott, Nishimura & Kato, 2006; Miller & Piller, 2005).

A framework for classifying educational uses of mobile technologies provided by Patten, Arnedillo Sanchez and Tangney (2005) suggest that the uses indicated above relate mainly to *administration* functions such as calendaring and timetabling; *reference* functions such as e-books and dictionaries; and *interactive* functions as in response and feedback activities. They argue that the theoretical underpinnings of these activities appear to be either non-existent or principally behaviourist in nature.

Uses of m-learning in education

Despite the significant potential of mobile technologies to be employed as powerful learning tools in higher education, their current use appears to be predominantly within a didactic, teacher-centred paradigm, rather than a more constructivist environment. It can be argued that the current use of mobile devices in higher education (essentially content delivery) is pedagogically conservative and regressive. Their adoption is following a typical pattern where educators revert to old pedagogies as they come to terms with the capabilities of new technologies, referred to by Mioduser, Nachmias, Oren and Lahav (1999) as 'one step forward for the technology, two steps back for the pedagogy' (p. 758). Adopting more recent theories of learning has the potential to exploit the affordances of the technologies in more valuable ways. Patten, Arnedillo, Sanchez and Tangney (2005) argue that the benefits of mobile learning can be gained, through collaborative, contextual, constructionist and constructivist learning environments. This is supported by Switzer and Csapo's (2005) observation that mobile technologies afford learners opportunities for collaboration in the creation of products and for sharing them among their peers. Authentic learning environments in higher education typically involve these characteristics (Herrington & Herrington, 2006).

This project moved beyond established approaches to create new pedagogies for mobile technologies that promoted their use—not for simple one to one communication or delivery of information—but to focus on their use as cognitive tools in authentic learning environments. While the project itself focussed on only two

specialised mobile technologies, the methods developed for the professional development workshops are applicable not only to other new and emerging technologies, but to a range of other contexts requiring a self-reliant, action-learning approach. The action-learning nature of the professional development lends itself to the ready adaptation, implementation and embedding of the approach in a range of different educational contexts.

This chapter presents the aims and scope of the *New Technologies, New Pedagogies* project, together with a description of the design and implementation of the professional development and the individual pedagogies developed. Resulting pedagogies and professional development activities are described in the chapters of this e-book.

Although general guidelines on the use of technology have been delineated by MCEETYA (2005), currently no specific and cohesive national policy on the use of mobile technologies in learning exists in Australia. Ideas such as those presented in the chapters of the e-book, will be ideally positioned to inform such policy.

Project aims and scope

The aim of the project was to develop innovative pedagogies using mobile technologies, to enhance teaching and learning in higher education.

The project set out to investigate the educational potential of three hand-held, ubiquitous mobile devices: mobile phones, personal digital assistants (PDAs) and digital audio players (mp3 players, such as iPods). However, in implementation, only two devices were used: smartphones (Palm Treo 680 mobile phones), and digital audio players (Apple iPods). An action-learning framework for professional development was designed and implemented with teachers from the Faculty of Education at the University of Wollongong. Action-learning is defined as an educational process whereby the participants study their own actions and experience in order to improve their performance. This is done in conjunction with others, in small groups called action-learning sets (Revans, 1982). Thus, each teacher explored and invented pedagogies that made appropriate use of a mobile device for a different subject area.

To avoid a technology-driven pedagogy the project investigated ways of designing and implementing teaching in authentic contexts that would enhance student learning with understanding. Specifically the project aimed to complete the following:

1. Investigate the potential uses or 'affordances' of two personal mobile devices.
2. Engage teachers from a Faculty of Education using an action-learning professional development framework to explore and invent pedagogies appropriate to the use of a mobile device in completing a complex task within an authentic learning environment.
3. Implement the use of mobile technologies and authentic tasks in learning activities over a period of 4-7 weeks in a range of different subject areas.

4. Describe, categorise and disseminate resultant pedagogies and professional development activities through a dedicated website and a published handbook.
5. Implement the professional development activities for mobile learning across other faculties at the University of Wollongong and disseminate to other universities across Australia and overseas.

Approach and methodology

Theoretical perspectives

The project was guided by two major theoretical frameworks. *Authentic learning* (Herrington & Oliver, 2000; Herrington & Herrington, 2006) provided the basis for the pedagogical activity while *action learning* (Revans, 1982) was adopted as the framework for professional development. Both theories reflect constructivist epistemology emphasising group collaboration in the creation of further knowledge and understandings.

Authentic learning situates students in learning contexts where they encounter activities that involve problems and investigations reflective of those they are likely to face in their real world professional contexts (Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991). Herrington and Oliver (2000) have identified nine characteristics of authentic learning:

*   *authentic contexts* that reflect the way the knowledge will be used in real-life
*   *authentic activities* that are complex, ill-defined problems and investigations
*   *access to expert performances* enabling modelling of processe*s*
*   *multiple roles and perspectives* providing alternative solution pathways
*   *collaboration* allowing for the social construction of knowledge
*   *opportunities for reflection* involving metacognition
*   *opportunities for articulation* to enable tacit knowledge to be made explicit
*   *coaching and scaffolding* by the teacher at critical times
*   *authentic assessment* that reflect the way knowledge is asses in real life.

These characteristics formed the basis for teachers to plan and design learning environments where mobile technologies could be used in their different subject areas and specialisations. However, individual teachers were free to use alternative theoretical perspectives for the design of the pedagogies if appropriate.

Action learning (Revans, 1982) was adopted as a professional development framework to assist in the design of each teacher's learning environment. The approach typically involves a small group of colleagues solving workplace problems utilising their own processes of sharing, reflection and facilitation (e.g., Zuber-Skerritt,

1993), an approach that contrasts with traditional professional development that relies on the transfer of 'outside' expertise.

Project focus questions

The following questions framed the project enquiry:

1. What are the technology affordances of smartphones and iPods for teaching and learning in higher education?
2. What are appropriate strategies for the professional development of higher education teachers in the pedagogical use of m-learning devices?
3. What pedagogical strategies facilitate the use of m-learning devices in authentic learning environments in higher education?
4. What pedagogical principles facilitate the use of m-learning devices in authentic learning environments in higher education?

The project was conducted in four phases over two years, comprising investigation of the devices themselves and their functionality, the design and implementation of action learning professional development sessions for university teachers, the design of 10 pedagogies to be implemented with either the smartphone or the iPod in classes across a range of disciplines in a Faculty of Education, and the evaluation and research of each project together with the creation of design principles applicable to higher education teaching generally.

Project team and communication

The project team comprised four team leaders, and a project manager. A *professional development and IT team* was also created to lead the professional development seminars and support the professional learning of the teachers. This team comprised three advisors with professional development, information and communications technology (ICT) and educational development expertise. Originally 12 teachers or teaching teams committed to the project. With the to-be-expected fluctuations and changes in personnel over semesters (such as changes in teaching loads, promotions, retirements, study leave, etc.), by the end of the project, 10 projects had been implemented.

The leadership team and project manager, together with the professional development and IT experts, met fortnightly in Phases 1 and 2 for planning and monitoring. A reference group, comprising leaders in educational technology throughout the world, was also invited to be available to the project. Communication with the team and project reference group was enhanced with the creation of a bi-monthly bulletin. The bulletin kept team members up to date with the project. It was also an important means of maintaining communication with the reference group, other interested parties within the University of Wollongong and informing the members on the progress of the project.

Conceptual summary of project

A conceptual summary of the entire project is provided in Table 1 below. The table columns show the four phases of the project, and deliverables and evaluation processes for each phase are shown in the last two rows.

Table 1: Summary of project processes and expected outcomes

|	m-learning affordances What are the technology affordances of smartphones, and mp3 players in higher education?	m-learning professional development What are appropriate strategies for the PD of higher ed teachers in the pedagogical use of m-learning devices?	m-learning strategies What pedagogical strategies facilitate the use of m-learning devices in authentic learning environments in higher education?		m-learning principles What pedagogical principles can guide the use of m-learning devices in authentic learning environments in higher education?
	Phase 1	*Phase 2*	*Phase 3*		*Phase 4*
	Year 1		Year 2		Yr 2 & beyond
	Semester 1 (August – Dec 06)	**Semester 2** (Jan – June 07)	**Semester 3** (July – Dec 07)	**Semester 4** (Jan – June 08)	**Sem 3, 4 & beyond** (June 08 on)

Smart phones
 	
 Mp3 (iPods)
	• Investigation of technology affordances through research literature, experts, and location of best practice exemplars in HE
	 • Preliminary planning of workshops
		• Preparation and planning of workshops
		 • Workshops for Faculty teachers on the development of authentic tasks using devices in pedagogically appropriate ways
		 • Trialling of pedagogies
			Individual projects in areas such as:
			  Science education
			  Physical education
			  Visual Arts education
			  Maths education
			  IT in education
			  Multimedia education
			  Web-based learning
			  Literacy education
			  Reflective practice
			  Adult education
					• Final project conference to present findings and discuss model and principles
					 • Finalisation of project website
					 • Publication of edited book
					 • Long-term evaluation

Products from each phase	*Phase 1:* Catalogue of affordances of m-learning technologies	*Phase 2:* Workshop resource (processes and procedures for others to implement)	*Phase 3:* 12 case descriptions and evaluations Website of exemplars and strategy descriptions		*Phase 4:* Final conference Edited book Project report Final public website
Evaluation (Reeves & Hedberg, 2003)	*Review* of literature and existing initiatives	*Formative evaluation* of PD workshops	*Formative evaluation* of learning environments and project website *Effectiveness evaluation* of 12 learning environments		*Effectiveness evaluation* of whole project *Peer review* of chapters by team & reference group

Project research approach and methodologies

The project used a design-based research approach (e.g., Reeves, 2006; van den Akker, 1999; Reeves, Herrington & Oliver, 2005) (also known as *development research* or *design experiments*) that involved four phases conducted over the life of the project (Figure 1).

Figure 1: Design-based research (Reeves, 2006)
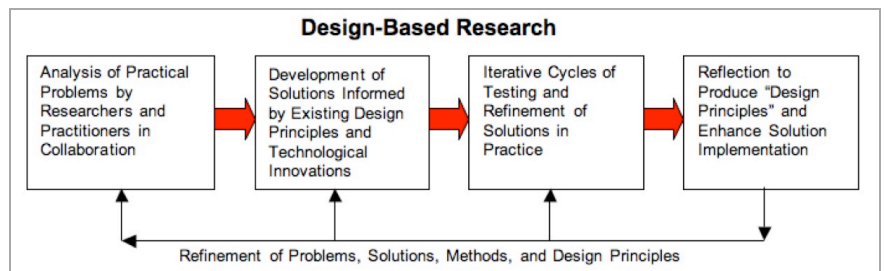
The four phases as they were implemented in the project are described in more detail below.

Phase 1: Analysis of problem by researchers and practitioners (Semester 1)

Phase 1 of the project focused on the exploration of the educational 'affordances' (specific enabling features, cf., Norman, 1988) of mobile devices for teaching and learning in higher education. This phase was conducted over the first six months of the project. A comprehensive review of literature was performed and an EndNote library created. Many electronic resources were collected (in Word or pdf format) and embedded into the EndNote library, and this was updated throughout the life of the project, resulting in a valuable and portable resource for use by team members. This literature review also

encompassed primary and secondary capabilities of each device to explore the obvious uses—and the less well-known functions—that could be employed as cognitive tools in educational contexts.

During this phase of the project sets of smartphones and iPods were purchased for use in the professional development workshops and implementations with students in classes. Other necessary peripherals were also purchased such as memory cards, protective cases, microphones, additional headphones and card readers.

All teachers in the project received an iPod and smartphone to allow for familiarisation and exploration prior to the commencement of the implementations with classes. This allowed them to experiment and familiarise themselves with the devices as they reflected on the needs and abilities of their students. With the devices distributed, seminars and brainstorming sessions were also held to create a catalogue of educational affordances to provide a useful reference on the functions of each device prior to the design of learning activities (this was done before the decision to combine the mobile phone and PDA in the one device, so the affordances for three devices are given). These catalogues are available on the project website (for example Figure 2 shows the catalogue for the iPod).

Figure 2: Web page of iPod features

This work enabled a starting point for teachers in the project to plan pedagogies for the use of the devices, and to link the affordances of the smartphone and the iPod to their subject objectives and tasks.

At the end of Phase 1, the project structures had been put into place (i.e., project management, team meetings, project website), a literature review had been conducted (EndNote library), presentation resources assembled (master slide set) and the educational affordances of the devices had been investigated and reported.

Phase 2: Development of solutions within a theoretical framework (Semester 2)

In Phase 2 the focus of the project moved to professional development of the teachers who would implement the mobile technologies in their classes. The research question that directed these activities was: What are appropriate strategies for the professional development of higher education teachers in the pedagogical use of m-learning devices? This phase occupied the second semester of the project.

Initial planning of the professional development was undertaken by the PD and IT team in consultation with the project leaders and project manager. The PD used an action-learning approach rather than a fully pre-planned scope and sequence of activities. Action learning is described by Revans (1982) as an inquiry-based approach for professional learning that focuses on the personal concerns or interests of the participants (see also, Hoban, 2004; Hoban & Herrington, 2005).

The PD framework generally took the form of regular action learning meetings where project members, IT and PD personnel worked collaboratively, reflecting and sharing ideas and experiences on a regular basis in order to find new ways to use mobile technologies for teaching (McGill & Beaty, 2001; Zuber-Skerritt, 1993). The focus of the first two workshops was to discuss the theoretical framework within which the project was situated and to investigate the affordances of both devices and their potential when incorporating them into learning and teaching experiences. The third workshop included hands-on activities with the devices and brainstorming in educational contexts, and the fourth workshop focussed on planning and reviewing specific activities to be conducted in the implementations in the various classes in Phase 3 of the project.

The workshops represented a 'group learning process' in which teaching ideas were discussed, and refined through all phases in an ongoing cyclical process. The workshop sessions drew on the expertise of those within the group. Recognition was made through the structure of the workshops of those with a range of areas of expertise (such as pedagogy or technology), where discussion allowed for the development of shared understandings and goals. In this way, the workshop model is one that any university or institution could readily adapt because it uses existing human and other resources to implement a self-sufficient, Faculty- or Department-wide solution to a problem rather than draw on outside experts to advise on 'correct' procedures. Such a process is beneficial beyond the financial saving of using expertise from within; it allows for acknowledgement of the expertise within the group, building stronger ties between members of that community. The teachers retained the mobile devices throughout the professional development workshop sessions, bringing them to each session to develop their skills in using the devices as well as to discuss their potential for teaching.

Each teacher used one or both mobile devices in depth, to explore the full range of affordances, and worked within the workshop environment to plan an authentic learning environment that comprised 4-7 weeks (about a third of a semester). Planning of a complex task, resources, supports, and integrated assessment items were included in

this process (Oliver & Herrington, 2001). Templates and examples were provided to support teachers' planning of activities and pedagogies in the workshops. These came from literature identified through the literature review, tools designed by different experts within the community and those created collaboratively as part of previous professional development workshops.

At all times, teachers were aware of the common goal of identifying innovative uses of the devices as cognitive tools rather than for simple recording of data, one way transmission of information (such as podcasting of lectures), or communication from one site to another. The teachers used the professional development workshops to share their tasks and the underpinning theory with a range of colleagues whilst they planned their procedures for evaluating the learning environment when the activities were implemented in Phase 3.

By the end of Phase 2, the teachers had designed learning environments ready to be implemented, each comprising: an authentic task, a range of resources, appropriate supports and integrated assessment strategies.

Phase 3: Evaluation and testing of solutions in practice (Semesters 3 and 4)

During Phase 3, the learning tasks were implemented and evaluated with students in classes conducted over two semesters. The focus of the project moved to the third research question: What pedagogical strategies facilitate the use of m-learning devices in authentic learning environments in higher education?

The teachers were thoroughly familiar with the devices by the time they were implemented in their classes. One set (25) of each device was used in this phase to ensure specific affordances were available to students as they completed a task. Each device was implemented four times (2 times x 2 semesters with a handover week mid semester), and each implementation tested a different pedagogical strategy with a different teacher and discipline area. Students were issued with an appropriate device on loan to use individually or in groups, as they completed the given or negotiated task. Students used the selected mobile device for a period of 4-7 weeks to engage with the tasks set and submit the assessment task.

Each case was evaluated using an approach or methodology that had been planned in Phase 2 as part of the workshops. The pedagogies that were implemented in Phase 3 are listed below:

Pedagogies with iPods

Using a games-centred approach to enhance student learning
Teacher: Greg Forrest
Target group: Second and third year Physical Education and Health (PEH) preservice teachers
Task: iPods were used by pre-service physical education and health teachers to enhance their understanding of questioning methods, the development of dialogue and the pedagogical use of Game Centred Approaches in physical education lessons.

Taking iPods into the field to create 'teacher wisdom stories'
Teachers: Lisa Kervin and Jessica Mantei
Target group: Fourth year primary pre-service teachers
Task: Students used iPods to create a collective of wisdom stories from experienced teachers that was made available to their peers as audio files.

Art on the move
Teacher: Ian Brown
Target group: Fourth year primary pre-service teachers
Task: Students used a public art gallery as a resource for interactive visual arts learning experiences. The students created presentations on their findings that were presented and submitted on the iPods as podcasts.

Using iPods to capture professional dialogue
Teachers: Jessica Mantei and Lisa Kervin
Target group: Fourth year primary pre-service teachers
Task: Students used iPods to capture professional dialogue for reflection on emerging professional identity. Emerging understandings and learning were reflected on to explore teacher identity and the development of professional identity through the coming together of theory and practice.

Digital story books
Teachers: Jan Herrington, Ian Olney and Irina Verenikina
Target group: First year early childhood preservice teachers
Task: Students in groups created digital story books for young children, using sound and images to author stories with elements that appeal to very young children. Students created their stories using PowerPoint and then published them to iPods as podcasts.

Pedagogies with smartphones

Energy management in environmental education
Teacher: Brian Ferry
Target group: Third year pre-service primary teachers
Task: Using the features of mobile phones, students prepared, implemented and evaluated a unit of work that supported the waste, water and energy management programs of classes in five host schools.

Mathematics (or Science) is everywhere
Teacher: Gwyn Brickell
Target group: First year preservice secondary school teachers
Task: Students worked with a partner to explore the different ways that presentation software can be used in classrooms, and prepare a presentation to share with the class. Using the smartphone, students prepared a presentation for beginning teachers on the theme: mathematics and/or science is everywhere.

Curriculum resources in adult learning
Teacher: Anthony Herrington
Target group: Postgraduate adult education students
Task: Using a constructivist perspective, students designed a resource for teachers/trainers that exploits the affordances of mobile technologies.

Teacher professional development and the use of smartphones in the analysis of K-6 numeracy concepts and pedagogies
> **Teacher:** Mohan Chinnappan
> **Target group:** Second year primary pre-service teachers
> **Task**: Students investigated the use of smartphones to facilitate interactions and reflections about K-6 mathematics concepts and the teaching of these concepts in the classroom.

Slowmation in science education
> **Teacher:** Garry Hoban
> **Target group:** Undergraduate science education students
> **Task**: Students used the multimedia capabilities of the smartphone to create slowmation videos for primary aged children in order to develop understanding of scientific concepts.

Teaching episodes
> **Teacher:** Anthony Herrington
> **Target group:** Postgraduate adult education students
> **Task**: Adult educators used smartphones to create a digital story for use as a teaching resource.

Evaluation of individual projects

On implementation, teachers used data collection methods such as focus group interviews, observations, video recordings, individual interviews, journals, weekly logs, reflective essays, student blogs, content analysis of artefacts, and so on, to investigate the nature and effects of the pedagogical strategies they had created. Ethical approval was sought and approved not only for the entire project, but also for each individual project. During these implementations, professional development—both as formal sessions and informal 'just in time' support—continued on a regular as-needed basis. A writing workshop for the team further enriched the teachers' analyses of their cases. At the workshop, the Endnote library was disseminated to the group to support their literature review for reporting on their findings. The teachers also created for each project a description of the pedagogy, to be uploaded to the project website. Figure 3 provides an example of one of the pedagogies on the website.

Figure 3: Example pedagogy on the project website

At the end of this phase, teachers had implemented the learning tasks (with appropriate resources, supports and assessment items), and uploaded descriptions of pedagogies to the project website.

Phase 4: Documentation and reflection to produce design principles (Semesters 3, 4 & beyond)

In Phase 4, the focus of the project moved to the fourth research question: What pedagogical principles facilitate the use of m-learning devices in authentic learning environments in higher education? In terms of chronology, parts of this process were conducted concurrently with Phase 3, especially for those projects that were implemented earlier in the phase, while other parts of necessity moved beyond the project timeframe of two years. While there were few factors that impeded the success of the project, as with all large projects, there were challenges that needed to be resolved to ensure that the project proceeded in a timely and effective manner.

This final phase of a design-based approach was to use the findings of the implementations and evaluations to create design principles that can be used by other practitioners. It is, in this sense, the most important phase in terms of dissemination because it is here that the collective knowledge of the research, the literature, professional development process, design, implementation and evaluation of the cases, the input of the reference group, and all other knowledge is synthesised into theoretically sound and practical guidelines. The final chapter in this book analyses the findings of the individual projects, the professional development and other aspects of the project to create design principles.

Conclusion

When information and communication technologies (ICTs) are used in universities, too often they are used merely as disseminators of knowledge, that is where students learn *from* the technologies rather than *with* them as cognitive tools (Kim & Reeves, 2007; Jonassen & Reeves, 1996). Jonassen and Reeves (1996) described cognitive tools as: 'reflection tools that amplify, extend, and even reorganize human mental powers to help learners construct their own realities and solve challenging tasks' (p. 699). Mobile devices were used in this project, not as low level communication or recording devices, but as cognitive tools.

The remaining chapters of this book explore mobile technologies in a range of different subject areas in teacher education. In each case, a different purpose and outcome is evident, and each demonstrates how mobile technologies can be used in innovative ways beyond the more widely experienced teacher-directed use of technology. The technical and practical problems of using these technologies are described, along with the successful pedagogical approaches and understandings that have emerged from the individual research studies.

University campuses are awash with mobile technologies, but in the main they remain hidden in students' pockets. This project endeavoured to explore the pedagogical uses of these powerful

devices, and the means to bring them legitimately into use in higher education learning.

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CHAPTER 2

Faculty development for new technologies: Putting mobile learning in the hands of the teachers

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Abstract:
This chapter identifies staff development strategies for the use of mobile learning technologies in higher education. We discuss how staff members were engaged in using the technologies for six months prior to introducing them to their students for learning activities within a Faculty of Education. We explain key concepts of authentic and mobile learning to underpin a methodology involving an action learning process. We identify five key strategies to support this learning: a shared understanding of the theoretical frameworks and philosophies; both an understanding of affordances of the technologies and time to develop skills; participation in authentic tasks; development of a shared language, knowledge and understanding of new pedagogies; and a cycle of reflection. Our findings support the notion that a social-constructivist framework provides an exemplary approach for staff development.

Introduction

In the last few years there has been an explosion in worldwide developments of new mobile technologies as the integration of visual and communication technologies associated with text, sound, audio, picture, and internet access collapse into single devices. Usage of such devices, which might have been out of the reach of the majority of students even 10 years ago, has significantly increased as costs tumble and firms claim their market niche.

Educators have been keen to incorporate the use of such devices in teaching and learning activities. Notwithstanding, we identify a need to move beyond training to use the technology, to examining new pedagogies for enabling their use to support learning more effectively.

While funding for the purchase of new technology is often forthcoming, funding for the development and support of new pedagogies and aspects of staff development is often left to chance. This was highlighted in a recent Australian initiative with a multi-million dollar funding initiative of the federal government's *Digital Education Revolution*. Initially the program failed to plan for the increased need for staff development to successfully integrate the use of these new computers within the curriculum indicating that this would be incorporated in preservice teacher training (DEEWR, 2008). However, by June 2008, the Minister acknowledged this gap and allocated significant funding to address the need of current teachers in 2009 while continuing to support the development of preservice teachers' skills through their university education.

It is this need to engage future teachers with new pedagogies that supports our argument that the supply of tools is not sufficient to ensure improved learning outcomes for our students at any educational level when no changes are made to current pedagogical practice. Whilst many students may be quite engaged with recent innovations in technology, many of their teachers indicate they are overwhelmed by heavy workloads and administrative requirements

leaving them little time to engage with new technologies, let alone spend time planning for their integration in learning activities or reflection on new pedagogies.

It is no surprise then that new technologies have not had a large impact on pedagogy when faculty find it challenging to engage in new ways of thinking about their teaching within current workload structures. The focus of this chapter is to provide an overview of a staff development program that addressed this gap through engaging staff with personal use of mobile technology for six months prior to implementation in their teaching; and the evaluation of the program's implementation through the eyes of the participants. This chapter describes and analyses the staff development process used to engage academics from a Faculty of Education in a regional university in Australia in an exploration of pedagogies for using mobile technologies in their teaching.

Background

The focus for this paper is the staff development phase of a larger project that investigated the potential of two mobile devices, a smartphone and digital audio/video player. Thompson (1999) argues that it is often difficult to convince academic staff that 'investment of their time in learning to use new technologies effectively will provide long-term gains, most especially in the current climate of competing priorities and demanding deadlines' (p.159). It was therefore a major design consideration to make the faculty development activities worthwhile and relevant to those involved. An action learning approach was adopted to immerse the faculty in the technologies and prepare them to meet the needs of millennial learners. This project sought to address ways to incorporate the everyday technologies their students are using with their courses and related assessment processes.

Changing teaching practice through engagement with new technologies is often carried out by enthusiasts, individuals working on their own projects influenced by the latest trends in technologies. Often this 'lone ranger' may allow the technology to drive the changes in teaching practice instead of allowing pedagogy to drive the changes required to improve learning outcomes (Taylor, 1998). More recently, the literature on faculty development has identified a key aspect of such activity should be based on a combination of practice and theory and that many successful faculty development activities move beyond the idea of 'one-off' workshops to integrated long term programs that focus on developing relationships and reflection as well as skill and knowledge development (Carew, Lefoe, Bell, & Armour, 2008). Of significance is a scholarly approach to this practice that provides avenues for the participants to reflect on their practice and disseminate through collegial sharing activities such as teaching forums and through publication in one of the many teaching and learning publications now available (Kreber & Cranton, 2000).

The basis for the design of the faculty development program required a process that would support the need for staff to own and use mobile technology in their professional and personal contexts in order to think differently about engaging their students in pedagogically sound ways. Many of the staff involved were hesitant about the preparation

required for such a project and had experienced more traditional approaches to faculty development.

Theoretical framework

The approach was guided by social-constructivist thinking that considers learning as an active process of building knowledge and skills within a supportive group or community. In particular we focused on the social construction of knowledge underpinned by the Vygotskian view that through enabling and supporting communication, interaction and collaboration, knowledge can be co-constructed (Kim, 2000; Oliver & Herrington, 2001; Vygotsky & Cole, 1978).

The approach was inclusive of notions of the development of a community of practice (Wenger, McDermott, & Snyder, 2002) and the role of reflection in learning (Schön, 1983). We identified that communities of practice are collectives where people share and co-construct knowledge and experiences in the workplace (Lave & Wenger, 1991). In order for this to happen we acknowledged the need for: mutual engagement, shared repertoire, and joint enterprise (Wenger, 1998). Mutual engagement implies that 'each member of the community contributes to a shared activity; the evolving community negotiates meaning by developing a shared repertoire; and learning results from the full joint enterprise of contributing to activity, negotiating repertoire and working with common purpose' (Carew, Lefoe, Bell, & Armour, 2008, p. 57). Reflective practice is identified as an important component of faculty development but it is 'only at the higher, critical levels of reflection that we expose and explore the values, beliefs and assumptions underlying our practice' (Carew, Lefoe, Bell, & Armour, 2008, p. 56).

These ideas were then used together with principles associated with mobile learning and authentic learning as the basis for the design and implementation of the faculty development activities.

Mobile learning

The research on mobile learning initially focused on the mobility of the technology, but has moved more recently from this interpretation to recognize that it is the mobility of the learner and the learning that is important (Sharples, Taylor, & Vavoula, 2007). Others have defined mobile learning as taking place when the learner is not in a fixed, predetermined location or when the learner 'takes advantage of the learning opportunities offered by mobile technologies' (O'Malley et al., 2005, p. 6).

This shift in focus from the device to the learner being mobile is also noted by Seppälä and Alamäki (2003) in their clarification of mobile learning as an extreme form of flexible learning where the 'mobile environment integrates studies that take place on campus, at home or outside universities facilities into one shared, flexible learning environment' (p. 330). Quinn (2000) has identified the exciting possibilities of the blending of mobile devices with e-learning 'independent of location and space'. The rapid increase of mobile learning tools coupled with the convergence of the technologies means improved access for many students.

We have considered these efforts to define and categorize these new environments and for the purpose of this paper we define mobile learning or m-learning as:

> Personal access to mobile technologies providing learners with opportunities to be flexible in the way they collect, store and share information to support their problem solving.

Authentic learning

In order to support knowledge construction and application as opposed to inert knowledge acquisition it was important in our context to model this within the faculty development activities through the provision of authentic real world tasks where 'meaningful learning can only take place if it is embedded in the social and physical context within which it will be used' (Oliver & Herrington, 2001, p. 78).

Authentic activities comprise *complex tasks* to be investigated over a sustained period of time; activities are completed in days, weeks and months rather than minutes or hours. They require a significant investment of time and intellectual resources. Herrington and Oliver (2000) suggest that there are a number of critical characteristics of authentic learning that have an impact on the way in which we design for instructional environments. They suggest that authentic learning environments should:

- Provide an authentic context that reflects the way the knowledge will be used in real-life;
- Provide authentic activities;
- Provide access to expert performances and the modeling of processes;
- Provide multiple roles and perspectives;
- Support collaborative construction of knowledge;
- Provide coaching and scaffolding at critical times;
- Promote reflection to enable abstractions to be formed;
- Promote articulation to enable tacit knowledge to be made explicit;
- Provide for integrated assessment of learning within the tasks.

The key concepts of mobile learning and authentic learning provided a common ground for discussion and development of the faculty based program and the iterative evaluation design. Combined with the theoretical underpinnings they guided the framing of our research question, namely:

> What are appropriate strategies for the professional development of higher education teachers in the pedagogical use of mobile-learning devices?

We address a gap in the literature identified in a recent report on teacher learning with digital technologies that there is an assumption that teachers *will* learn with digital technologies but there is little research on *how* they will learn (Fisher, Higgins & Loveless, 2006). The following section describes the methodology used for the research.

Methodology

We used an action learning framework over a period of six months to provide opportunities to explore and develop new pedagogies for mobile devices in a variety of subject areas. We believe this allowed for the concerns and needs of individuals to be met through inquiry learning rather than a fully pre-planned scope and sequence of activities and is appropriate for professional learning needs in this context (Revans, 1982; Zuber-Skerritt, 1993).

During the following twelve months, the participants implemented their projects with their students. This chapter focuses on the first six months only, though acknowledges the ongoing role of informal faculty development through interaction with peers and support staff over the next year.

Data were collected through reflections that were recorded during the meeting sessions and feedback was sought through anonymous evaluations. The cycle of plan, act, observe, reflect was used to continuously review the process of faculty development (Zuber-Skerritt, 1993).

We expanded our research question to include the following sub-questions:

•   How can an action learning approach support staff professional development in using mobile learning technologies?
•   How do the workshop activities support participants' understanding of the affordances of mobile learning technologies?

Using a qualitative approach these data were collected and analysed, as indicated in Table 1.

Table 1: Data collection matrix

	Primary sources	Secondary sources
Sub-Question 1 How can an action learning approach support staff professional development in using mobile learning technologies?	Semi-structured interviews during regular meetings Observation and informal discussions	Individual reports on project website Institutional documents including subject outlines and assessment tasks
Sub-Question 2 How do the workshop activities support participants' understanding of the affordances of mobile learning technologies?	Anonymous feedback surveys Observation and informal discussions	Individual reports on project website Institutional documents including subject outlines and assessment tasks

The data were used in an iterative way to redesign further support and activities to meet the needs of the group. The secondary sources provided rich descriptions of the learning design and environments in which the faculty members worked and interacted with students. It provided a detailed picture of the environments in which the devices were to be deployed and helped clarify the purpose and possible outcomes of the intended projects.

Participants

The twelve voluntary participants in the staff development process included a range of teacher educators from a Faculty of Education in a regional university. They were skilled lecturers in a range of disciplines including mathematics, science, physical and health education, curriculum, visual arts, educational psychology, literacy, early childhood and educational technology. They brought a diverse and solid understanding of educational pedagogies but with a varied understanding of how new technologies can impact on the learning of their students. Some participants were experienced users of a variety of technologies with a student-centred learning focus. Their enthusiasm and commitment to the project, willingness to change and adapt their understandings to improve student outcomes through the development of new pedagogies was an important contribution to the overall project.

Learning activities: formal and informal

An overview of the staff development activities, both formal and informal, is provided in Table 2.

Whilst the meetings regularly addressed such things as relationship building, device usage, technical issues, reflection on practice and development of shared understanding, there were five key understandings required for implementation. Firstly, an understanding of the theoretical frameworks of the larger project (that is authentic learning and action learning) was necessary, and developing an understanding of mobile learning was essential. Secondly, developing an understanding of the affordances of the technologies at hand, and thirdly identifying the new pedagogies for learning that were emerging and the implications for the practice and teaching role. The fourth key was being able to model the practice through the use of authentic tasks and finally, within all meetings, there was a cycle of reflection on the implications for the development of new pedagogies presented by the five initial understandings.

Table 2: Framework for staff development

Meetings	1	2	3
Activities	Discuss theoretical underpinnings of project Review technology skills and develop through introduction of the smartphone and iPod	Reflection on use of devices and affordances between meetings Identification of pedagogical viewpoints Further technology skills development	Reflection on use of devices and affordances between meetings Modeling group activities Reviewing pedagogical viewpoints Planning student activities and implementation plans

Meetings	1	2	3
Focus	Familiarity with new device and improved confidence with technology Engaging with related theory for authentic learning and mobile learning	Examining mental models Engaging in scenarios for use Enhanced skills development	Authentic learning activities to model possible uses
Outcomes	Relationship building Common agreed goals and shared language development Getting 'buy in' for project activities Technology skills development	Relationship building Changing mental models Reflection on action Enhanced technology skills development	Reflection on action Identification of new pedagogies for learning Enhanced technology skills development through identifying relationships between devices and computers Planning for implementation within subjects

Results and discussion

1. The relationship of mobile learning and theoretical frameworks

The first meeting provided an overview of authentic learning and action learning as used in the larger project (Herrington & Herrington, 2006). It then tackled the issues of what is meant by 'mobile learning' and how it is being applied in educational contexts. A variety of studies were identified highlighting a lack of applications in higher education that adopt an authentic learning perspective. An exploration of the term 'mobile learning' from a number of sources reflected a definition that recognised the convergence of learners using mobile technologies and learning while mobile (Sharples, Taylor & Vavoula, 2007).

The key focus for this activity was on sharing knowledge and developing shared understandings for future learning. After an introduction to the iPod and the Palm Treo the group identified their preliminary thoughts on possible affordances of the technologies in their teaching. Many activities related to personal use for managing and administrating teaching at this stage rather than students as constructors of their learning for example. The focus was very much on learning to use the technologies themselves but the evaluations indicated the usefulness of the meeting: 'Being new to the project and hearing about the design and theoretical frameworks consolidated the reading I had done' (Meeting 1 participant). Another indicated, 'Thanks for the effort put into planning and implementing the first session. It's nice to have the opportunity to be part of a team'. This was reiterated by others, 'An informative morning; I feel my brain is stretched; and obviously well thought through'. And the inevitable, 'thanks for the great food', as the project leader and manager contributed to the relationship development through the provision of homemade cakes for each meeting. This allowed for the informal discussions and reflections during a break, which further supported the learning of the participants.

In the second meeting, we were conscious of the importance of modelling inquiry-based practice for using the devices, and based on the feedback from participants about their needs, designed interactive activities that allowed sharing of knowledge and practice across smaller groups. The third meeting built on this model through authentic learning tasks to engage participants in the kinds of activities they might use with their students.

2. Understanding the affordances of the technologies

The initial meeting provided the first use of the technologies for a number of the participants. Some indicated a need for more support to use the devices in their feedback, '[I need] time to explore the Treo.' Another indicated their concern about using the devices with students 'I am a little anxious about introducing the technology to the students – will [name] and [name] be available☺? With a six week time frame [for the teaching activity] we can't afford to waste time'.

As faculty became familiar with the devices that they had access to, they developed better understandings of the affordances of these technologies. Participants found that discussion between meetings, and the general ability to support each other through 'corridor conversations' and 'at elbow' support was critical in the early stages. However, they tended to focus more on using the technologies for existing practice. We developed scenarios of use to encourage people to think more broadly about how they might use the technologies. We were mindful that for faculty to engage with mobile technologies they needed to 'Be[ing] confident in its use and undergo[ing] training where necessary' (Becta, 2004, p. 1).

3. Identifying new pedagogies for learning

Each meeting included an opportunity for participants to reflect on the learning activities they may engage in with their students and the usefulness of the devices to support this learning. The variations in responses indicated the disparity in the group in terms of depth of understanding and experience in using such devices: For example, clarifying concepts, recording preservice teachers explaining and demonstrating; then sharing with others for reflection; collectively constructing a story; and supporting group work. Our response to this was to plan the next meeting to engage the participants in group activities to share their knowledge through discussion of possible scenarios of use. Examples are included in Table 3 of two of four scenarios and the responses by participants (cf, Lefoe & Olney, 2007; Lefoe, Olney & Herrington, 2008 for discussion of the scenarios).

Table 3: Scenarios of student activity and summary of participants' responses

Scenario one: Student on campus	Participants' response
Xin Ro is enrolled in the first year of the primary program. She is involved in a collaborative assessment task about global warming. ... *What kinds of learning activities are likely to be on their project plan? How can mobile devices support these kinds of activities?*	• Collect data from around the world with others to graph trends and note changes • Recording voiceovers of extreme weather events • Give personal perspectives and understandings about the causes and solutions to the problem • Interview a range of ages for a range of perspectives

Scenario three: New academic	-	Participants' responses
Dr Way T. Longtime is a new academic in her second year at the university. She must prepare a new first year subject focused on indigenous education for the next semester. …. *What strategies could she use to add perspectives from the local schools and community to her subject? How could mobile technologies support her or her students to do this?*		• Interview the visiting speaker • Recording phone calls to key people for podcasting • Audio comments • Set up iPod as database for others to draw on • Recording interviews • Collecting reflective evidence of teaching to plan for future teaching

Feedback from the participants through evaluation and reflection indicated that the scenarios were a positive experience and that having a point of focus for their discussions was an important component of identifying possible uses in student learning. Whilst participants could clearly see the potential for new uses within student learning activities they did not demonstrate an understanding of significant changes required to the current practices of academics. We concluded that making the devices their own is an important facet of staff development for using mobile technologies, a concept supported in the literature (Kulkulska-Hulme & Traxler, 2005).

4. Modeling the practice through authentic tasks

Authentic tasks were introduced during the third formal meeting to engage participants with further understandings of the affordances of the technologies, for example through using the camera and video tool on the smartphone, and voice recording using the iPod. It also provided a model for different ways of thinking about the pedagogies with which they would engage their students. One activity aimed to give participants an example of the way the smartphone could be used to create digital narratives or stories that could then be used with their students in authentic contexts.

Digital narratives is an activity described by Patten, Arnedillo Sanchez & Tangney (2006) as one that 'embodies a collaborative, contextual, constructionist approach to learning with handheld devices' (p. 303). The task involves creating a 2 to 3 minute video using the smartphone's video, picture and audio functionality, saving the media to an SD memory card, transferring the media to a computer, then creating the story using movie editing software such as iMovie. Workshop participants were shown an example of a digital narrative and arranged in pairs to develop their own. Children's toys were provided as props and participants were asked to plan the story using a storyboarding template that required sketching scenes in chronological order and indicating dialogue and or possible voiceovers. They completed this task within a one hour timeframe and then presented their movie to the group. This provided an excellent example of how the devices could be used within a learning context in the classroom as the participants quickly became familiar with the combination of movie, photo and sound recording. The next activity used the iPods for interviewing people about their place of work and the resultant recordings were then transferred to the computer and published as podcasts to share with the other participants.

Even though most participants had only a developing knowledge of the smartphone and movie editing software all were able to achieve a satisfactory outcome and could see the potential for such an activity with their preservice students, as indicated in the feedback, '[Best thing about today was] the introduction to the possibilities available from the software offered. The greatest challenges faced included: having time to fully explore the software presented'.

5. Reflections on implications for learning and teaching activities

Throughout the meetings the devices were used to support the learning and reflective aspects of the activities. For example, photos were taken during the meetings by all participants engaging in various activities and frequently shared with each other and on the project website.

During the reflective stage of each meeting the iPods were used to record the reflections for later analysis by the researchers. Questions were used to focus reflection towards the end of each meeting and Table 4 provides an example of questions used after one activity. We used think-pair-share activity to encourage reflective activity and sharing with another to help clarify ideas. Individuals then shared with the larger group and these were recorded to assist people later when they were identifying learning activities to use with their students.

Table 4: Example of reflective activity

MLearning Workshop Reflection
Please jot down points for discussion and hand in after discussion – feel free to keep adding to it during the discussion.
1. Today's workshop has modelled a number of teaching activities using the iPod and mobile phone. What have you learnt today that you might practice with a student group? How might these kinds of tasks be used within one of your subject assessment tasks?
2. List some related assessment tasks you think might be relevant for your subject and students.
3. Expand on two possible assessment tasks – frame them in the way you would write them in your subject outline.

The responses to the reflective activity (Table 4) conducted during the third meeting indicated a number of areas where important learning had occurred over the faculty development activities. The following comments are from the participants indicating they had:

- A developing awareness of the different contexts in which adult learning occurs;
- Used group work in the past but liked the storyboard approach;
- Become more confident with the technologies, the mechanics of transfer for files and the 'language' to use to explain this to their students;
- An understanding of how to break the assessment tasks into more manageable chunks;
- Clarity of instructions and support framework;
- Wondered why the cellular aspects of the phones weren't being used; and

- A need to allocate time to understanding the additional features of new software not yet on the devices.

Participants also clarified the kind of assessment tasks they might use in their subjects.

Conclusions

Engagement and interaction through technology is an essential aspect of many of our students' lives. Our findings conclude that just as students need to 'own the technology' if they are to make effective use of it then so do the teachers (Kulkulska-Hulme & Traxler, 2005). Comprehensive staff development and support are key aspects of ensuring effective use of educational technologies with a strong focus on pedagogy within the curriculum.

Our overarching research question sought to identify strategies for the professional development of higher education teachers in the pedagogical use of mobile-learning devices. Our findings show that the social constructivist approach to support an active and collaborative community, where the learner is in control of the activities and is able to question and plan the appropriate strategies relevant to the environment and the new technologies, has been most suitable for this project. We believe the action learning approach provided a suitable framework to support this learning.

Of significance was the ability for faculty to be able to use the devices in their everyday work and to become familiar with them to such an extent that they were then able to incorporate their use in the curriculum. Once in the classroom there were often students with a greater knowledge of the devices or similar and the students then supported each other (and sometimes the faculty member), with learning how to use them.

We identify five important strategies to support such an implementation:

1. A shared understanding of the theoretical frameworks and philosophies of the project were essential for all engaged in the project.
2. Developing an understanding of some of the affordances of the technologies at hand, and having a significant amount of time to develop these skills before using with students, is an important component of using new technologies.
3. Participating in authentic tasks which modeled the practices being discussed provided opportunity for insights into new pedagogies that assisted the move from theory to practice.
4. Developing a shared language, knowledge and understanding of new pedagogies and the implications for practice and teaching role.
5. The cycle of reflection on the implications for the development of new pedagogies presented by the four initial understandings.

In order that today's preservice teachers are able to meet the needs of their future students we need to develop and understand different ways of teaching and learning. We need new pedagogies to support this. The staff development aspect of this project has provided some useful insight and strategies as to how we can better support faculty to engage with new technologies, and they in turn have used this to engage their own students in different and creative ways. We feel that this is absolutely essential as 'Faculty development for existing and future faculty is a pivotal investment for integrating technology in higher education' (Moore, Moore & Fowler, 2005, p. 11). By working with preservice teachers there are many opportunities to engage in new pedagogies to influence changed practice from early childhood through to secondary and tertiary education.

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CHAPTER 3

Using a smartphone to create digital teaching episodes as resources in adult education

Anthony Herrington

Abstract:
Creating digital narratives or stories is a pedagogical approach that has a great deal of potential for learning in higher education. This chapter outlines adult educators' use of a smartphone to create digital narratives to be used as a resource or teaching episode in their teaching and training. The task was part of an adult education postgraduate subject designed to assist adult educators integrate the use of technology in their teaching. The study involved observing and documenting students' use of the devices and follow up interviews to determine how they went about the task, and what they perceived as the strengths and benefits of the technology and the pedagogical approaches involved in such a task. All students successfully completed the task and highlighted the benefits of the technology for use in spontaneous contexts across time and space.

Introduction

While mobile technologies are not yet widely and routinely used in education, they have the potential to be used in a multitude of pedagogical and other contexts in higher education. For example, Patten, Sanchez and Tangney (2006) have identified several categories of use:

- Administration, e.g., the use of calendars, exam reminders, grading software;
- Referential, e.g., dictionaries, e-books and office applications;
- Interactive, e.g., quizzes, response software;
- Microworld, e.g., simulations, games;
- Data collection, e.g., data logging, note taking, audio recording, eportfolios
- Location aware, e.g., augmented environments, gps navigation and tagging; and
- Collaborative, e.g., pod/vodcasting, blogging, instant messaging.

The aims of this research were to evaluate the technological and pedagogical affordances of using a smartphone (combined mobile phone and personal digital assistant) as a data collection tool to create digital narratives or stories designed to be used by adult educators as curriculum resources in their teaching and training. In this study, video, pictures and audio were captured with a Palm Treo smartphone.

The New Media Consortium and Educause 2008 *Horizon* report uses the term 'grassroots video' to describe the new and emerging way that video is currently being created with mobile phones and used in education:

> Over the past few years, the ways we produce, use and even think about video have undergone a profound transformation. Literally millions of videos are just a click away for any internet-connected user. As the numbers and quality of user-produced clips have increased, our notions of what constitutes

useful or engaging video have been redefined—and more and more, it is a two to three minute piece designed for viewing in a three inch browser window or on a mobile phone. That same phone is often the video capture device, with surprisingly high quality when viewed on a small screen. (p.10)

McGreen and Arnedillo Sanchez (2005) suggest the use of mobile phones to create digital narratives or stories where learners collaboratively plan a story, either fictional or non fictional, then create and edit the story using mobile phones and movie editing software, finally sharing the story through social networking sites such as YouTube. The major reasons for the use of mobile phones in this context have been the ubiquitous nature of the technology and the minimal cost of production and distribution (NMC & Educause, 2008).

Creating digital narratives is shown to be a successful authentic learning approach for K-12 schools (Kearney & Schuck, 2006) and typically involves students planning a story, acting it out, recording it using a digital camera or video and presenting it to an audience. This approach has been described by Patten, Arnedillo Sanchez and Tangney (2006) as one that 'embodies a collaborative, contextual, constructionist approach to learning with handheld devices' (p. 303). As such, the activity was chosen not only as a way of helping adult educators learn about mobile learning and how to integrate it into their teaching but also because it provided a social constructivist alternative to knowledge construction compared to the didactic approaches that are more commonplace in adult education even when new technologies are utilised (Alexander & Boud, 2001).

Context

The study involved students enrolled in an Adult Education postgraduate subject titled *Design and use of New Technologies in Adult Education/VET and Higher Education*. The subject consisted of four equally weighted modules each having an assignment. One of the modules, the context for this study, was concerned with mobile learning having an assignment that required students to create a teaching episode using a mobile phone. The teaching episode needed to reflect an 'authentic' activity (Herrington & Herrington, 2006) found in the students workplace or professional life. During the semester students completed three other assignments that involved the creation of a web site to present ways in which technology is used in adult education; an essay describing issues around the use of learning objects; and an analysis of online communities of practice relevant to the student's profession.

Research questions
The study was guided by the following research questions:

- How do adult educators use a smartphone in creating a teaching episode within an authentic learning environment?
- What are the affordances of a smartphone for creating a teaching episode? What was possible with a smartphone that would have been difficult or impossible without it?

- What pedagogical strategies were required to assist the students' use of the smartphones as data collection tools for their teaching episodes?

Methods

The research was carried out with a class of 14 students from a variety of backgrounds including school teachers, vocational educational trainers, nurse educators, educational designers and correctional services employees. Students could attend face to face classes as on campus students or enrol at a distance. An online subject website was available for all students to access and enabled links to electronic resources, group email and communication via threaded discussion boards. Students were required to engage in the module readings and complete the following assignment task for the mobile learning module:

Assignment task

> Create a 2-3 minute teaching episode (digital narrative) following the procedure below:
>
> - Choose an adult education skill you teach
> - Write a storyboard demonstrating the skill
> - Capture and create pictures and videos using the smartphone
> - Download multimedia into movie editing software (e.g., iMovie)
> - Record audio narration, and insert music and sound effects (e.g., using GarageBand).
> - Upload and share video using social networking software (e.g., TeacherTube)

To assist in completion of the assignment, on campus students were given the option of attending a 90 minute workshop on using a smartphone to collect multimedia. Students were shown how to obtain audio, pictures and video; how to save media to an SD card; how to transfer the media to a computer via a USB card reader: how to download the media into iMovie editing software and how to create a short movie. Students were given a simple template and shown how to developing a storyboard to assist in planning for the task.

Students were asked to post their storyboard to the threaded discussion forum on the subject web site and to post peer feedback on two other students' storyboards. One student, for example, chose to create a teaching episode demonstrating the use of Audacity that is software for converting analogue to digital data. His storyboard is shown below:

> My project is an instructional video on how to convert analog audio (from a cassette tape) to a digital format (mp3) using the freeware computer recording program Audacity. Basically, this is what I plan to include:
>
> - An explanation of the differences between analog and digital audio;
> - A description of the hardware and software that I'll be using for the conversion (using still and video shots taken with the mobile phone);

- A description of the setup I'll be using (cassette player, soundcard, laptop, etc.), this will be done with short video clips (taken with the mobile phone) of me making the physical connections (player to soundcard, soundcard to laptop, and so on);
- A short description of the recording/conversion process (using screen captures of the software);
- Finally, a short description of what can be done with the finished product (send via e-mail, upload to an mp3 player, etc.), using short video clips and jpegs.

Other students presented their storyboards in a more visual manner as suggested by the template. All the students followed the request of posting feedback on their colleagues' storyboards. In the above case two responses suggested to the student that he keep it simple for those lacking expertise in technology and to show greater relevancy for the procedure:

> I find the idea of this video interesting. As a person who is not as computer literate as you I look forward to an explanation of this process (hopefully using language I can understand!)

> I like that you'll show how the end product can be used (not only in the workplace).

The assignment task was planned to cover three weeks of the semester, however, on campus students were each given a smartphone for a period of six weeks. This enabled them to spend three weeks getting familiar with the device and if they wished inserting their own sim card and using the device as their regular phone. Students studying at a distance used their own phones.

Following the completion of the subject, after grades had been finalised, all students were interviewed individually about the activity. Each interview lasted approximately 20 minutes, was digitally recorded and involved the following questions:

- Can you describe your use of the smartphone in your creation of a teaching episode?
- What were the advantages of using the device?
- What were the disadvantages or challenges of using the devices?
- What were the most difficult aspects of creating a teaching episode?
- What were the most positive aspects of the task?
- How would you use smartphones with your students/ colleagues?
- How useful were smartphones as a tool for teaching?
- What advice would you give to other adult educators wishing to conduct similar teaching episode activities?
- What principles of good use can you suggest that have emerged out of your use of smartphones during the course of the activity?

Each student's teaching episode was viewed and analysed along with postings to the website forum.

Findings

The results of the interviews and observations of the final products are considered and discussed below in relation to each of the research questions:

How do students use a smartphone in creating a teaching episode within an authentic learning environment?

Even though the majority of students found the task initially quite overwhelming, each student managed to successfully create a digital teaching episode in either iMovie or Moviemaker and were surprised at how easy the task became. One student commented that: 'Had I not done it I would have thought it much harder to do.'

Roles in the episodes involved themselves, colleagues, students and in some cases family members. A wide range of topic areas was developed reflecting the diversity of the group, these included risk analysis, medical procedures, using explosive tools, oriental massage, navigation, citizenship, customer service and so forth. The students' products incorporated audio, pictures and text, and were in general either demonstrations of a skill or developing skill awareness.

All students managed to successfully submit their finished product to a social networking site which included YouTube, TeacherTube and Blip TV. On reflection, students commented on their enjoyment of the learning process, the relative ease of the task and how rewarding it was to achieve such an outcome as expressed by one student: 'I never thought that by using a phone you could create something as good'.

The following link provides an example of one student's teaching episode: http://au.youtube.com/watch?v=kcQ3-Q73hjE. The video was created and uploaded to YouTube to motivate a group of adult migrant learners in a community college setting studying to pass the US citizenship test. This video shows some of the technical difficulties with the device, for example, the difficulty of filming in low light situations. Nevertheless, the video also shows the affordances of the device to record unscripted dialogue collected at different times and in different places. This supports some of the observations discussed below that indicate the benefits of using the smartphone to capture spontaneity in contexts across time and space.

What are the affordances of a smartphone for creating a teaching episode? What was possible with a smartphone that would have been difficult or impossible without it?

Students saw the portability and ease of use as the smartphone's main advantages as one student indicated she could 'easily pull it out, use it, get what I needed and transfer it to my computer.' other benefits included spontaneity of use; as one vocational education teacher commented 'I see somebody doing something that is so good and so current that I don't have the opportunity to go and get the camera so I have my phone in my hand and go on and record it'. The expansion card enabled adequate memory for the purpose and the picture quality for the purpose was also seen as sufficient which surprised one student who said that when 'I was shooting it (the image) it didn't look as

clear on the phone but when I transferred it to the computer it was very clear'.

The main disadvantages centred on the lack of video format compatibility between the smartphone and PCs; the incompatibility between the mobile image aspect ratio and that used with the video editing software; lack of resolution in low light situations; and audio recording difficulties in some cases where interviews occurred for example, capturing children's voices. One student noted 'Sometimes when you're filming and somebody's talking at a slightly different angle you don't pick up the audio as well'. Another disadvantage identified was that the smartphone video does not have a zoom capability.

Students expressed the view that taking video or photos with the smartphone could be done spontaneously without the planning that would be needed if one relied on a digital camera or video. And in some situations the smartphone was seen as less intrusive than using other devices.

What pedagogical strategies were required to assist the students' use of the smartphones as data collection tools for their teaching episodes?
Because the device was new to most students they reacted positively to being able to 'play around' with the device before having to concentrate on the assignment. In the words of one student 'Having the time to play with it, to see what it does made one more comfortable with it so that when it was time for the assignment it felt like an easier process'.

One student commented that the smartphone phone initially appeared cumbersome, but after having the time to use it, he found that the displays were easier to read and texting much easier that his current mobile phone saying that '[my] perception totally changed when I was actually using it to when I was given it to evaluate [initially]'. Planning the task, for example, using storyboarding, was seen as essential for successful completion of the task. Although minimal directions were given on how to collect the media and transfer it to movie editing software most students appeared comfortable in tackling the challenge even with limited scaffolding from the teacher and their peers. However, some students indicated the need for some advance warning of the problems they were likely to encounter.

Students indicated a number of pedagogical affordances such as using the smartphones to evaluate students' skills: 'Being able to film each other, or for me to film them, then evaluate it themselves will give them that perspective they don't normally have'; to assess students in a real situation for example on a building site; Other suggested engaging their students in similar digital narrative projects. Creating teaching episodes for professional development was seen as useful, albeit time consuming.

Students suggested some guiding principles which involved 'keeping it simple', getting only one message across in each scene, and getting used to the technology by finding out what you can and can't do with the smartphone. One student recommended that the learner needed to 'look around at what others are doing around the world and locally using video sharing sites for inspiration'. Planning was seen as critical

especially if there are limited chances for filming, planning the scenes considering lighting, audio and the form that the presentation will take. Students also suggested taking advantage of spontaneous situations and being aware of the need for participants' consent.

Being able to share concerns and issues with other students on the website forum was seen as important allowing for sharing of ideas and recognising that others had similar problems. As one student noted: 'To see that others had the same problem meant that I didn't have to persist down that path'.

Conclusion

The students saw the affordances of multimedia available on the smartphone as powerful enablers for the task. Most agreed that they would continue to develop similar tasks for professional purposes for students in their own classes. One student is now planning an activity for her neophyte nursing students that would involve them videoing nursing procedures for placement on a workplace intranet.

One major limitation involved incompatibility issues involving video files. Interactions on the course LMS forums demonstrated students' willingness to engage with the problem and their peers to solve these issues. The incompatibility of technology can cause problems particularly when video taken on the smartphone as 3gp is incompatible on some PCs. It was necessary for many students to access sites such as http://www.miksoft.net/mobile3GPconverter.htm to convert the video to compatible avi files.

On reflection, and as a result of similar workshops with adult educators, it may have been even more motivating for students to conduct an initial group activity where students create a fictional digital narrative or story, by first constructing a storyboard using prompts. This way the students quickly get to know how to take and save pictures and video, and to piece them together using movie editing software to create an outcome that can be displayed to others in the class. However, this option may be less effective for those studying at a distance.

One of the main affordances of the technology suggested by the students appeared to be its spontaneous use. Only a few of the teaching episodes seemed to acknowledge spontaneity, as for example, in 'street interviews'. Similarly, few of the episodes involved using the technology in circumstances where the learner was mobile. It may be that the nature of the task and the requirement for planning would seem to lessen the need for both these features of the technology.

Nevertheless, for adult educators who are overly familiar with teacher centred transmissive approaches to teaching and learning, this activity provided an introduction to the application and awareness of authentic learning enabled through mobile technologies, albeit in contexts where learner mobility was not emphasised. The affordances of mobility will be considered in future implementations, recognising the current view of mobile learning as the convergence of mobile technologies and the mobility of the learner (Sharples, Taylor & Vavoula, 2007).

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CHAPTER 4

Digital story telling using iPods

Ian Olney, Jan Herrington and Irina Verenikina

Abstract:

This chapter describes the experience of using iPods with preservice early childhood educators in an introductory ICT course. The approach taken was to use the mobile devices, not as the object of study in themselves, but as cognitive tools to be used to complete a complex and authentic task. Students used the iPods in groups to create digital stories appropriate for very young children, in the style of a children's picture book. The research explored the students' responses to the task and the pedagogical affordances of the devices in the early childhood setting.

The challenge

Many teacher education courses offer units or subjects in Information and Communication Technologies (ICTs), in order to prepare neophyte teachers for the 21st century classroom. It is envisaged that such a classroom is one infused with technology, where students use technologies as cognitive tools to solve problems and create realistic and accomplished products. However, instead of preparing these future teachers to use technologies in creative and innovative ways, teacher education courses often focus on teaching *about* the technologies themselves, rather than how students can use them as 'partners in cognition' (Salomon, 1991), or to learn *with*, rather than *from*, technologies.

Too often, ICT courses focus on the hardware and software that is deemed appropriate in classrooms, where topics include: how to create a document using word processing software, how to make a spreadsheet, how to create a presentation (such as PowerPoint), how to access the internet and use browsers, and how to make a webpage using simple html. Such an approach has been likened to teaching 'hammer' rather than 'carpentry' (Oppenheimer, 1997, p. 62).

Instead, the learner, the technology tool, and the activity that students complete can form a joint learning system, where they build expertise, not only in the tool itself but also in the learning environment and activity within which they make use of the tool (Kim & Reeves, 2007). If such a learning environment is an authentic and complex one, it would provide: an authentic context and task; opportunities to access expert performance; multiple perspectives; opportunities for collaboration, reflection, and articulation; scaffolding by the teacher, and integrated, authentic assessment (Herrington & Oliver, 2000; Herrington & Herrington, 2007). Students can engage with a variety of technology tools as and when required, so that they are using (and learning) the tools to achieve a real purpose rather than as skills that can be checked off as completed.

This chapter describes a project where mp3 players (Apple iPods) were used as cognitive tools to create an authentic digital story book. The task involved creating a picture-book story for children, in a digital form with sound and visual effects.

Context of the study

The study was conducted within a core ICT subject, offered at the beginning of the second year in BEd (Early Childhood) program. The subject was designed to provide preservice early childhood educators with the knowledge and skills of implementing modern ICT in a variety of early childhood settings in order to promote the development of young children. The subject aimed to address specific issues of the use of IT in early childhood education. These include:

• Developmentally appropriate ways of using ICT in early childhood settings,

• Integration of appropriate ICTs in early childhood curriculum and play, and

• Critical appraisal of ICT and computerised toys manufactured for young audiences.

Early childhood literature suggests that to be effective, ICT should be used in a pedagogically appropriate manner suitable for young children, that is, in an environment where children can play, actively explore, investigate, look things up, solve problems, and do puzzles and other activities which promote communication, interaction, discovery and problem solving (Downes, Arthur & Beecher, 2001, p. 144). It should be consistent with the child-centred philosophy of the early childhood classroom where children are active participants in their own learning and engage in a variety of hands-on activities (NAEYC, 1996a). In such an environment, the technologies would become 'integrated into the regular learning environment' of young children and would be 'used as one of many options to support children's learning' (NAEYC, 1996b).

The approach outlined above informed the design of the assignment tasks in the ICT subject for preservice early childhood educators, including the digital story task.

The authentic task

The assignment comprised a complex authentic task that included six weeks' work in a 13 week semester (Weeks 4-9). Students were required to research and write a story suitable for young children, and to then use iPods and a range of other technologies and software as necessary to create a digital version of their story. The final product, a digital story, was aimed to be suitable for educating young children in an early childhood centre. Additionally, the students were encouraged to produce the kind of digital story that could be readily created in an early childhood centre by early childhood educators together with the children in their care given the appropriate resources. There were three classes of approximately 18 students, and eight iPods available for each class.

In the first of the six workshop classes, students were introduced to the iPod and its features, and to the task of creating a digital story for young children. The construct of 'cognitive tool' was also introduced, including discussion of how the device could be used to create a story, where students might invent new ways to use the device in context. Practical aspects of the exercise were then addressed, including determining the technology that would be available to students.

Students formed groups of two or three, and one iPod was issued per group. Additional technology such as video and still cameras needed to be sourced, but generally the students themselves provided these items. The groups also had access to computers (a Macintosh lab), and additional software that was required to create the digital story (e.g., PowerPoint, GarageBand, iTunes, iMovie, iPhoto, Word, ComicLife and a range of image manipulation software programs). The students were also required to reflect on the process of creating the digital story in an online journal or personal blog.

In order to assist with the creation of a genuinely engaging and appropriate story, an author of children's books was invited to present a guest lecture for the class. In creating their stories, each group followed a different procedure but typically the processes included:

- Researching and choosing a suitable topic
- Brainstorming ideas for the story (using mindmapping software Inspiration, or pencil and paper concept maps)
- Writing and storyboarding the story
- Capturing and creating pictures and videos, or illustrations, as required
- Creating the 'pages' of the story (e.g., in PowerPoint)
- Recording audio narration (using iPods with attached microphones), and inserting music and sound effects (e.g., using software such as iMovie or Movie Maker)
- Combining all elements, together with credits, using PowerPoint, or iMovie (or similar) software.
- Creating a stand alone movie file by saving the PowerPoint story as a .mov file, or exporting the digital story (from software such as iMovie) ready for publishing either as part of a podcast, or sharing by display on the iPods.

On completion, students presented their stories in class sharing the creation and design process by way of PowerPoint presentations, movie demonstrations and explanations.

Research methodology

In order to explore the educational potential of the digital audio players (iPods), research was conducted to investigate ways of designing and implementing teaching in authentic contexts that enhance student learning with understanding. For the project as a whole, the research focus of this stage was:

- What pedagogical strategies facilitate the use of m-learning devices in authentic learning environments in higher education?

Specifically for the use of iPods in an early childhood context, the research questions comprised:

- How do students respond to the use of mobile devices within an authentic learning environment?
- What are the affordances of an iPod for creating resources for early childhood learners?

- What pedagogical strategies were required to assist the students' use of the m-learning devices as cognitive tools for their digital books?

The participants of the study involved 12 preservice early childhood educators –comprised of six story-writing groups (2 from each class). Group interviews of approximately 30-40 minutes were conducted at the completion of the task. Groups were selected on the basis of those most likely (in the view of the teacher/researchers) to provide the richest source of data across a range of views and levels of achievements. Reflective journals of participants were also reviewed and field notes taken as the task progressed. The interview questions focussed on the following areas:

- Technology affordances: What were the participants' views on the technology affordances of digital audio devices (iPods) for personal use, for higher education generally, and for early childhood education?
- Pedagogical strategies: What pedagogical strategies do participants believe facilitate the use of m-learning devices in authentic learning environments in higher education, and in early childhood education?

All data sources were analysed using a constant comparative method (Merriam, 1998) of determining major themes and issues. Data were further considered within the framework suggested by Miles and Huberman (1994) of the three stages: data reduction, data display and conclusion drawing and verification.

Discussion of findings

Students' response to iPod use in authentic learning contexts

In relation to the first research question *How do students respond to the use of mobile devices within an authentic learning environment?* in general, the preservice teachers responded very positively towards the use of the iPod, both in terms of their own learning and leisure, and in pedagogical contexts. When issued with the iPods, students were encouraged to ensure that all members of the group had a chance to keep the device for a couple of weeks and use it for a range of purposes, including leisure. In this regard, students reported using the iPod to download music into iTunes, downloading podcasts in areas of interest, and downloading television programs from sites such as the *Australian Broadcasting Commission* (ABC). They also reported using it to download books, as well as for a range of learning and reflective activities in their own roles as higher education students. For example, one student recorded her own reflections on content in another curriculum subject:

> I recorded my PE [Physical Education] notes and played it in the car, through the stereo, while I was driving along.

As might be expected, however, not all students responded positively to the devices from the outset, because of their own circumstances. For example, some mature age students reported that they did not have enough time to explore the use of the iPod for leisure because of the pressure of study, work and family commitments.

Listening to podcasts and other content sources (including the University's *EduStream*: a system to provide audio recordings of lectures, presentations and visual images) appeared to be a common use for the iPods, reflecting the multitasking role that is almost mandatory for the modern student, many of whom have jobs and families to care for. One student explained how she had used the iPod, with the microphone attachment, in a classroom practicum to quickly note comments and anecdotal reports of student progress for assessment purposes.

In terms of the authentic task that students completed in the early childhood subject, they used the iPod principally to record the audio for their digital story, and other audio aspects of the task. For example, one group used the microphone attachment on the device to record several characters' voices over a period of time. This group also used the microphones to create individual sound bites for each page of the story, so that sound could be attached independently to each slide within the PowerPoint story.

One annoying aspect of the task related to issues of compatibility between operating systems (e.g., Windows and Mac OS) and between different programs (e.g., PowerPoint to iMovie). Nevertheless, when asked what were the most positive aspects of the task, one group agreed that learning a different operating system was beneficial:

> Learning how to use a Mac, and the team work - it made us stronger and able to overcome deleting dilemmas.

Some students lost work through problems with synching on different computers with different versions of iTunes. Some students who were not familiar with iPods reported that it was not easy for them to deal with the interface. Some asked their younger siblings to assist them. More than one group also spent quite a lot of time perfecting animations and transitions in PowerPoint only to discover that these would not import into a .mov file.

As the student groups became more involved in the task, they sourced additional software in order to solve certain problems (e.g., editing of audio files or images). This in turn introduced additional issues associated with learning how to use the software and compatibility of file formats. In addition to the normal group project issues, such as coordinating meetings and participant contributions, the different levels of technology expertise was also a problem for a number of the groups. Interestingly this reduced as the project progressed and the groups gained more confidence in their ability to solve some of the technological problems. Informal lab sessions were also beneficial for sharing problems and solutions.

Generally, the response of the students to learning new and potentially complex technologies and software was made much more focussed and achievable through the use of the authentic task. The myriad of technology-related problems that were revealed in detail in many of the students' online journals were generally overcome because of a clear view of the final effects that the students wanted to achieve in their stories. This required some very advanced and creative problem solving.

Pedagogical affordances of the iPod

In relation to the second research question: *What are the affordances of an iPod for creating resources for early childhood learners?* the students generally expressed the view that such technology is not readily available nor a particularly appropriate technology for very young children. They saw the iPod as an unusual technology to use, believing quite reasonably that most children in the target group would not themselves own or have access to mp3 players. However, the participants were able to suggest a range of activities that would be possible even if there was only one iPod (such as the teacher's own, or a school's device) in use in the classroom. For example, when asked how they might use iPods with young children in an early childhood centre, one preservice teacher suggested:

> I'd definitely like to get them to write a story and paint the pictures [for a digital story]. It wouldn't be a big task … but the whole process would be fun for them. And they would really enjoy listening to the final story.

When prompted, students were able to suggest many appropriate activities using the iPod in an early childhood setting, for example:

- Recording students singing and telling stories: 'they love to hear their own voices',
- Recording classroom interactions to play back to demonstrate 'using your manners',
- Singing songs and making a class CD,
- Recording events that happened on holidays to share with the whole class,
- Recording children's voices and then letting them listen: 'your recorded voice usually sounds quite different to what you might imagine. It would be quite interesting for young children to get to know the sound of their own voice'.
- Record children's reading so they can listen and reflect on how they read,
- Teaching them reading: 'have some difficult bits of text recorded for them so they can listen if they need help',
- Keeping files as a record of children's progress ' such as anecdotal records and running records',
- Producing presentations with a variety of sounds.

One student commented:

> I feel through the tutorials, lectures and assessments I have gained some great ideas for my future classroom, in particular the digital book. I have seen how easy and enjoyable it can be.

Additionally, some of the preservice teachers anticipated that younger generations might be more familiar with the technology than early childhood educators themselves. For example one student noted:

> You wouldn't need to teach young children how to use iPods, they probably would already know!

Another pointed out that teachers might be surprised at what their children produce in working with technology:

I think that there are probably lots of other uses that it could have with the younger generation of our students. As teachers, we set them an assessment and what they give us will surprise us because they will be giving us ideas about how to use things. They've just got that wider view of how things could be used, whereas we tend to use it the way it's been introduced to us.

When asked how iPods could be used by preservice early childhood educators in their own study at the University, the participants were able to offer a number of ideas. As well as suggesting the downloading of podcast lectures, students suggested other more reflective tasks such as listening to supplementary audio recordings in the car while driving, or making anecdotal records about their own learning. One student also suggested that the iPod could be used by lecturers 'to capture the students' progress with the task, not only the final product'.

After brainstorming the potential uses of the iPod both in class and in the interviews, the students were able to suggest many interesting and innovative pedagogical uses of the device both in their roles as early childhood educators and as students at university.

Pedagogical strategies

The final research question asked: *What pedagogical strategies were required to assist the students' use of the m-learning devices as cognitive tools for their digital books?*

The design of the pedagogical strategies in the early childhood learning environment drew upon principles of authentic learning, namely: providing an authentic context, an authentic task, expert performance, multiple perspectives, collaboration, reflection, articulation, scaffolding, integrated assessment (Herrington & Oliver, 2000; Herrington & Herrington, 2007).

The use of the authentic context and task of creating a digital story book appropriate to the teaching setting of early childhood proved to provide a strong framework for learning the ICT skills required of the introductory course. Not only did students learn how to use standard software packages such as PowerPoint and iMovie, but they also acquired and used additional software to achieve a given effect (e.g., Garageband, Audacity, Photoshop). Since many students used hand-drawn illustrations, they also learned processes such as scanning and importing images, and they learned how to import and edit sound, music and sound effects. One student commented on this learning:

The product may not have been exactly what we wanted but we learned so much about what works, what doesn't work and how to apply the technology, that the product itself wasn't as important for learning as the process was.

Expert performance was provided in story telling largely through the guest lecture provided by a well-known children's author. In terms of the technology skills to be learnt in the course, it was provided through lectures and tutorials and the modelling of processes by course teachers, but also through reference to self-guided resources such as online support from hardware and software companies, and

printed sheets with basic instructions that were available from the subject website. This kind of support also provided multiples perspectives on the task and how it could be achieved. Some students said they perhaps would have benefited from more guided time with an expert for exploring the iPod and some of the pieces of essential software such as iMovie. They felt that self-exploration was beneficial but some concentrated input regarding the tools in the early stages of the task would have assisted many of the students. Nevertheless, such direct instruction was not part of the philosophy of the approach, and the sophisticated problem solving required by students, and the learning that resulted, in some ways vindicates this less didactic approach. As one student noted:

> This was certainly a project which had it all, tears and laughter, frustration and excitement and even a little swearing thrown in for free. I am glad that we did not take the easy way out in the beginning. I have certainly learnt a lot.

Students collaborated in groups to achieve their final product and generally this was very successful. Students were advised to share the iPod during the weeks of use, so that all could become familiar with its features. One student pointed out: 'It was hard to share the iPod. It would be great to have one each'. Some groups also chose to co-operate rather than work together in a truly collaborative way. For example, one group chose to assign the iPod to a single person 'because she had a younger brother who had an iPod and could explain to her how to use it and during the whole task she was in charge of it'.

Through the group process and through public presentations of their work, the students had the opportunity to articulate their growing understanding of the technologies and processes they were learning. They were also able to reflect both *in action* and *on action* in this task (Schön, 1987), in action as they made decisions about how to proceed, and on action in their reflective journals. One student noted in relation to the problem-solving aspect of their reflection in action:

> We faced a LOT of problems, but by asking people and through trial and error we came up with a solution. I really enjoyed working on our book with [my group] and I hope that our final product emulates the good times we had completing it!

The teachers' roles in the activity were: to provide initial information on processes; to support and scaffold the students as they worked on their stories; and to assess the students' stories and journals. The aim was to facilitate learning and to encourage the students to try new and innovative things with technology. This was illustrated in one student's comment about no longer being afraid of the technology:

> What a challenge, but what a great feeling of achievement we all feel now its complete - well almost. We still need to transfer it on to the iPod and save it to Quicktime, but piece a cake right?? Yes indeed, these tasks no longer scare me, because we have proved to ourselves that with a little trial and error, perseverance and a few tears, we can succeed.

Conclusion

The digital story task was one that used an authentic approach to the learning of introductory ICT skills in an early childhood degree. As such, it proved to provide challenging and rewarding opportunities for students to learn to use mobile and other technologies not as an object of study but as cognitive tools to achieve a genuine product and significant learning outcome. This was evident to the students despite problems, issues, frustrations and tears during the process. Nevertheless, on completion all the products were polished and successful. The students enjoyed very much the process of sharing their accomplishments. One student summed up the purpose of the course well with this revealing comment:

> This has been a really challenging assignment but I did learn things I had never even heard of before, I guess that was the idea!

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CHAPTER 5

Using mobile phones to enhance teacher learning in environmental education

Brian Ferry

Abstract:

This study focuses on how action-learning sets helped preservice teachers (PSTs) to use mobile phones to augment their developing pedagogy. These school-based, action-learning sets consisted of groups of PSTs allocated to five schools that participated in the study. For six weeks they worked in pairs to teach a class for two hours per week. During this time the PSTs had access to mobile phones that had an inbuilt camera, Excel, Word, audio recording, video recording, internet, and email features. The phones were used to support and inform the teaching of an environmental education unit that had as its focus on waste and energy management. The findings indicated that the action-learning sets provided a vehicle for sustained and targeted professional growth.

Introduction

For the first time in history many pupils are more adept than their teachers in using a variety of technologies to acquire and transmit knowledge (Kirschner & Selinger, 2003). Jonassen (2000) claims that these pupils are often prolific and fearless users of technology and can assimilate new software and hardware as if it were second nature. Further, Kirschner and Selinger assert that 21st Century pupils are 'light years ahead' of their parents and teachers with respect to the possible uses of information and communication technologies (ICT). Much to the dismay of their teachers and parents, some of these 'net generation' pupils rapidly become bored and frustrated with school. Education systems may feel obligated to provide teachers with the knowledge and skills to effectively use ICT in the classroom and to work in technology-supported partnerships with their pupils (Kennedy & Krause, 2007). However, if the goal is simply to get teachers to use technology in the hope of appealing to a disengaged group of students then the chances of success are slim.

We have learnt that teachers cannot just be provided with the technology and left to their own devices; they need visions of the educational possibilities that the technology can provide. Just providing the tools is not enough, teachers need to know when, why and how to use these tools, and this requires just-in-time support, the time to experiment and on-going professional development (Ison, Hayes, Robinson & Jamieson, 2004). Thus modern technologies need to be seen as essential tools for teaching and learning, but they are not 'a panacea for all educational ills' (Kirschner & Selinger, 2003, p.5).

The purpose of the study was to make use of an action learning framework to provide on-going professional development, some just-in-time support and time to experiment with supplied Palm Treo 680 mobile phones that were used to augment the developing pedagogy of preservice teachers (PSTs) in primary (elementary) schools. The action learning process was documented in order to understand how the PSTs used the mobile phones to enhance their understanding of the impact of their teaching of an environmental education unit in a local primary (elementary) school.

Action learning (Revans, 1982) was adopted as a professional development framework in this context as the approach typically involves a small group of colleagues solving workplace problems utilizing their own processes of sharing, reflection and facilitation. These groups, known as action learning sets, formed the basis for PSTs to plan and design learning environments where the mobile phones could be used to record and support their classroom practice. Proponents of action learning argue that it is particularly suitable for adults, as it enables each person to reflect on and review the action they have taken and the learning points arising. This should then guide future action and improve performance. During this study the author of this chapter took on the role of a facilitator. This role was to use a combination of face-to-face, online and SMS communication strategies to scaffold the PSTs action learning sets.

Background

One of the National Goals for Australian schooling is for pupils to 'be confident, creative and productive users of new technologies, particularly information and communication technologies, and understand the impact of those technologies on society.' (DEST, 1999). But, like many other western countries Australia falls well short of achieving this goal and in 2007 one of the factors leading to a change of government was a clearly articulated 'education revolution' by the incoming Labor Government. In 2008, the Rudd Labor Government began to invest $1 billion over four years to turn every secondary school in Australia into a digital school. This will allow every Australian student in years nine to twelve to have access to their own school computer (Official website of the Australian Labor Party, 2007). All this capital investment is designed to make Australia more competitive in the digital age but there is the potential for disappointment if this strategy just sits pupils in front of a computer with access to the internet.

There seems to be an assumption that better learning will occur as a result of this investment. However, many students already have access to this form of technology at home and are more proficient than their teachers as users of the technology. There is also a danger that teachers will be left behind in this educational revolution and classrooms will be full of computers and other ICTs that are not used in ways that utilise the educational potential of the technology. To address this issue more attention will need to be paid to the ongoing professional development of teachers. The current policy document mentions that existing teachers will be progressively trained and that all new teachers will achieve competence in the *use of ICT only* – no mention is made about pedagogy. Further, this policy does not address the use of the mobile technologies that are ubiquitous in the lives of many children. For example a survey conducted in 2004 (the Age, September 28th, 2004) found that 89% of teenagers in Sydney and Melbourne had mobile phones. Further, various international surveys about mobile phone usage have been conducted in recent years reporting that the adoption rate among teenagers is so high that in many countries, teenagers are more likely to own a mobile phone than their parents (Netsafe, 2005; Campbell, 2005; Sulake, 2007).

Surveys conducted by Sulake (2008) between October and November 2007 summarized data from more than 58 486 teenagers across 31 countries. These data showed that youth use their mobile phones to text message, play games, listen to music, and take pictures. However, to many, the mobile phone is not a device for making phone calls, but rather, a 'lifeline' to the social network and an instrument for coordinating their everyday life (Matthews, 2004).

The figures in 2008 are likely to be even higher, and rather than restrict or ban mobile phones, schools may be better off integrating them into their normal routine. However, this will challenge schools as often mobile phones are seen as a disruption to a school's routine when students use them inappropriately. For example surveys such as those by *The Age* (2004) and Sulake (2007) show that more than half of teenage students leave their mobile phones switched on during lessons, leading to unauthorized messaging that disrupts their learning.

A number of studies have been conducted about the use of mobile phones as a tool for learning and functions such as the calculator, creating messages and the alarm reminder have been reported (Ison, Hayes, Robinson & Jamieson, 2004). Some of these studies targeted disengaged youth and found that these devices were helpful in building teacher-student relationships; this in turn facilitated improved learner engagement. Teachers in higher education in the UK have made use of SMS (short messaging service) as prompts for course requirements, polling classes and pop quizzes with some universities experimenting with phone exams where the user's voice print identifies them as the test-taker. However, there is some evidence that young people resent this as they see the messages as an intrusion (Geser, 2005). In general, universities have made use of personal digital assistants (PDAs) that may or may not be integrated with mobile phones to store and retrieve information such as e-books, courseware, and timetables. Many research studies report on the transmission of information that is created and sent out by the teacher to students using podcasts (e.g., McCombs & Liu, 2006; Pownell, 2006; Scott, Nishimura & Kato, 2006; Miller & Piller, 2005), but little opportunity is given for the students to demonstrate their own understandings using these or other devices. Modern mobile phones can be used to help learners access web-based content, remix it, share it, collaborate with others, and create media-rich deliverables for the classroom teacher as well as a global audience. Such functionality provides learners with new opportunities to demonstrate their understandings and this study represents a contribution to this area of research by focusing on the use of mobile phones as a tool to augment the developing pedagogy of preservice teachers in primary schools.

Teacher as learners with technologies

While education systems have focused on the use of mobile phones to communicate information for administration (e.g., attendance, homework, security alerts, communication with parents) as well as support for student learning (e.g., surveys, audio recording, video recording, web browsing, testing), less attention has been paid to the professional development of teachers. But, the ever-presence of

mobile phones, does not necessarily mean that teachers are willing or capable of integrating such technologies into their classroom practice. Even if education systems ensured that teachers were as proficient as their students in using new technologies such as mobile phones, there is still no guarantee that teachers will want to integrate mobile phones into classroom practice as in many cases the technology does not enhance what they already do and only adds an extra layer of complexity.

Most teachers do not belong to the generation of young people who Prensky calls the 'digital natives' generation (Prensky, 2001). The 'digitial natives' generation was brought up with this technology, and their teachers either struggle to keep up or just give up in the race to understand and use the latest technology. Often the 'digital natives' concept is offered as an explanation or excuse for the disappointment expressed by education administrators when the latest technological innovation fails to fulfil its promise in the classroom. However, as Bennett, Maton and Kervin (2008, p. 783) assert 'young people's relationship with technology is much more complex that the digital native characterisation suggests'. Therefore, it may be more productive to consider how educators can take steps to meet the challenge of these new technologies within their educational context as 'there is no evidence of widespread or universal disaffection' with schooling as is often claimed in the popular press (Bennett, et al., 2008, p. 783). Rather, there is a need to integrate *appropriate* technologies into existing education systems. This view supports the work of Ison, Hayes, Robinson and Jamieson (2004) who reported that during the *Txt Me* project the pre-existing technology skills of teachers were less important than their teaching and learning philosophy. Teachers who were keen to develop and sustain meaningful connections with their students felt motivated to acquire the necessary technological skills. They argued that professional development programs need to focus not only on the technology, skills and knowledge required to implement mlearning strategies, but also on the skills and knowledge needed to support a blended learning environment that makes appropriate and targeted use of technologies that support the overall learning goals. The question then arises as to what form should a professional development program take?

Hoban (2005) reported that it has been well documented that action learning is an effective methodology for many teacher professional development programs but it needs to be supported by a facilitator whose role is to scaffold practitioner collaborative learning using, for example, a combination of face-to-face, online and mobile synchronous and asynchronous communication strategies. This study contributes to the professional development of teachers in the appropriate use of mobile phones to enhance their pedagogy by focusing on how action learning helped preservice teachers to use mobile phones to augment their understanding of the impact of their teaching.

Methodology

During this study action learning was used as an educational process whereby the participants studied their own actions and experience in

order to improve their performance as a teacher. This is done in conjunction with others, in small groups called action learning sets. Each action learning set was located in one of the five participating schools. The 22 preservice teachers involved were divided into action learning sets as follows: four action learning sets each contained four PSTs, and one set contained six PSTs.

This following section is divided into five parts the equipment, the participants, training, teaching and the data gathered.

Equipment

The participants had access to PalmTreo 680 mobile phones. These devices not only function as a mobile phone, they also have email, messaging, and web access capabilities. In addition they can be used as PDA, as a digital camera (static and video), audio recording and as well as an MP3 device and internet radio. The PalmTreo 680 also supports Word, Excel, PowerPoint and PDF files.

When this study was conducted many of the more advanced features of the phone were only available through the older version of General Packet Radio Services (GPRS) and this was more expensive than more modern 3GSM. As the budget was limited web browsing and email functions were not used.

Participants

The 22 participants (1 male, 21 females) were third year PSTs enrolled in a Bachelor of Primary (Elementary Education degree). All owned a mobile phone and were very familiar with the basic functions. Three of the 22 participants owned BlackBerry mobile phones and were familiar with the advanced features offered by this device.

Training

All training took place in a computer laboratory that contained 20 computers. The PSTs were organized into action learning sets based on their school groups. Each action learning set was to discuss how they could use the mobile phones to record and reflect on their teaching. In addition, they were to consider how they could use the mobile phones with the pupils in the classes they would teach. These ideas were then shared with other action learning sets.

When the mobile phones were issued the facilitator conducted a two-hour session about how to use the mobile phone. A user-friendly manual had been prepared and this was used as the basis of the training session. After the session the PSTs took the phones with them and spent the intervening week practicing the skills they had learnt. The following week they re-met in action learning sets to demonstrate the skills they had practiced and learnt. During this second two-hour session preservice teachers were supplied with a USB card reader and they were shown how to use it to transfer video and digital photographs captured with their phone. By this stage they had also met their classes and the host teachers and were aware of the school policies regarding the use of the phones. All schools had parental consent for children's learning activities to be recorded, in addition there were no restriction on the use of mobile phones for educational purposes.

Teaching

The mobile phones were used in an elective subject that focused on environmental education. The major assessment task for this subject required preservice teachers to work in pairs to prepare, implement and evaluate a unit of work about waste, water and energy management with a class of year five or six students (10 to 12 years of age). In each of the five host schools, pairs of preservice teachers were allocated to a class to teach for two hours per week for six weeks. During this time each pair of preservice teachers shared a mobile phone that they could jointly use.

Teaching commenced the week after the second session. At the conclusion of each teaching session action learning sets were required to meet in the computing laboratory to download files and to share their teaching experiences. The facilitator attended these meetings where further ideas about using the phones were shared and additional training was provided on a just-in-time basis by a combination of peer teaching, facilitator teaching, and on one occasion, the expertise of an academic who had proficiency with all features of the phone.

Data gathered

Each week a pair of preservice teachers was allocated the task of leading the follow up discussion with their action learning set as this provided a valuable professional development experience for them and allowed the researcher/facilitator to act more as an observer. Another pair of preservice teachers from each action learning set was assigned to act as recorders and at the end of each meeting their summary was emailed for sharing among action learning sets. In the interim SMS messages were sent among members of the action learning sets to arrange meetings. At the end of the teaching experience an open-ended survey was used to follow up key themes that emerged from the emailed summaries. These data were also supplemented by the final assignments (a reflective e-record of their teaching) and the pupil PowerPoint presentations that occurred at a combined school culmination meeting. The audience at this meeting consisted of parents, teachers and pupils from participating schools and the researcher.

Results

The results are presented in four sections. The overall results are outlined in table 1, then these data are expanded to describe how the mobile phones were used by the PSTs and their pupils. The strengths and weaknesses of the phones as a tool are presented and finally the data that supports the use of mobile phones to augment the developing pedagogy of PSTs are presented.

Table 1 shows that the preservice teachers and their pupils often used similar functions on the mobile phones.

Table 1: The main uses of the mobile phones by preservice teachers and primary pupils

Feature used	Camera	Video recording	Audio recording	SMS	Other	Examples
Pre-service teacher use						
Recording of key teaching events for later review and sharing with action learning set	✔	✔	✔			Video of instruction of pupils about how to make a worm farm. Image of students weighing paper waste. Audio recording of questions about recycling paper.
Interviews with children to identify misconceptions		✔	✔			Video of a child drawing a diagram to show how the greenhouse effect occurs. Audio recording of a child's explanation of how evaporation takes place.
Record feedback from supervising teacher and partner PSTs			✔			Audio recording of teacher and partner feedback.
Record brief reflective comments			✔			Short audio comments on pupil progress in creating their worm farm
Recording pupil performance		✔				Pupil presentation to parents
Send supportive message to peers				✔		eg. 'Hope the composting went well'
Respond to SMS enquiry about progress				✔		eg. 'Can email you a copy of your lesson plan'
Calculator					✔	To tally weights and to calculate averages with the children
Pupil use						
Recording aspects of their work that they were proud of	✔	✔				Images of steps in a process such as measuring the waste paper produced each day. Video of pupil explanation of how to mix compost.
Recording steps in a process e.g. composting	✔					Video of pupil explanation of how to mix compost.
Short progress reports	✔	✔				Students produce a short report on the progress of their worm farm
Record a brainstorm session			✔			Ways of reducing paper waste
Calculator					✔	To tally weights and to calculate averages

Pre-service teacher use of the mobile phones

The most successful preservice teacher use of the mobile phones was as a video recording device or as a digital camera. In both cases the preservice teachers were capturing episodes from their lessons that illustrated the impact of their lessons on pupil learning. While the audio function was seen as useful when teaching, the difficulty in transferring audio files to a computer limited its use as a follow-up tool for reflection. Some of the other tools such as the cut down Microsoft Office suite of applications were of limited use as the size of the keyboard was seen as a problem for rapid data entry. Instead preservice teachers used standard computers that were available at their schools. Email and web browsing functions were not used, as it was cheaper and more convenient to use existing university facilities.

Pupil use of mobile phones during lessons

The pupils focused on episodes that reflected achievements that they were proud of such as their worm farm and compost bin. Examples were the posters they created, a role-play they created and their design of an earthworm farm.

Figure 1: An audit of the school's water usage

They also enjoyed the audio recording facility and used this feature to conduct peer interviews about events such as the construction of their worm farm or a brief survey of members of their group about a recycling question. They used the playback function during lessons and were not concerned about downloading their recordings to a computer. However, they did want to download their digital photographs into PowerPoint presentations that they could use at school so their PSTs loaned them USB card readers for this purpose. The quality of the PowerPoint presentations was high and these were not only presented to peers but also to parents. This allowed the school to showcase its work in the area of recycling and this was clearly appreciated at the parent meeting observed by the researcher.

The photographic examples in Figures 1 and 2 show the sorts of activities that the children and teachers captured. The first is an audit of the school's water usage and the second is paper making using waste paper.

Strengths and weaknesses of mobile phones

All PSTs responded that they found the phones easy to use and it was easy to transfer photographs and video to the computer for later review. The size of the device made them convenient to use for just-in-time recording of a significant event during their teaching. However, sound files were difficult to transfer to the computer. Those who persisted played back the sound file and re-recorded it on a personal iPod, but this created an additional layer of complexity. Some also had difficulty turning the phone off as the off button needed to be pressed for an extended period of time.

Another problem encountered was the limited charging capacity of the phone batteries. In general the Palm Treo 680 phones needed to be charged daily whereas many other phones that preservice teacher had used in the past could last three or more days between charges. As a result some Palm Treo 680 phones ran out of charge during their initial use in schools.

Figure 2: Paper making using waste paper

Use of mobile phones to augment the developing pedagogy of PSTs

PSTs recordings and photographs typically included exemplars of a successful teaching episode, an example of a student misconception that they had to address (e.g. often children link ozone depletion and global warming), an unsuccessful teaching episode (usually related to a classroom management issue) or a creative student work (e.g. a poster, table of data in Excel, PowerPoint slide or except from a pupil's journal). The presentations of successful teaching episodes were kept to a maximum of five minutes as this enabled all set members to share experiences during meeting times. These teaching episodes included explanations, conservation games, activities such as composting and recycling, pupil led activities such as weighing and recording paper waste, and pupil plays. The misconceptions presented related the greenhouse effect, ozone depletion, evaporation and condensation, and energy transformation – in particular the understanding that when energy is transformed the process in not 100% efficient.

Classroom management issues could be categorized into two themes; those that related to the management of the lesson and those that related to behaviour management of individual pupils. The second was mentioned less because of the nature of the schools that participated. Management issues arose when the PSTs worked in less formal settings and with a variety of equipment and much of what was presented related to the PSTs' inexperience in such contexts. Over time these problems were less evident and it seemed that the support and advice of set members contributed to this developing pedagogy. The recordings and photographs helped to focus discussion and to provide a context and it could be argued that a digital camera would have been just as good. However, the mobile phones allowed a supportive network among set members and SMS messaged were used to follow up on issues raised in set meetings. This provided encouragement and immediate support. Typical messages were:

> PST 1: How did u go?

> Response: Good better organized? U?

> PST 1: Awesome my role-play was great. Kids made a video so u can c it.

In the above example the students were following up on goals they had set for themselves at their previous meeting.

The weekly meetings of action learning sets in the computer laboratory provided a vehicle for sharing progress and the function of the mobile phones was to provide evidence that acted to focus and stimulate discussion. The formal assignment of roles such as leaders and recorders helped to create productive meetings that were able to concentrate on improving pedagogy. Thus members of the set had many opportunities to either provide constructive feedback that could lead to further improvement or to share ideas that could be used to solve similar problems. Also, the members of the action learning set shared the responsibility for their professional improvement among all members of the group. In this situation the facilitator had a supportive role in creating a climate that fostered professional growth. During this study the class was a small group of committed PSTs, however, if the group had been larger it may have been necessary to formalise the roles within the action learning sets and to make these roles assessable. In this situation this strategy would help to ensure that all action learning set members made a strong contribution.

Conclusion

There are some generalizations that can be made about the professional learning that took place and the lessons that may apply in other contexts. First, in this context action learning provided a vehicle for sustained and targeted professional growth that focused on short-term, clearly defined goals that would be reported on in a subsequent meeting. Second, the phones provided a means of providing evidence of this growth as well as evidence of problems that may have arisen. Third, the SMS function allowed for almost immediate affirmation of success or a call for help from a supportive peer. Fourth, the meetings allowed the PSTs to develop and share appropriate learning strategies that may or may not have included the use of mobile phones.

The main messages for professional development that arise from this study are similar to those raised in the study by Ison et al., (2004) and these are summarised below. An m-learning professional development program should include two aspects - a technology aspect and a pedagogy aspect. The technology aspect needs to include a basic understanding of telecommunication networks and providers sufficient for participants to know the cost implications of approaches they may adopt, an understanding of the mobile phone functionality and the ability to send, receive and manage messages using an SMS. The pedagogy aspect needs to include some understanding of the mobile phone communication culture of young people, and some understanding of the learning styles of young people. This needs to be supported by a professional learning framework such as action learning in order for teachers to develop the skills and knowledge needed to successfully integrate m-learning strategies into teaching programs. Any form of m-learning needs to be used judiciously and in ways that enhance the work of teachers and their pupils. Action learning sets provide a vehicle for critical discussion and feedback on evidence that could be provided by mobile phones or other recording devices. To support such professional learning education systems would need to provide time for the action learning sets to meet and the resources (mobile phones, card readers and computers). Most of the resources are available so the challenge is for education systems to provide the time. Often this requires money and one way would be to start with a single, action learning set and then target other sets in subsequent years.

As Kirschner and Selinger (2003) have said '… today's technology are essential tools of the teaching trade.' And while many pupils may be more adept than their teachers in using technology, young children in particular need dedicated teachers to create rich learning environments that allow them to make effective use of the technology to acquire, create and display the knowledge that they are gaining. It is hoped that this chapter makes a contribution to this exciting field of learning.

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CHAPTER 6

Incorporating mobile technologies within constructivist-based curriculum resources

Anthony Herrington

Abstract*:*

In the context of an introductory postgraduate subject on ICT in education the aim of this research was to evaluate postgraduate education students' abilities to develop appropriate pedagogical strategies for the use of mobile technologies in constructivist learning environments. The postgraduate students were all working in educational settings. The results indicate that the affordances of mobile devices can be embedded in constructivist based curriculum resources especially in tasks that involve students learning as they are mobile such as in fieldwork and excursions. The devices also appear well suited to be used in tasks that involve connectedness with other technologies such as web 2.0 and learning management systems.

Introduction

The aim of this research was to investigate the educational potential of incorporating mobile technologies in the postgraduate student design of curriculum resources that adopted a constructivist perspective on learning. The rapid advancement in the use of educational technologies has occurred in parallel with notions on learning. It is recognized that adult learners particularly those enrolled in postgraduate courses will have ready access to current technologies and a motivation to learn (Mason, 2006); it is not clear, however, how well equipped these students are at utilising these technologies in educational environments that reflect current theories of learning.

A recent survey of postgraduate student use of mobile technologies suggests that although ownership of the devices is quite high, their use for personal and student centred learning is limited, indicating a need for educators to provide initial support and guidance (Pettit & Kukulska-Hulme, 2007).

A critical understanding of pedagogy is necessary for those studying education; and constructivism and its various off shoots continues to be the predominant theory of learning. Honebein (1996, p.11-12) suggests seven approaches necessary to create constructivist learning environments:

1. Provide experience with the knowledge construction process
2. Provide experience in and appreciation for multiple perspectives
3. Embed learning in realistic and relevant context
4. Encourage ownership and voice in the learning process
5. Embed learning in social experience
6. Encourage the use of multiple modes of representation
7. Encourage self-awareness of the knowledge construction process

The approach taken in this study was to engage postgraduate students in a constructivist learning environment where they would learn about both the theory of constructivism and the use of mobile devices in learning. Mobile technologies appear to offer many affordances in such contexts (Patten, Arnedillo Sanchez & Tangney, 2006) and are rapidly becoming part of mainstream education (New Media Cosortium & Educause, 2008).

Students were set a task that was flexible enough to be relevant to their work place, where they would develop curriculum resources that required the use of mobile technologies by their own students.

Context of the study

The curriculum resource task was part of the assessment of a postgraduate subject in ICT in Education titled *Introduction to technology in education*. The subject was designed to:

- Develop students' theoretical and practical skills in designing, developing, and evaluating teaching and learning environments using a variety of instructional systems, particularly using information technologies.
- Review the research into learning and instructional design of information technology based systems.
- Review areas for the development of information technology in education and training such as interactive multimedia and alternative delivery systems.

Students could access the subject through face to face class sessions held fortnightly over a thirteen week semester and or could flexibly access the subject through a learning management system site which provided subject readings, resources and communication through threaded discussion boards.

The subject contained three separate assignments. The first assignment asked students to describe how technology is used in a context relevant to either their learning or teaching or both, explain what and how technologies are used and discuss some of the significant issues that arise in the use of technology in education. The second assignment, which formed the basis for this research, required students to create a curriculum resource using mobile devices that adopted a constructivist perspective. A third assignment required students to create a web site to present research around a current topic involving technology in education such as online communities of practice.

The research was carried out with a class of 21 students coming from a variety of technological, educational and cultural backgrounds each with the intention of entering or furthering their careers as educational designers, teachers or trainers in the school, university, vocational education, or adult and community education sectors. The students were a mix of domestic and international students from a range of professions, many of whom were school teachers, nurse educators, TAFE teachers and recent IT graduates.

Research questions

The research focused on the following questions:

- How do teachers/trainers develop curriculum resources that make use of mobile technologies within constructivist learning environments?
- How are the affordances of mobile technologies used in the curriculum resources? What uses were made of the mobile technologies that would have been difficult or impossible without them?
- What pedagogical strategies were required to assist the teachers/trainers use of mobile technologies as cognitive tools for their curriculum resources?

Method

Students were required to engage in the subject readings on topics that included theories of learning, instructional design approaches, and mobile technologies and complete the following assignment task:

The task

Designing a curriculum resource

Using a constructivist perspective the students were required to design a resource for teachers/trainers that exploited the affordances of mobile technologies. In the curriculum resource, they were to provide the following:

- A rationale for using mobile technologies
- Aims and learning outcomes
- Outline of a challenging activity for learners
- Guidelines for teachers/trainers
- Additional teacher/student resources
- Outline of assessment

A voluntary workshop was organised to help students become familiar with a constructivist approach to learning using a mobile devices. The workshop showed students how to use a smartphone and various other web based technologies to create a digital narrative (McGreen & Arnedillo Sanchez, 2005). This involved a problem solving activity where students collaboratively used the smartphone to collect digital media (pictures, video and audio) combining them to create a video digital story that is then shared with their colleagues.

Introductory activity

Students were introduced to the activity where they were shown an example of a digital narrative created by the author. Students were then grouped in pairs and asked to think up a story where they could create a 2-3 minute video using prompts selected from a provided 'bucket' of children's figurines and toys. Students were asked to complete a brief story board prior to shooting any of the scenes. Pictures and videos were then taken to represent the story and they were downloaded to computers and imported into iMovie where

students used voice overs and imported iTunes to create the digital narrative.

The session concluded with presentations of each story and a discussion of the affordances of the smartphone and characteristics of constructivist learning environments. These ideas were supplemented with readings available on the subject LMS site.

The students already had access to the smartphone some weeks before the assignment was due for implementation and submission. The idea here was to let students become aware of a particular mobile technology and what it was capable of doing following a short presentation given by the lecturer. Students had the option of using their own sim cards and using the device as their regular mobile phone.

The survey

Following the completion of the subject and after grades had been finalised, all students were asked to participate in the research and complete an email survey on the assignment task with these questions:

- Can you describe your intended use of mobile technologies in your curriculum resource?
- What would be the advantages of using mobile technologies?
- What would be the disadvantages or challenges of using such devices?
- How would you prepare teacher/trainers for the use the devices in your curriculum resource?
- How would you prepare students for the use the devices in your curriculum resource?
- Did you feel sufficiently prepared to create curriculum resources using mobile technologies?
- What were the most difficult aspects of creating the curriculum resource?
- What were the most positive aspects of the task?
- What other pedagogical uses can you think of for mobile technologies?
- What advice would you give to other teacher/trainers wishing to implement activities that use mobile technologies?
- What principles of good use can you suggest that have emerged out of your use of mobile technologies during the course of the activity?

Each student's curriculum resource was viewed and analysed.

Results

The results of the survey and observations of the final products will be considered in relation to each of the research questions:

How do teachers/trainers develop curriculum resources that make use of mobile technologies within constructivist learning environments?

As would be expected from any assessment task a wide range of abilities was in evidence. Generally most of the students had come to grips with the set readings on constructivism and were able to provide

sound rationales for using mobile technologies to support the main tenets of constructivist learning environments. The arguments for using mobile technologies were also well appreciated. Interestingly, most of the students chose to base their curriculum resource on the use of smartphones possibly due to the experience of having one lent to them in the subject. Nevertheless, many were willing to go beyond the single device and describe activities gleaned from the literature where mobile devices could be linked to groupware such as learning management systems and interactive whiteboards. However, some thoughtful arguments were given about not using smartphones based on cost and low ownership of the device amongst their own students.

The nature of the tasks that were described, although justified in terms of current learning theory, did not necessarily exploit the affordances of the device or the notion of mobile learning suited to learners that are mobile. For example one student provided mathematical word problems for his primary grade children to solve that clearly involved, higher order thinking, collaboration between pairs of students, communication, justification and reflection on outcomes all of which made sense from a mathematics education perspective. However, the recommended use of the smartphone was to simulate a calculator, determining an arithmetic answer, conveying this to a classmate and blogging a reflection around the method and solution. In reality, of course, any experienced mathematics teacher would simply use a calculator and then engage the students in a meaningful discussion. The postgraduate student is aware of constructivist approaches, aware of the functionality of the mobile device but what seems to be lacking is an appreciation of its affordances and the context in which it could be used most effectively. On the other hand, tasks that reflected the affordances of the devices for mobile learning can be seen in the examples that follow.

How are the affordances of mobile technologies used in the curriculum resources? What uses were made of the mobile technologies that would have been difficult or impossible without them?
The tasks developed by the students highlighted particular affordances of mobile technologies especially where learners themselves were mobile in their work or study environment. One student described a task where new graduate nurses were required to use smartphones to develop collaboratively an assessment framework for cancer patients based on their spontaneous postings as they made ward visits. Postings were made to a web-based portal where wikis and blogs were utilised. Interestingly, the student had gone beyond the requirements of the assessment task and actually implemented the learning environment. Another student planned the use of laptops as recording devices for his year 10 students to record interviews with Vietnam War veterans. The interviews would then be posted to a website for further student analysis. Both of these tasks were justified in relation to learning theory and used the functionality of the devices in conjunction with web 2.0 technologies.

Fieldwork and excursions were seen as particular contexts in which the affordances for mobile technologies could be exploited. Gathering data in the form of pictures, videos and sound recordings and note taking all appeared valuable activities that supported constructivist-based activities set in contexts outside the classroom and lecture

theatre. The proposed use of these data to enable creative presentation formats such as iMovie and Powerpoint again went beyond the functionality of a single device.

The time flexibility of mobile learning was seen as a particular affordance for non traditional workers as one student commented: 'The use of mobile technology means that access to learning can be around the clock and does not require face to face facilitation … this allows for shift workers and non-traditional or casual employees to have access to relevant materials.'

The examples reflect theoretical notions of mobile learning where mobile learning occurs within the convergence of mobile devices and mobile learners. The key assumptions are that learners are mobile — learning across space, time and content; that learning incorporates both informal and formal contexts; and that learning involves knowledge that is socially constructed through personal and shared technologies (Sharples, Taylor & Vavoula, 2007).

What pedagogical strategies were required to assist the teachers/trainers use of mobile technologies as cognitive tools for their curriculum resources?
Most students believed that the devices required little direct teaching as most people already owned one. Gaining familiarity by 'playing around' with the device seemed to be a common approach. Being aware that students often know more about the technology caused one student to advise facilitators to ' recognise that students will probably know more and utilising their expertise in mentoring and leading.' Nevertheless, the use of mobile technologies in teaching and learning still warrants the facilitator to keep abreast of the latest developments as one classroom teacher noted: 'the teacher does have to keep on reading, researching and trying new equipment which will enthuse and engage the student.'

A number of students observed the difficulty in accessing smartphones and other mobile devices for their students and were unsure about the cost of using the communication aspects of the devices. *Who pays?* seems a common concern. Additionally, infrastructure such as wireless networking may not be available in many workplaces. Making use of technologies already owned by the students and making mobile learning activities optional appear to be practical approaches for overcoming these concerns.

Conclusion

Providing students with a complex curriculum task involving mobile technologies set in the context of their classroom or workplace was a daunting but rewarding task for most students. As shown by one student's comment 'Considering that this was a task that scared me when I read it in the [subject] outline during the first week of session, it was probably the one I ended up enjoying the most.' The tasks that were created by students reflected a sound understanding of constructivism, in particular, authentic learning, as well as the technical aspects of the mobile devices, however, the affordances of the devices in terms of mobile learning were not always in evidence.

The affordances were clearly visible when the devices were used in environments where the learners were mobile such as hospital wards,

field trips and excursions. The devices lacked credibility when their suggested use was simply to mirror other, better-suited technologies such as calculators. The potential for affordances were recognised but the realities of cost, non ubiquitous ownership and the lack of supporting infrastructure meant that some tasks may only be 'good in theory'.

Blending mobile technologies with other technologies provides additional affordances. Capturing media using a mobile device, then co creating and sharing content through wikis, blogs and learning management systems characterises the notion of produsers coined by Bruns (2005). Bruns argues that emerging generations are 'no longer producers or consumers, publishers or audiences, but both at the same time'.

Developing curriculum resources is an authentic task for teachers and trainers. Integrating mobile technologies in the resource requires consideration of a number of issues that include an understanding of theories of learning – constructivist, authentic and mobile as well as the enabling aspects or affordances of mobile technologies that support such learning. Suitably combined, the results can provide challenging and motivating environments in which both teachers and students can potentially achieve significant learning outcomes.

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CHAPTER 7

Using iPods to capture professional dialogue between early career teachers to enrich reflective practice

Jessica Mantei and Lisa Kervin

Abstract:

Teachers early in their careers usually describe classroom teaching as complex and at times overwhelming as they endeavour to put into practice their beliefs and understandings about learning. For many, their university experiences seem removed from the reality of the classroom, they struggle to make strong links between theory and practice and as the collegial networks forged in the tutorial setting become less accessible, many teachers feel isolated from familiar and trusted networks. In this study, iPods were used to extend an established learning community beyond the university setting by creating audio files of professional dialogue captured during workshops and uploading them to a repository for teachers to access as needed. This chapter explores the process of capturing and sharing dialogue around teaching reflections between and among early career teachers.

Challenges for teachers in transition

The literature describes teaching as a complex task that draws on a range of attributes, both personal and professional. From the outset of their employ, teachers face many of the same responsibilities and dilemmas as their more experienced colleagues (White, 2005; McCormack, Gore & Thomas, 2004), and it is this combination of simultaneously teaching and learning how to teach that creates tension for early career teachers (Manuel, 2003; Pajares, 1992 in McCormack et al., 2004). Opportunities to collaborate and build collegial networks during this transition from preservice teacher to early career teacher is important in the development of professional identity as it supports strong connections between theory and practice and an understanding of what it is to be a teacher (Bintz & Dillard, 2007; Allen, 2005).

Hammerness, Darling-Hammond and Bransford (2005) argue that the transition from preservice teacher to teacher can be examined through three principles of learning as follows.

Principle 1

Preservice teachers enter the profession with a number of preconceived ideas about the nature of teaching based on their observations as a primary or secondary school student and their subsequent inferences about 'what good teaching looks like and what makes it work' (p. 367). These beliefs are not necessarily the reality of teaching and are therefore challenged early in a teacher's experience.

Principle 2

Teaching requires deep theoretical, content and organisational knowledge and the ability to enact that knowledge as it is required. This is supported by White's (2005) observation that experienced teachers are able to make 'split second' and intuitive decisions that result in success for their students (p. 15). The ability to make these types of decisions in the moment can remain challenging for some time as deep

understandings continue to develop (Griffin, 2003). Teachers early in their careers are often tempted to revert to methods of teaching and learning that they perceive to be safe, that is, experiences from their own education (Griffin, 2003).

Principle 3

A metacognitive approach enables the transition from preservice teacher to early career teacher through reflection on their development, the acknowledgement of their strengths and the identification of areas for professional growth. The metacognitive approach can be supported by a reflective journal enabling the construction of professional knowledge throughout their careers (Griffin, 2003); such a method affords reflective practice that is rigorous and systematic rather than simply mentally replaying an event (Rodgers, 2002).

It is acknowledged that no amount of preservice education can fully prepare or equip teachers with all of the skills and strategies needed for successful classroom teaching (Gore, Williams & Ladwig, 2006). However, teacher education programs that attempt to develop in students the ability to challenge preconceptions, to build deep understandings and to systematically reflect on practice have the potential to prepare teachers who are competent in their capacity to learn from their teaching (Darling-Hammond, 2000). Strengthening professional networks through dialogue is one way early career teachers may be supported in this transitionary period.

Technology affords these opportunities

Mobile technologies such as iPods have the potential to support early career teachers in their transition from preservice teacher to teacher as they work both within and beyond the physical university context. Whilst much of the research is focused on the use of iPods as a tool for dissemination of information from teacher to learner (e.g., Scott, Nishimura & Kato, 2006; Miller & Piller, 2005; McCombs & Liu, 2006), Frydenburg (2006) argues that their potential is greater, describing iPods as not only a 'useful tool for disseminating course information to students but [that they become] even more powerful when students are responsible for creating that content for their classmates' (p. 9). It is within this creation of audio texts as a tool for reflection both on one's own dialogue and on the dialogue of others that the opportunities are realised for quality learning and community building.

Quality learning occurs when learners have time and space to make connections between theory they have studied and the experiences they have had in practice (Billings, 2005); and mobile technologies can create these opportunities. A blended learning environment—one that includes both online and physical learning experiences—is identified in the literature as powerful in catering for a range of learning preferences because it builds on the community within the physical environment and provides flexibility in the virtual (Soccio, 2005). Frydenburg (2006) argues that one is complemented rather than replaced by the other, observing that audio files such as podcasts 'added value to, but did not replace the in-class experience' (p. 9).

This finding is exemplified by Ito's (2003) observation that the power of the blended system is not only its convenience but that it also facilitates learning that is 'non-threatening and extremely flexible' (p. 47).

Using iPods to capture professional dialogue between and among early career teachers creates the opportunity for these conversations to be revisited. Frydenburg (2006) found that the majority of tertiary students who accessed audio files in his study did so to clarify understandings. Pownell (2006) identified the opportunities for students to access such professional experiences outside the confines of the traditional tertiary teaching setting and at times suitable for the learner as a benefit of using mobile technologies to support learning. It is this chance to revisit, clarify, challenge and integrate new understandings that make the opportunities afforded by the capture and provision of professional dialogue files valuable for learners as they transition from preservice teacher to early career teacher.

Theoretical framework

A community of learners is defined as a 'place where caring, responsive people nourish each others learning in the context of authentic relationships' (Miller, 2000, p. 9), these relationships are enriched through just inclusion of all members in discussion and decision making in a safe and supportive environment (Wells, 1999). Members in the community take responsibility not only for their own learning, but for the development of the collective knowledge of the group as well (Groundwater-Smith, 1999). Such a framework supports this study through its focus on the development of the collective professional knowledge of all early career teachers within the group and their transition from preservice teacher to early career teacher.

Common to the research around communities of learners are the principles of trusting relationships between members, reciprocal learning, diversity in experience, expertise and interests of members, commitment to learning and the development of shared understandings for the benefit of both community and the individual (Cooper & Boyd, 1997; Grundy, 1999; Miller, 2000; Collins, 2006). It is through the lens of a community of learners framework that the development of professional identity and professional growth may be examined.
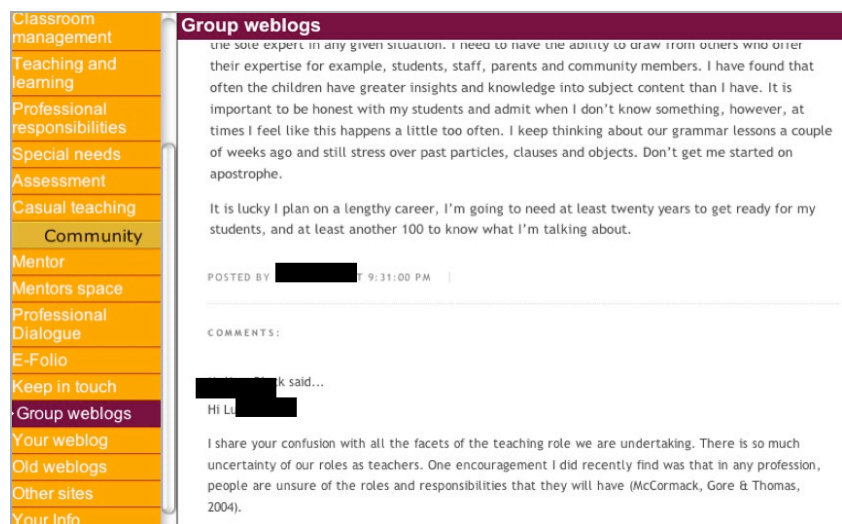
The context of the research

A total of 48 early career teachers, nine men and 39 women participated in this study. The participants were enrolled at the University of Wollongong in the Bachelor of Education degree. Having completed a three year Bachelor of Teaching degree, these early career teachers are qualified to teach in primary school classrooms while they complete their fourth year of study – the Bachelor of Education. The opportunity to teach and study simultaneously provides these participants with opportunities to test out their beliefs and approaches to facilitating learning in classrooms and to reflect on their efforts within an academic environment focused on enriching the theoretical underpinnings of sound pedagogy. At the

time of this study, the participants were completing *Reflective Practice*, a core subject within their degree that explores the complexity of teaching and the crucial role that systematic and sustained reflection plays in the development of professional identity and deep understanding of the nature of learning.

The *Reflective Practice* subject engages learners in both physical and virtual environments. The early career teachers participate in face to face workshop sessions for three hours per week over a 13 week semester and also interact as an online community of learners on the BEST website (*Beginning and Establishing Successful Teachers*). This website was created for the use of students within the Faculty of Education at the University of Wollongong. Among its many features, it affords a range of interactions between community members including online mentoring and the creation and sharing of weblogs (Herrington, Herrington, Kervin & Ferry, 2006).

Figure 1 shows an example of interactions through blogs on the BEST site.

Figure 1: Interactions through blogs on the BEST site

Describing the context of the study

Professional reading and reflection form a significant component of the workload for early career teachers in the *Reflective Practice* subject. Readings are selected to support and develop the focus of workshop sessions and in response to the needs of those enrolled in the subject. In this study, ten readings were selected that represented the diverse circumstances of the early career teachers in the subject.

Table 1 lists the focus of each workshop and the corresponding reading selected to support the focus and to stimulate dialogue between and among the readers.

Table 1: Reading and its focus for workshops: Professional Reading Schedule

Reading	Dialogue focus
McCormack, A., Gore, J., & Thomas, K. (2004). Learning to teach: Narratives from early career teachers. *Paper presented at the Australian Association for Research in Education,* University of Melbourne, Melbourne.	Values and identity
Cambourne, B. (2001) What Do I Do with the Rest of the Class?: The Nature of Teaching-Learning Activities. *Language Arts* 79(2), 124 – 135	Curriculum
Lapp, D., Flood, J. & Goss, K. (2000) Desks don't move – Students do: In effective classroom environments. *The Reading Teacher,* 54(1) 31 – 36	Planning
Hopkins, D. (2003) How to teach better: Good pedagogy is good learning. *Curriculum Corporation Conference*	Learning
Rodgers, C. (2002). Defining Reflection: Another Look at John Dewey and Reflective Thinking. *Teachers College Record* 104(4), 842 – 866	Assessment
Labbo, L. D., Montero, M. K. & Eakle, A. J. (2001). Learning how to read what's displayed on school hallway walls - and what's not. *Reading Online* 5(3). Available: http://www.readingonline.org/newliteracies /lit_index.asp?HREF=labbo/index.html	Organisation
Clarke, M. (2000) Direction and support for new non-Aboriginal teachers in remote Aboriginal community schools in the Northern Territory. *Australian Journal of Indigenous Education* 28(2), 1-8 OR Trimingham-Jack, C. & Hitchen, H. (2004) Giving all/reaping rewards: An account of a new graduate teaching in remote Indigenous community schools. *Education in Rural Australia* 14(1), 32-50 OR Cameron, J. M. R. (1994) Beginner's tale. *Education in Rural Australia* 4(2), 15-21	Values and identity
Townsend, D. (2005). Facing reality: Talking about the big educational issues is the key to school success. *Australian Educator,* 45, 24-27	Communication

The task for each person was to read, reflect and respond to the literature in relation to his or her existing understandings, ready to engage in professional dialogue with their peers during workshops. The expectation was conveyed during initial workshops that everyone would be prepared to contribute to the discussion and to explore the issues and themes within each reading. A framework was provided to support reflection on the reading and subsequent sharing during professional dialogue. The framework allowed the readers to consider each article in response to the following questions:

- What are the key points in this article for me and why?
- What puzzled or confused me?
- What are the implications for my professional identity as a teacher?

The early career teachers self selected into groups of three to five members and one iPod and microphone was allocated to each group. Consent was obtained from each participant to capture the professional dialogue of the group and for it to be uploaded to the BEST site for the benefit of not only group members, but for other members within the *Reflective Practice* learning community as well. Each week students met as a group to discuss the reading with the

goal of capturing 15- 20 minutes of sustained professional dialogue on the iPod. All workshop members were asked to refrain from naming schools, staff members and students throughout the dialogue in order to maintain confidentiality and protect their identity. The researchers monitored the dialogue and used editing software to remove identifying remarks prior to converting them to mp3 files and uploading them to the BEST site.

The professional dialogue files were available to participants as they reflected on their practice, constructed and modified weblogs, responded to the issues raised in both the virtual and physical communities and as they completed assessment tasks. Although not assessed as a separate entity, the professional dialogue informed reflection, analysis and synthesis conducted in assessment tasks throughout the *Reflective Practice* subject.

Framing questions

The following research questions framed our investigation of the role of professional dialogue in the professional growth of early career teachers:

- How do early career teachers describe the process of reading, reflecting and sharing their emerging professional understandings?
- How can mobile technologies support the processes of reflection and sharing?
- How does the creation of a repository of professional dialogue audio files support early career teachers studying and teaching in the Reflective Practice subject?

Subsequent to reading each article, groups met to discuss their response using the framing questions as a guide. Group members were observed to build on each others emerging understandings as they made connections to personal experience, experiences of those within the group and the stories they knew from their extended networks. By way of example, the dialogue below shows how discussion began with the framing questions, moved into personal response and then encapsulated the varied experiences within the group.

Excerpts from one group's response to a dialogue task

P1 I thought the article was very insightful with regard to…
P2 Yes, I agree – I agree with…
P3 And I agree
P1 What are the key points of this article?
P2 I'll just read this quote, shall I?...
P3 Well I agree with it.
P1 Totally! 100%
P2 …do you agree?
P4 Absolutely

P2 Do you want to hear the quote again? (Reads the quote)
…
P4 Who defines who's… And that's the big debate – that's kind of like…
P1 But I'm talking about…
P4 But doesn't that come back to your own personal opinion? ...
P3 Well, that's exactly what I was going to say…
P2 Yes, well see for me, what I think – listening to that quote – I think…

P3 And do you think that comes with time?
P2 Yes
P1 Do you think a new, new out teacher actually has that?
P4 That's exactly what it's sort of like on my prac…

P3 Yes, I've read that in there somewhere.
P1 And I think that's a really good quote that sums it up.
P3 Yes! Totally!

Findings

Students were asked to evaluate the learning opportunities offered through the professional dialogue recordings through both closed and open questions. Forty two students completed this survey and questionnaire designed to explore the ways that they conceptualise the task within the context of their own professional growth and experience. Quantitative data (closed questions) were collected as the students were asked to rate the benefits of the experiences on a Likert scale of 1 to 5, with a score of 5 indicating that the student believed the activity to be of the highest benefit to their learning. Qualitative data (open questions) enriched this information as the students elaborated on the challenges and benefits of using iPods to capture and share professional dialogue. For the purposes of this chapter descriptive statistics generated will be examined in connection with our preliminary analysis of open ended questions.

Question 1 asked the students to identify the degree to which the professional dialogue task supported their engagement with the set readings for the *Reflective Practice* subject and the results are graphed in Figure 2. Most students identified that the responsibility attached to the expectations for professional dialogue was either somewhat or quite beneficial in supporting them to engage with the readings, whilst only 3 of the 42 students felt the task was low in benefit for supporting their engagement with the readings.

Figure 2: Engaging with the professional readings

Benefits of engaging with professional readings
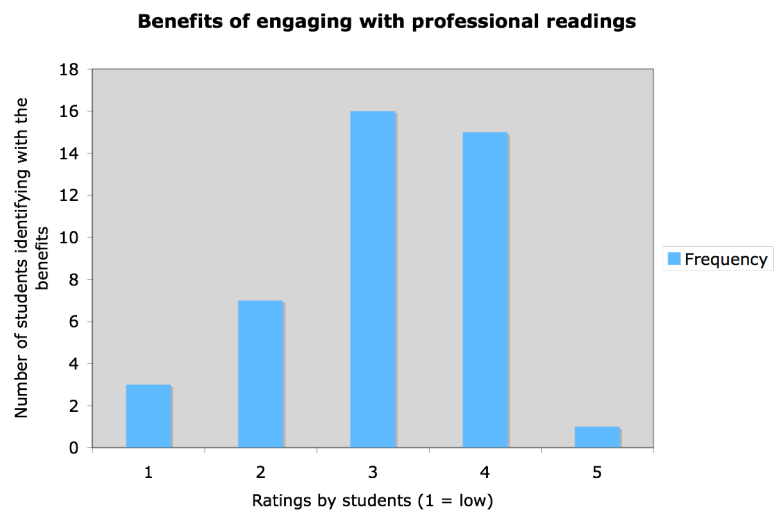
Analysis of responses to open questions in the questionnaires revealed commonalities between responses; students identified the opportunity to explore points of view within the literature, meeting the responsibilities of completing and reflecting on the readings each

week and being prepared for peer discussions as benefits of the requirement that the readings were read in preparation for each tutorial workshop. One student's response encapsulated the responses of many, '…it forces you to do the readings – Ha! But no, it goes further than that as it forces you to think about them as well'.

The second question explored the students' opinions about the value of participating in professional dialogue with their peers and the results are graphed in Figure 3. Each week, the students met with the same (self selected) group and many used the framework of questions each time to guide their discussion. Data analysis revealed that the students considered the opportunity to spend time engaging with their peers was of considerable benefit to their learning. No student identified the opportunity as being of low benefit and just 2 of 42 students considered it of little benefit.

Figure 3: Opportunities for professional dialogue with peers
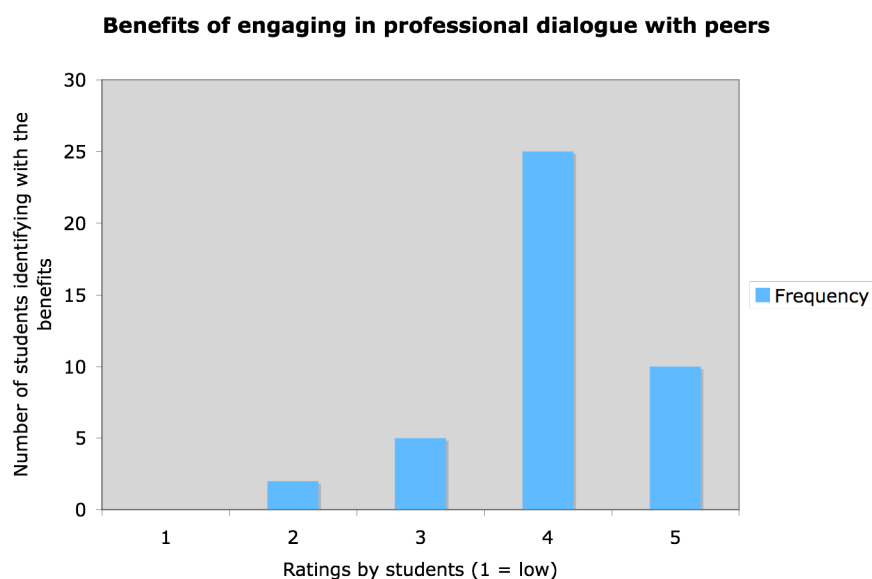
Reasons the students valued the opportunity to spend time in professional discussion were revealed within the questionnaire. Most students indicated they felt it was a valuable opportunity to 'talk out issues, questions and thoughts', to gather different perspectives or to confirm developing beliefs of their own.

A smaller group identified as beneficial the chance to hear about the experiences of others, both in the readings and in the professional dialogue group. For example, on reading the experiences of a range of early career teachers in McCormack, Gore and Thomas' (2004) article, Learning to teach: Narratives from early career teachers, one student explained

> I really took to heart the fact that all these people are coming out here [to teach]…all of them are finding the same thing, so it makes me feel so much more reassured. Yes, reassured that when I go out and go, "Oh my gosh, I cannot believe that happened", that other people are feeling the same way.

Those who identified the task as being less beneficial observed that some of their peers took the time as an opportunity to demonstrate

their superior knowledge and thinking and that they felt somewhat intimidated to share what they really believed due to ' worry about what others may think'.

In responding to the third question, exploring perceptions of the benefits of working each week with the same group, the students demonstrated a strong bond within the groups. Evident in the graphed results in Figure 4, most students identified as quite beneficial (18 students) or highly beneficial (10 students) the chance to regroup with a familiar set of people each week. No student indicated that retaining the same groups was of low benefit to their learning.

Figure 4: Benefits of talking with the same group each week

Benefits of talking with the same group throughout the experience
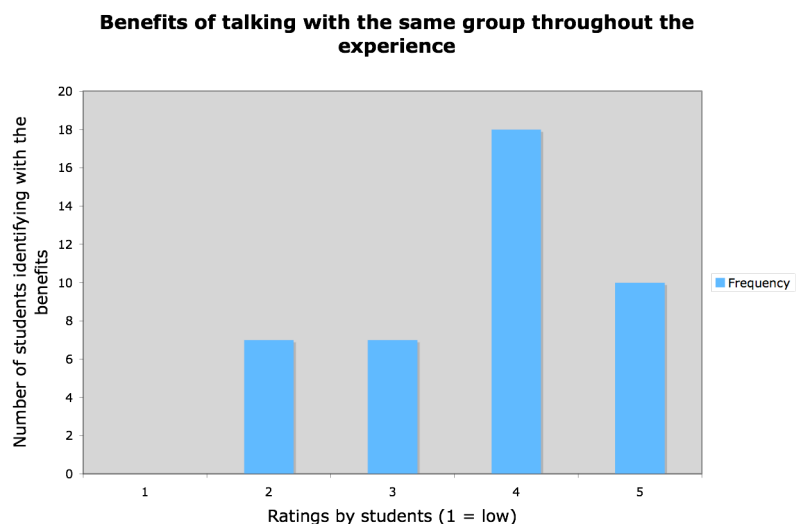
Whilst all students provided informed consent to participate, almost all described initial discomfort about being involved in the task, they used such terms as 'nervous', 'awkward', 'apprehensive', 'intimidated', 'weird' and 'self conscious'. One student responded 'I really don't want to do this', whilst another felt that the task was an 'invasion of privacy'. What is interesting, though, is that the majority of students indicated that their discomfort eased as they became accustomed to the group dynamics and the dialogue process. Later descriptions revealed that the students felt 'fine', 'more confident', 'looking forward to the discussions', 'comfortable' and even 'excited'. In fact, the student who felt indignant about the invasion of privacy later said

> [Now I am] not so worried about what I have to say and I like finding out what's in their [other group members'] heads. I enjoy it, especially when we get to go outside and relax on the grass and enjoy the afternoon. It's a nice way to wind down after a flat out lesson with the copious amounts of work and thinking that is required.

Questions 1 to 3 on the survey aimed to gather information about the students' perceptions of the recording of and the implications on their learning. The final questions sought to understand the role of the professional dialogue audio files in supporting reflection and developing understandings. Students were asked about the benefit of being able to download the audio files from the BEST site to listen to

the dialogue outside the tutorial setting in support of their learning preferences and learning styles. Initial reservations shared were organisational, some students expressed concern about the time required to listen to a file and also the inconvenience of breaching the university quota for allowable student downloads.

More promising, though, were the comments of the students who had solved these issues of management. These students made strong connections to the value of belonging to this community. One student described it as valuable in providing an 'insight into how others took the readings and the experiences they've had', while another felt reassured 'knowing that my fellow peers are feeling the same as me and experiencing similar situations, knowing that I am not alone – which makes me feel a whole lot better!'. Evidence of a growing professional identity among some responses was clear as the students referred to themselves and their fellow students as 'teachers', 'professionals' and 'colleagues'.

The potential for learning beyond the tutorial setting was also recognised as a benefit of the professional dialogue task. Responses included the observation that the use of iPods and the BEST site enabled them to 'listen in' to the conversations of other groups that they were not part of, further informing their professional understandings. The opportunity to revisit the dialogue as part of reflection also allowed the students to clarify their understandings of their own conversations and also to check the interpretations within the conversations of others in the group.

An unintended, yet pleasing benefit was also identified within 10 of the evaluations from this group; the use of iPods was recognised as supporting these teachers in developing technology skills for use in their classrooms. The ability to 'stop and start a recording', to 'learn about another use for iPods' and to 'learn the technology of the iPod' was something deemed useful to add to the teaching armoury. While this may not have been a learning objective as we defined and set the task, it is an important area of professional learning.

Discussion

Opportunities for groups to meet regularly to discuss the professional readings built community amongst this cohort of students. The mobile devices enabled the students to meet and record dialogue in places where they felt comfortable. Students reported feeling more supported and less alone as they shared their thoughts, heard ideas that confirmed and challenged their interpretations, and reflected upon subsequent implications for their professional practice. They were actively involved in creating their own materials (Frydenburg, 2006) to represent their learning and provide aids for further reflection.

The iPods offered significant affordances for the task. Having the iPod to record the dialogue to be later uploaded onto the BEST site increased the students' accountability for the task. Students reported the need to keep up with the reading schedule so they were able to offer their thoughts, comments and reflections as silence was so obvious through the virtual medium. With this accountability came

rigorous and systematic reflection (Rodgers, 2002) as students prepared for, engaged with, and reflected on the task.

The mobility of the devices supported the learning beyond the tutorial workshop because they could access files outside class time and listen to them in a range of locations. This flexibility of time and space allowed students to make deeper connections (Billings, 2005) between theory and practice. The BEST site served as another learning space as the dialogue files were housed in the community repository. This provided convenient access to materials uploaded to the BEST site where students could access materials as needed, revisiting key content, ideas and interpretations. This provides a good example of the potential for mobile technologies to support learning where students direct both space and time (Pownell, 2006).

Concluding comments

The practice of teaching is complex and at times overwhelming for preservice teachers as they endeavour to put into practice their beliefs and understandings about learning. This study provides example of how mobile technologies can be used to record professional dialogue focused on complex issues to support students in making strong links between theory and practice as they operate in collegial networks. Our research has shown the ability to record, store, access and share these materials supported this cohort of students.

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CHAPTER 8

Role of mobile digital technology in fostering the construction of pedagogical and content knowledge of mathematics

Mohan Chinnappan

Abstract:

The need for practicing teachers to reflect and build on their knowledge of mathematics for effective practice, and ongoing professional development is well recognised by the educational community. In this chapter I examine two dimensions of this knowledge (content and pedagogical content knowledge) as reported by two teachers who are new to the profession. The knowledge dimensions were examined by using a mobile technology tool (smartphone) to reflect on the design and teaching of fractions. Results indicate that the participants were competent users of smartphones and displayed a wide repertoire of the knowledge that was relevant for teaching of fractions in the primary curriculum. The smartphone appears to be a useful device for mediating teachers' content and pedagogical content knowledge.

Context

The quality of teaching and the education of mathematics teachers are emerging as crucial elements vis-a-vis the global demand for numerate citizens and scientific talent. In this regard, the professional development of mathematics teachers has become a focal point of discussion for mathematical reforms in many countries including Australia (Council of Australian Governments, 2008). That teacher quality plays a key role in the mathematical learning outcomes of our students is a recurring theme in current debates. The multidimensional facet of teacher quality has spawned different models and characterisations. However, one dimension that continues to drive the deliberations on teacher quality is the state of knowledge that teachers bring to the teaching-learning interface, and how this knowledge influences students' cognition and participation in mathematics (Sowder, 2007).

In light of the above developments, the need for practicing teachers to continue reflecting and updating their knowledge and skills has become a core issue for research on teacher expertise. One stream of such research has begun to examine the growth and trajectory of teachers' knowledge within the framework of teachers as communities of learners and practice. This research focus underlines the need to examine teacher knowledge and the profound impact this knowledge could have on the quality of practice.

In his seminal work, Shulman (1986) argued that teachers needed to build a solid subject matter knowledge base or content knowledge (CK) and transform this knowledge into forms that would help them address learning needs of children. This latter knowledge was referred to as *pedagogical content knowledge* (PCK). The development and accessing of this knowledge, and its role in teachers' actions *in situ* continues to interest researchers (Ball, 2000).

There are many contexts in which teachers could reflect on and construct new understandings of these two principal components of knowledge, and one would expect different learning environments will constrain the development of this knowledge differently (Shulman & Shulman, 2004). The advent of information technology provides a powerful learning environment for teachers to experiment with, reflect on and share their knowledge as practitioners. However, for this to happen, teachers must assess and revise their own knowledge and understand students' cognition underlying the learning of mathematics. Thomas and Chinnappan (2008) developed the notion of *epistemic mediation* in order to recast the role of technology as effective tools of pedagogy. The implication is that researchers need to draw on technology to help teachers build, activate and expand their repertoire of knowledge for teaching.

The focus of the study reported here is the identification of pedagogical and content knowledge relevant to the teaching of mathematics in primary schools that could be activated by the use of a mobile technology specifically a smartphone. This device was assumed to facilitate co-learning among professionals by fostering teacher-to-teacher interaction better than other tools in that teachers could share their knowledge more spontaneously before, during and after practice (Olney & Lefoe, 2007).

Theoretical framework

The research was guided by a framework of teacher knowledge (Shulman, 1986; Ball, 2000; Chinnappan and Lawson, 2005) that consisted of the following dimensions: (1) the quality and the quantity of the mathematical content accessed and exploited by teachers both before and during teaching depends to a large extent on the organizational quality of the *teachers' repertoires of substantive mathematical knowledge and their reflective awareness of that knowledge*, (2) the mathematical content accessed and exploited by teachers will be mediated by the teachers' repertoires of pedagogical content knowledge and their dispositional orientation towards mathematics as indicated by the *teachers' perceptions and beliefs about mathematics*, (3) the quantity and the quality of the knowledge about the learners is based on teachers' observations of the learners before and during teaching and that these observations are mediated by teachers' pedagogical content knowledge, perceptions about the learners and perceptions about their roles as teachers, (4) the quality and the quantity of the knowledge about how to teach the mathematical content accessed and exploited by teachers depends to a large extent on the organizational quality of the *teachers' repertoires of pedagogical content knowledge and their reflective awareness of that knowledge*, and (5) the knowledge about how to teach the mathematical content accessed and exploited by teachers before and during teaching is also influenced by the following set of mediators: *the teachers' perceptions and beliefs about the role of a teacher* and *the teachers' perceptions and beliefs about the learners.*

While teachers need a knowledge base with the above dimensions, equally important is the relationship among these knowledge fragments as revealed by the quality of their connections. These

relationships can be analysed against the framework of *schemas*. A schema can be defined as a cluster of knowledge that helps teachers and students understand and represent a problem, and provide cues for the activation of relevant strategies. Marshall (1995) identified four primary components of schemas: feature recognition knowledge, constraint knowledge, planning knowledge and implementation knowledge. The more tightly connected these components are the easier it is for the parts to be accessed. In a similar vein, Mayer (1992) has suggested that schemas are involved in any successful problem-solving effort including teaching.

The report here investigated the educational potential of a mobile digital technology involving a smartphone. We used the device (See Figure 1) with primary teachers to facilitate interactions and reflections about K-6 mathematics concepts and the teaching of these concepts in the classroom. The aims of the research were to evaluate a) the quality of understandings that teachers developed as they discussed and shared each other's knowledge and experience and b) the type of teaching aids that were deemed to be relevant to the teaching of a chosen mathematics topic.

The development of understandings can be examined in terms of the content, links and the structure of the knowledge schema that evolve during the course of their interactions with their peers as elucidated by framework above. These interactions and the ensuing activation of CK and PCK can be facilitated if teachers are supported in ways that would empower and encourage them to think 'on the run'. Our framework about teacher knowledge also suggests that providing teachers with varying contexts and tools of communication to externalize their knowledge can be an effective strategy in order to generate a more complete picture about teacher knowledge.

The above line of reasoning led us to consider the following research questions:

- How do teachers respond to the use of mobile devices when they are required to share and critique a mathematics concept and appropriate pedagogies?
- What are the representations and models that teachers could construct with the aid of a smartphone?

Methodology

An action-research methodology was utilised that provided professional development opportunities for the participating teachers. The study was conducted over a 13-week period within a mathematics elective subject. The teachers who participated in the study were practising teachers who wanted to enhance their knowledge and skills in teaching numeracy via a postgraduate program.

Each participant was invited to explore the use of smartphones (Palm Treo 680). Treo 680 came with a large colour touch screen and an easy-type keyboard. It had a number of easy-to-use features including mobile phone, email, web browsing, multimedia, personal organiser, text messaging and document development. Participants could utilise one or more of these features in the development of innovative pedagogies for mathematics learning and teaching. Teachers could use

the smartphone to capture images, develop videos, share ideas around a particular theme, and revise their ideas in light of peer feedback from a partner.

Figure 1: Smart phone

Following the introduction to smartphones, teachers were asked to think about using the device as a cognitive tool that could be used to design a range of mathematics learning experiences for children with diverse learning abilities and needs. Such a design expected teachers to activate not only their prior content knowledge of mathematics (CK) but also the translation of that knowledge into forms that would better relate to and engage learners (PCK). The participants were divided into collaborative pairs to initiate discussion and create digital products that could be used to support the learning of a mathematics concept. In so doing the teachers were asked to consider lesson aims, learning activities, their children's prior experiences and learning outcomes. This phase demanded that participants select and analyse a focus mathematics concept, and the teaching of that concept. It was further suggested that they identify learning difficulties associated with the focus concept and teaching aids that could be used to help children. The report here examines the data generated by one of the above teams.

The teachers could capture and create pictures and videos, develop documents as well as record and email audio narration of each other's views. While they could have accessed the internet for ideas, each team had to create its own product that could be used in practice and justify its appropriateness. Team members were instructed to use the smartphone for all communications particularly while they were in the school. Our view was that the mobility of the smartphones should be exploited fully to share insights especially when teachers were unable to meet face-to-face and while on the move.

Data and analyses

In order to generate data relevant to our research questions, we drew on two main sources of data: smartphone discussions and use of available digital tools. The digital tools included features such as in-built audio and video functionalities. Teachers were asked to engage in as many discussion sessions as was necessary. The average number of discussions was six with each recorded session lasting about five minutes. Students commented that they wished to conduct a number

of informal dialogues before using the device to record key events of their talk. This was allowed because it was decided that the informal talks would provide another way to help the teachers activate their CK and PCK. The recorded dialogues occurred at different locations depending on what members of each team wanted to teach. This included staff rooms in the schools, at home as well during our tutorial sessions.

The initial discussions were mainly concerned with decisions about selection of a suitable focus concept, types of learning resources and activities in which to immerse children. The teaching and learning resources formed the cognitive tools and the dialogue they engaged in about the tools provided windows into their quality of CK and PCK. The interactivity was an important element in the accessing and utilisation of schematised knowledge from long-term memory as well as evaluating the impact of smartphones.

Smartphones had inbuilt communication tools (*email and mobile phone*) that could be used to share audio messages and teachers showed a willingness and ease with which to utilise this technology from the day they were inducted into the project. However, we ran into problems with the use of the email and phone options as teachers had to register with the local email provider in the state of New South Wales.

As well, all participating teachers had their own mobile phones and this made the registration for a second SIM card rather difficult and teachers were reluctant to use their own SIM card with the smartphone. We circumvented this issue by allowing the teachers to use their own mobile phones for 'on the run' conversations but did record the main points of their discussions into *Documents* and *Memos* on the device. These documents were then emailed to each other via the university's email system for reflection and critique. The smartphones were most effective in constructing video images of learning resources for the teaching of the focus concept.

In this report, I provide data from one team of two teachers (given the pseudonyms Sonia and Lisa).

Lisa1

> Given that we will be concentrating on fractions and decimals within the number strand, I think we should concentrate on the Stage 2 and 3 outcomes. In doing so, I think we will be able to develop hands on activities, with concrete materials, such as different sorts of shapes and objects. These activities could then be followed up with written work and activities, and in working mathematically, will cement the concepts of fractions, decimals, percentages and how they are related. What do you think?

Sonia1

> First of all I feel that looking at fractions and decimals within the number strand, will be something different for a change, as I feel that there is a lot of emphasis placed on the other subjects of the number strands including; whole numbers, addition and subtraction, multiplication and division, and although these are used in everyday life and students need to

know how to use these concepts, in my practical experiences not much time is spent on fractions and decimals, and I do believe that this number subject is just important.

I also think that concentrating on Stage 2 and 3 is a great idea, because I believe it is at this stage that they start to question and reason more deeply, and the basic skills test is also introduced in these stages, which unfortunately for Indigenous students they are well behind on scores.

In the above dialogue, the team identified fractions as an important area as teachers did not spend much time with this sub-strand of numbers. Sonia agreed with Lisa about the appropriate learning stage of potential students their teaching should be aimed at. In the state of New South Wales (Australia), children in Stage 2 and 3 are generally working at learning levels that can be expected in the last two years of primary school. Both teachers showed adequate knowledge of the mathematics curriculum and the importance of the topic within the Number strand. Sonia also showed another aspect of PCK that concerned the role of cultural roots of children, in this case Indigenous children of Australia.

Lisa2

I am thinking this could be an early Stage 2 activity, so that by the end of Stage 2 the concept of a half and more complex percentages and fractions have been cemented, this can be done by using objects within the school, or in our case the uni, you can take pictures of basketball courts, football fields, artworks and so on. Have a look at the picture I took at uni, and tell me what you think!

Lisa captured an image of her school with the smartphone (Image 1).

Lisa: Image 1

Sonia2

Your picture was a great example, and really would bring the students out into their environment, searching for halves, quarters etc… Because not only should we use basic shapes like a circle, but also shapes/objects used by students everyday, such as the food they eat or the toys they play with, this way they will better understand the reasoning behind

learning about fractions and decimals and be able to put it into an everyday context, which I think presents another learning difficulty in that when children are learning a new concept,

In this second interaction, Lisa reflected on the learning stage at which fractions could become a challenge to students. She identified the more complex features of these numbers and their links to other forms of fractions such as percentages. Here, one could detect the teacher's knowledge of multiple representations of fractions and the need to teach for connectivity in mathematics. This constituted further evidence of a schema organised around solid content knowledge and PCK. Sonia was sharing pictures taken on the smartphone.

Lisa3

Building on the concept of a half, I think it would be beneficial to introduce the relatedness of a fraction to a decimal and to percentages. This could be done using a number line, with numbers 1 through to 100. The number line could then be folded in half, marking the 50 number. A discussion could be held then with students about the representation of 50 as ½, as .50 and as 50%. I think it would be beneficial if all students in a Stage 2 class had their own number line to manipulate as a concrete material. What do you think of the number line idea?

Sonia3

The number line is a great idea, because it gives the students a visual representation of the numbers and the concept of half, I think that we should not just stop at the number line, but also tap into concepts of multiple intelligences and use a variety of representations to suit all the students learning needs, especially our Indigenous students. Other examples we can use, are getting students to draw, cut out and paste the concept of a half, which can then be progressed to a ¼, etc…

Lisa's comment above suggests that she was able to identify not only interrelated mathematical concepts such as percentages and decimals, but also articulated the modelling of these concepts via a number line. While she was happy with this approach, she found it necessary to get a second opinion from her partner. Sonia was in agreement with this visual representation of fractions. Recognising the pedagogical value of number lines, Sonia suggested that they extend the number line approach to other representations and fractions.

Lisa4

I agree with you in that students need to have a variety of experiences to understand a concept, because no students learn the same way as other students. In continuation with manipulating concrete materials (NS2.4 and NS3.4), I think it would be good to develop activities where students had to order different materials according to size. For example, students could order shapes representing 1/2, 1/3 and 1/4. This could then be translated into percentages and decimals.

I think that this activity would be most appropriate for stage 2, with the concepts needing to be concrete before students' progress to stage 3. I have taken a photo of this concept in

ordering different shapes, in representing a 1/2, 1/3 and 1/4, take a look at it and tell me what you think.

Lisa: Image 2

Sonia4

Yeh, I really liked the idea of 'Fraction Families', lots of shapes and lots of examples, and I definitely agree in that before students progress to stage three and the more complex fractions, percentages and decimals they need to have a concrete understanding, and I believe this would come from the constant reasoning that we should be implementing into lessons, so students are able to make that connection to everyday life, and how certain concepts should work.

I think that by using a variety of ways to show a ½ that we discussed earlier should be again implemented in using 1/3, and ¼. The only trouble and learning difficulty that presents it self is the time factor, and what I mean by this is that as a teacher we don't always have enough time to spend on certain concepts, and so deep understanding is not always achieved.

In the above dialogue, both the teachers showed a deep appreciation of different models of fractions in the way they talked about *Fraction Families*. There was evidence of use of a blend of concrete and abstract approaches in the above exchange. It would seem that both teachers were aware of the need to design learning experiences to cater for children with varying learning styles. This is evidenced in their discussion about the different ways part-whole relations could manifest in fractions such as decimals and percentages. The notion of *multiple intelligences* from a psychology subject was weaved appropriately to buttress their case for the interpretation of different models of fractions.

Video

In addition to the discussions above, the teachers used the smartphone to shoot videos that would complement their teaching of fractions. Sonia's video showed the concept of half in four different but related modes: half of a circle, half of a rectangle, paper folded onto to equal parts and slicing a banana in to halves and quarters). Figure 2 shows a

screen shot from one of the videos. The paper folding actions and cutting of banana were shown in the full video display.

The video was used to generate further exchanges about the multidimensional nature of fractions including the value of using it to help other children conduct similar learning activities.

Figure 2: Video Display

Discussion

The aim of the study was to examine how a group of practising teachers would use digital mobile technology to access, modify and share their content and pedagogical content knowledge that was deemed to be relevant to creating effective learning contexts for children. The expectation was that this tool would help teachers share their knowledge more readily and spontaneously. Data on the artefacts that were constructed and discussions held between two participating teachers suggest a number of interesting ways they had gone about using the tool resulting in the activation and further development of their CK and PCK.

Firstly, in the brief period the teachers were exposed to smartphones, a number of features were utilised including audio, video and text analyses. Both the participants saved their pictures and used them in subsequent discussions that in turn led them to develop other models for teaching fractions. There was clear evidence of the teachers' developing competence in the use of the smartphone. It would seem that the ubiquity of mobile phones in general might have facilitated the uptake of smartphones that were used in the present study as both shared similar features in wireless communication.

Did the use of mobile technology reveal anything significant about the accessing, modification, state and development of teachers' CK and PCK around fractions? The answer, it would seem, is yes. The

discussions held between the two teachers show that they have built up a reasonably robust body of knowledge about fractions. This was evidenced by the different concepts of fractions that surfaced both in their discussions and the variety of digital video artefacts.

One could also detect the availability of sophisticated schematised pedagogical content knowledge amongst the two teachers. This was indicated by their deliberations about which model (e.g., Number line) would be appropriate for children who have attained different conceptual maturity. The need to anchor core mathematical concepts in powerful models and use them in the rationale for effective classroom practice as displayed by the teachers here are consistent with arguments advanced by Sullivan (2005). Theories of multiple intelligences suggest that learners differ in the way they acquire, make sense of and develop new knowledge. The multi-model approach developed by Lisa and Sonia is consistent with such theories in that it has the potential to support learners with varying learning styles.

Our theoretical perspective suggests that, to be effective, mathematics teachers need to have a body of well-connected CK and PCK that they can access and modify before, during and after practice. This is an ongoing process that helps teachers to update their knowledge as they grow and interact with peers in the profession. Within the confines of one area of mathematics, there is evidence here to support the claim that the use of smartphones did help the teachers reflect critically on their own prior knowledge about fractions and the teaching of fractions. Further, the device afforded the modification and restructuring of that knowledge by supporting a high level of interactivity between the participants.

The use of mobile technology could involve teachers developing an additional body of knowledge that was described as Pedagogical Technology Knowledge (Hong and Thomas, 2006). Pedagogical Technology Knowledge (PTK) encompasses not only the pedagogical content knowledge but also teachers' understanding of the mathematical content, the representation of that content via a technology medium and learning styles of individual students. Even though the present study did not directly examine PTK, the results do suggest that both teachers had a solid start in the development of this knowledge. The enactment of PTK during classroom practice on a long-term basis is an interesting area for future research.

In this study, both teachers have shown a high level of collegiality and openness in wanting to engage in a dialogue about using mobile technology in developing sound learning contexts. The willingness to take risks and be a co-learner in the use of technology was also found to be an important factor in teachers' attitudes to and confidence with these tools (Goos, 2003).

With regard to use of mobile technology by teachers, it is important that teachers develop a good understanding of the tool that they will be using during the activity. Practitioners should allocate ample time for individual teachers to become familiar with the many features of the smartphone. The pedagogical value of the mobile technology is better emphasised by participants engaging in tasks that are reasonably demanding as in the case of the present study. Our experience with smartphones shows that in the initial stages of the

project, it would be useful to provide print or web-based assistance on the devices themselves, and to show participants inbuilt help screens and contextual support that appear in the software.

In the present study, analyses of CK and PCK were made based on dialogue between teachers. Future studies could improve on this strategy by examining concept maps. Participants could be asked to map their own schemas that they have developed. The trajectory of schemas (evidenced by the changes in the concept maps) as the teachers reflect on and engage peers via the mobile technology, would provide a valuable source of data that teachers could draw on in order to modify their numeracy-related content and pedagogical content schemas.

The above views are based on two teachers' experiences with smartphones. Consequently, I am cautious about making generalisations regarding the impact of such tools on the larger cohort of teaching population. It is possible that the pattern of results reported here might be similar to one that emerges from a larger sample of participants but that has to be established in future studies. Although the teachers did not utilise all the email and phone options that were available, the participants did share a considerable amount of knowledge and understanding by drawing on other available technology. It would seem that future studies that help participants use all the options of smartphones could provide even more avenues through which teacher educators and researchers could examine the many attributes of their CK and PCK.

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CHAPTER 9

Using iPods to enhance the teaching of games in physical education

Greg Forrest

Abstract:

Game Centred Approaches (GCA) have been present in the Australian sporting community for the last ten years and more recently as the focus of physical education lessons in some Australian schools' curriculum, especially in NSW. However, the effectiveness of GCA as a teaching method is limited by the skill of its practitioners, especially in developing the questions needed to generate dialogue based on game play to generate learning opportunities for students in classes. This chapter will outline how the use of mobile audio devices were used by preservice physical education and health teachers at a New South Wales university to enhance their understanding of questioning methods, the development of dialogue and the pedagogical use of GCA in physical education lessons.

Pedagogies of games in physical education in Australia

The dominant discourses in physical education and coaching in Australia over the last century have been based around two main themes, the playing of 'sport' and the development of confidence in playing sport. This has in part been due to the relationship of our national identity with physically active students and improved national health outcomes (Tinning, MacDonald, Wright & Hickey, 2001). The dominant pedagogical method (to be referred to as the traditional model from now on in this chapter) to achieve these aims has changed very little and is based on the format of warm up, drills for technical skill development, modified game and then the actual sport. The underpinning philosophy of the model has, at its foundation, the belief that students need to master the technical skill aspects associated with a particular sport as a pre requisite for playing the actual sport. Lessons in the technical model are for the most part teacher centred and tend to follow a part-whole-part approach with students being told what to do and how to do it and then applying this knowledge to an adult version of a sport with adult rules and conditions (Hopper & Bell, 2001; Light, 2003).

Issues with the traditional model

Research on the use of the traditional model has revealed key issues relating to its pedagogical success, especially in relation to school physical education. Oslin and Mitchell (2006) have summarised these findings and linked the use of the approach to reduced student engagement, self-confidence and self-perception based on their perceived ability to perform the technical skills. They argue that this leads to reduced student enjoyment in physical education lessons. Other studies suggest that the approach cannot sustain and even reduces levels of student motivation, has an negative impact on overall levels of participation in physical activity, can decrease the meaning and relevance of the subject and can impact on physical activity levels of students in post school years, especially for those who are less skilled (Mandigo & Holt, 2000; Light, 2003). In addition, Launder and Piltz (2006) suggest the traditional approach can result in students leaving lessons, lacking even a basic understanding of the

fundamental nature of the sports they are being taught or even an understanding of the primary rules required to play. Thus, the outcomes of using the traditional approach seems to be at odds with claims that participation in physical education lessons will lead to improved participation in sports and improved student attitudes relating to engagement in physical activity for life through, in part, involvement and exposure to a wide variety of games and sports (Board of Studies, 2003).

Game centred approaches

The term *Game Centred Approaches* (GCA) is a collective name for pedagogical approaches that have the use of games as its central learning context (Oslin & Mitchell, 2006). The approach uses games as the core learning tool, focussing on decision making, tactics and strategy and technical aspects as the essential skills of playing. There are many variations of the original *Games for Understanding* model developed in 1982 by Bunker and Thorpe, including *Teaching Games for Understanding* (Werner, Thorpe & Bunker,1996), *Games Sense* (ASC, 1991, cited in Light, 2003), *Play Practice* (Launder 2001), the *Tactical Decision-Learning Module* (Gréhagne, Wallian & Godbout, 2005), *Playing for Life* (ASC 2005) and *The Games Concept* (Rossi, Fry, McNeill, & Tan, 2007). The key theme of all models is the importance of placing students in game situations that allow tactics, decision-making and problem solving to be examined (Webb & Pearson, 2004). The models all tend to follow a whole-part-whole approach to learning, providing opportunities for the students to develop greater understanding of all aspects of the game through play, answering the age old question that all students ask at the start of the lesson, 'Can we play a game?' GCA are by intent more student centred than the traditional approach and have strong links with constructivist perspectives of learning as students are assumed to be active in the construction of knowledge for learning to take place (Kirk & McPhail, 2002; Rovegno, 2006).

The teacher's role as facilitator is central to the use of GCA as the learning and understanding that is taking place and the meanings that are being created by students occur through the selection of games and the dialogue that develops in the lesson. The use of questions related to this play is the foundation of student understanding and by using these in an appropriate and timely fashion, teachers can set games as problem-solving opportunities, providing students with a variety of opportunities to demonstrate their understanding of the concepts. Technical skill development and execution still play an important role in lessons, but only after the students / players recognise the requirement for competency in these skills to complete their objectives or achieve their aims (Werner, Thorpe & Bunker, 1996).

The pedagogy of GCA

Many advocates of the approach such as Turner (2005) acknowledge that using GCA are both difficult and challenging for teachers to use. Chandler (1996) links the effective use of GCA with teachers' deep knowledge of games, the development of appropriate game forms, transfer of games skills within categories and the development of appropriate procedures to do this. He also suggests the effectiveness

of the GCA in developing learning outcomes for students seems significantly more dependent on the pedagogical and game skills of the practitioners than the technical model.

According to Piltz (2004), the ability to observe and develop appropriate questions to provide meaningful feedback are fundamental elements for those wishing to use a GCA and are essential to its success. Gréhaigne, Wallian and Godbout (2005) argue that it is essential for students, preservice teachers and teachers to develop a deep understanding of what they term action – debate – action cycles, where the dialogue developed in response to questioning is used to enhance student learning and understanding of the games and sports they are playing. Therefore, a key element to the successful use of GCA is the dialogue that develops in between the teacher and students and between the students themselves in the lesson in response to teacher questions relating to play.

The way meanings are constructed by students in the lessons and the learning and understanding that develops from this are derived from the questions and games used by the teacher. Wright and Forrest (2007) suggest that many GCA lessons may be no more constructivist in nature nor more liberating for students than the traditional method due to the simple 'Initiate – Response – Evaluate' structure used by teachers in their questioning and dialogue management. If this is the only form of questioning structure used, the teacher still remains the holder of the knowledge and questions used may not allow any meaningful construction of knowledge by the students themselves. They also argue that as there is very little literature to model the ongoing dialogue that evolves from dynamic game situations, it is difficult for practitioners to develop the appropriate questioning and communication skills to manage the learning in a constructivist manner. Those new to the approach or trying to implement it as a pedagogical method may simply copy games and imitate questions shown or demonstrated to them, assuming the questions used and answers given are the only correct solutions.

In this sense and if used this way, the development of dialogue in GCA remains very teacher centred, radically reducing the student's ability to be involved in decision making, problem solving or student engagement so valued by its advocates.

The challenge

As part of the undergraduate degree, preservice teachers in the Physical and Health Education degree at a New South Wales University participate in a number of practical studies games subjects which aim at developing a deep understanding of games and sports, and related pedagogical content knowledge. GCA pedagogy is the focal point of the games and sport component of the courses. In previous years, assessment on competency and development in teaching a games lesson and using a GCA was based on a student presentation of elements of physical education lessons and self-reflection post-presentation, based on their perceptions of the positives and negative of the lesson. However, to allow students in the course to gain a deeper understanding of the requirements of using a GCA across different sport contexts, students had to be more active in their

development of knowledge and understanding about GCA and base this understanding on more than a one off recollection of the lesson. They needed to be able to analyse what had occurred when they attempted to use a GCA and be active in the analysis of the questions they used, the answers they received, the manner in which they created meaning for those in the presentation and the areas that needed improvement.

These issues then defined the challenge for mobile learning in relation to GCA, to create or enhance a task to allow preservice teachers to examine the practice beyond the theory, by investigating the claims made by proponents of GCA relating to the constructivist nature of the pedagogy and the issues that arose in relation to its use in the actual field that teachers will be working in during games lessons. The task also had to fit within the broader framework of the brief for the project, to develop innovative methods of teaching and learning through the use of a mobile device. To fulfil the teaching and learning brief, the content of workshops and tutorials, consultations, presentation observations and general observations on tutorials and understanding of GCA were also recorded. This became an interactive audio diary to be used as part of the analysis process for the study.

Teaching and learning activity

The task was for the project was in two parts. Firstly, students (in groups of three or four) were assessed on their use of a GCA when teaching a 'lesson' in one of the sport contexts for either net court or invasion/territory game. As part of the task, students were expected to:

- Develop appropriate games for the purpose of the presentation
- Manage the group effectively during the presentation
- Develop appropriate dialogue and questions based on observations of game play in the lesson and student responses

Secondly, presenters were required to complete an individual two-page reflection and analysis of the presentation based on their use of a GCA in the particular sporting context selected. The reflection included an evaluation of the positives and negatives of the session and an evaluation of the questioning methods used to establish and determine learning and meaning within the lesson. The data for the reflection were collected in two ways, firstly via digital video camera and more importantly for the project, through the use of a mobile audio device, in this case, an iPod with an attached microphone. Students were instructed to allow the iPod to record the entire presentation to ensure both their dialogue and the intended and unintended dialogue of the participants in the presentation was recorded. This was then stored for the presenters to use when developing their reflection and analysis of their presentation.

Technology

Students involved in the course used a 30gb iPod as their mobile audio device. A portable microphone was attached to the base of the iPod. The attachment of the microphone initiated an automatic *Record now* menu and two settings related to the quality of recording. For this task, considering the amount of interference that may have occurred in

a lesson outside a classroom, the recording quality was set at the highest quality to allow capture of as much the dialogue that occurred in the presentation as was possible. Students presenting held the iPod during their presentation, allowing the true mobility of the device to be utilised. If the recording ceased at any time, the iPod had a *Stop and save* function, which saved the lesson up to the point where recording had paused. It then reverted to the *Record now* menu option and the students repeated the initial recording process by pressing *Enter*. Recordings were saved on the device and once all presentations for the tutorials in that week were completed, the dialogue was saved. As there were not sufficient iPods to allow the students to have their own for the duration of the semester, their audio from the presentation was burnt onto a CD for student presenters to use as the basis of their reflection and as a permanent record.

Participants

Data for the study were collected in semester-long practical studies classes at the University. Ethical approval was granted prior to the commencement of the semester and permission was sought and gained from the students in two cohorts of the course.

The participants in the study were all students in the University's undergraduate Physical Education and Health degree. There were 119 students involved in the research, all of whom were enrolled in one of two subjects, a second year two credit point component of *Skills Analysis and Performance* subject and third year two credit point component of an *Advanced Skills Analysis and Performance* subject.

The second year subject focused on the game category of invasion / territory games (where one team enters the other team's territory to score points) with the sports of hockey and soccer as the context. The structure of the course allowed for four weeks of instruction using hockey as the context for understanding GCA pedagogy followed by two weeks of presentations where students were assessed on their demonstrated their competency in using a GCA in Hockey. This was repeated for the second half of the semester with soccer as the context. Each presentation lasted for 20 minutes.

Students in the third year subject had four sport contexts to examine net court games (where one team / player attempts to manipulate an object over a net so it cannot be returned by the opponent/s): volleyball, badminton, squash and tennis. They had two weeks of instruction in GCA relating to Volleyball, followed by two weeks of presentations where students were assessed on their demonstrated competency using GCA in a Volleyball context. This was repeated for Badminton, Squash and Tennis. All presentations were again for 20 minutes.

Findings

For this project, data were categorised according to themes emerging from the analysis of the individual two-page evaluation of the lesson. These emerged specifically in relation to the criteria for the reflections and were; how the use of the device allowed students to examine the positives and negatives of their presentation, how the use of the device assisted the students analyse their use of questioning and how the

device assisted students to analyse the development of dialogue in their lesson. The analysis was based on a constructivist and situated framework in which students were active in the construction of their knowledge in a context that was authentic to physical education teachers using a GCA. The themes emerging were then compared with the audio diary data from tutorials and consultations and then with others in the physical education community to ensure trustworthiness and credibility.

Positives and negatives of the presentation

> I noticed that I need to project my voice more. I speak very quietly and believe I need to show more enthusiasm in my voice when I am teaching. (Student B)

Students used the audio to reflect on the positives and negatives of the presentations through features evident in their dialogue at a variety of levels. Most tended focus on clarity of instructions, pace of speaking, tone of voice and appropriate vocabulary as key notions relating to positive of negative aspects of the lesson.

> Our questioning during the lesson allowed the students to think strategically about the game and allowed the students to focus on key concepts that make up volleyball (Student E).

Students also demonstrated their understanding of GCA by reflecting on the use of questions within the lesson, especially the link between the questions and the activities and linked this with a positive or negative element. However, others noted that this questioning was the source of issues with their lessons.

> It was very evident when listening to my lessons that we did not create an optimal learning environment due to the nature of our questioning, which was regularly without purpose or related specifically to the games used (Student C).

Nature and purpose of questions

Students recognised the need to use questioning to probe for understanding and noted this as a key component in their successful use of a GCA. Some students made note of role of the answers to questions in learning.

> Each of the players gave the answers I was looking for and if I received a blank look, I usually reworded the question and a great response or the response I wanted to hear was then given (Student M).

This indicates that the students were cognisant that the type of questions they asked would enhance the learning but in turn were not necessarily reflecting on the role of students in the class being active in knowledge construction as opposed to telling the teacher the answer they wanted to hear. However, other students focussed on this area and analysed this in a different manner.

> A number of times I used closed questioning and gave away the answers while waiting for the class to respond (Student A).

Others wrote:

> I also found that when asking a question, I tended to answer the question for them or lead them so much that the only answer required was yes (Student C).

This response was common in the reflections, suggesting that analysing the dialogue gave students the ability to recognise not only the importance of the type and nature of the question but more importantly, their response to the answer or indeed the lack of an answer. Another student further expanded on this theme.

> One aspect of questioning absent that could have improved the learning was to use further probing questions. Generally there was only one question asked to students and when answered, that was it (Student L).

This was supported by another reflection, where the author, Student A, noted:

> When a student gives me what I feel is the correct answer, I simply say yes and move on as opposed to investigating this further through other questions or other student responses.

These students are recognising the need for a variety of answers to the questions they are asking and perhaps the relationship between the learning that is occurring for all students and the constructivist nature of the approach rather than accepting learning has occurred through single responses. They are also noting that if an answer is not given, it may require further exploration as opposed to those in the class not knowing. Other analyses of questions expanded even further and noted the role that personalising the questions could play increased effectiveness in learning.

> I believed that I could have further supplemented the questions asked to the class as a whole by asking more questions personally…it adds to the educational value as it is concurrent in the game and gives them (students an opportunity to implement (their answers) in the game (Student J).

This is of particular interest as the ability of the student to listen to the dialogue has allowed them to move beyond the GCA structure of game, questions, and progression of game and examine how questions can identify and enhance learning at different levels of learning and understanding in the class.

Use of dialogue to establish and determine understanding

Students used the dialogue recorded in the lesson to reflect on the level of learning through the answers received. While most simply indicated that the answers they received indicated understanding, some went further in their analysis.

> When students asked if the cones made it easier or harder from an attacking point of view, they responded with 'It made it harder but made us realise ways to create space and promote awareness of where other players were'. The defensive players agreed and included that they had used the background knowledge of the player's use of the cones to prepare for their approach (Student E).

The ability to have the dialogue from the lesson allowed the student to evaluate both the questions and the answers received and compare the responses from both teams in relation to their own observations. Others noted that:

> Answers given such as "running to the ball" did indicate that students did make mistakes and could articulate this, seeing why it was a mistake but this was not always reflected in play (Student T)

> I did receive a good response when she talked about how positioning yourself between the player and the ball was successful. I then asked how that particular method helped you defend (Student T).

Here, Student T is not only acknowledging the ability to recognise appropriate responses in relation to the question he had asked but also to begin to develop a dialogue and interact with the students based on their responses.

At its best, the link between the discussion and the play and teacher practices was very in depth. For example, Student C suggests in relation to implementation of strategy in a game and it relationship to the dialogue and his own construction of the reasons for player response.

> At first I just decided that these players weren't skilled as their opponents however, the fact that I did not encourage them further to describe their strategy (and its requirements) … meant that their defensive structure broke down in certain circumstances.

Here the ability to reflect and analyse feedback and questions allows Student C to recognise his role in the learning and understanding of students in relation to the problems he is setting. He recognises that it is task complexity and an interpretation of the response in relation to the question he has asked that needs exploration rather than a simple judgement on skill that is leading to poor play.

Issues impacting on questioning and dialogue

The ability to access and analyse the dialogue allowed students to not only reflect on the questions they were using but the reasons they were keeping the dialogue open or closing it. Student T recorded that:

> I received a good answer but then I went on with a speech about space and stuff to get through the lesson.

Student J noted that:

> I feel that while I was receiving answers that indicated understanding, I did not have the depth of knowledge to investigate some of the implications of these answers further and simply moved on to avoid this.

The ability to capture the dialogue allowed the students to recognise that limits in game knowledge and worries about efficiency were keys in closing the dialogue. Students also acknowledged the difficulty of

using the approach due to their ability to use dialogue and its role in GCA approaches. Student A noted:

> I feel that I need more knowledge in GCA, which would include more theory, but in particular questioning practice would enable me to give the questions more purpose.

Student M, noted:

> Listening to the dialogue indicates I need more practice and knowledge at using a GCA, especially when it comes to questioning

This also supports this statement, demonstrating very active participation in the construction of knowledge.

Use of the device as a learning tool

While not a component of the reflection, nearly all of the students made comment on the value of the device to enhance their analysis, despite some initial reservations.

> At first I was nervous being taped but soon forget I actually had it. (Student A).

Others noted the difficulty completing the reflection adequately without the device.

> (The analysis) would have been a whole lot easier for me if I had remembered to turn the microphone (iPod) on but at least I had the other group members dialogue (Student K).

Students also made note of the value of the device in improving their teaching and pedagogical skill.

> I hope to listen to myself again as I learn a lot by listening and would like to see if I have taken the comments I have made on board (Student A).

Student M also noted:

> While I was a little intimidated at first with hearing myself, it was actually something I would like to do again as I was able to critique my teaching style and find ways to improve my teaching.

The mobile device here is giving students the capacity to enhance their pedagogical skills and allowing them to be active in ways to improve their pedagogical skills in a manner that is non intrusive and easy to use.

Discussion

Wright and Forrest (2006), Prain and Hickey (1997) and Chen and Rovegno (2001) argue for the value of examining what is actually occurring in the dialogue of lessons (in relation to both discourse and use of constructivist methods), as both deeply affect the thought processes and the nature of what is learnt in the subject. The use of the mobile device and its ability to capture the actual dialogue from practice and store it for repeated use by the students in analysis

allowed students to actually hear what they were saying in the class and to evaluate the questions they used, the strengths and weaknesses of their development of dialogue and use of a GCA as a pedagogical method at a variety of levels rather than simply attempt to recall what had occurred. Some students, however, only analysed the lesson at a more simple level, based on the asking of questions, voice clarity and instruction while others used the dialogue to provide a more in depth analysis based on the learning that was occurring as a result of the nature of the questions being asked, the responses to the question and at its deepest, the relationship of this dialogue to the movement responses of the students in the games being used and its indication of student understanding. Of real interest was the ability of the dialogue to allow students to determine the nature of the questions they asked, the type of dialogue they were creating in the class and their own requirements in relation to both GCA pedagogy, creating a positive correlation between the nature of the question and the learning occurring and its importance in student's constructing knowledge in GCA.

The implications of the research project have also had a positive impact on the structure and requirements of the games and sport component of the practical studies course. Pre service teachers in the course:

- are required to complete compulsory readings and related quizzes to enhance theoretical knowledge for GCA, other pedagogical approaches and the role of dialogue and questioning in learning
- have more observational time for students to develop the skills needed to formulate questions
- have been given greater scaffolding of question structure and observational focus points in games to enhance learning for students
- are required to develop the video and the dialogue together as part of the analysis process.

The use of the mobile digital audio device was a positive benefit for this task. While there were some initial reservations from students, the ability of the audio was actually well received and perceived as a valuable tool. There were some initial teething problems with recording issues, microphone attachment and the logistics of charging and recharging but these were insignificant. The device was able to capture the dialogues and allow students to evaluate and reflect on what actually occurred in the lesson, and what learning and understanding was occurring. While many students still made assumptions about the approach, for example the use of questions in a lesson equating to the use of GCA, others were able to extend their analysis beyond this and examine their role in questioning and knowledge construction and the role of the dialogue developed in lessons and its relationship to learning and understanding. The role the device played in allowing students to do this is important for two reasons. Firstly, the link between questioning and verbal responses and cognition relating to movement is often overlooked when determining learning and successful outcomes of physical education classes where movement, participation and high activity levels are

seen as the benchmark of success. Secondly, the dialogue provided the opportunity for students to conceptualise through practice the issues associated with using a GCA and requirements to use it successfully based on the dialogue developing and occurring in the lesson. This device allowed further development in the examination of movement pedagogy in a meaningful way for the students due to their active participation in the process.

GCA approaches are a valuable pedagogical tool and can greatly enhance student learning in physical education and sport if used appropriately. The use of a device as a cognitive tool in this field has the capacity to enhance the preservice teachers understanding of GCA in a meaningful and valuable manner in a way that has applications in other pedagogical practices beyond Physical Education.

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Collaborative gathering, evaluating and communicating 'wisdom' using iPods

Lisa Kervin and Jessica Mantei

Abstract:
The processes of gathering and evaluating evidence are essential to inform and guide professional practice. This chapter explores the use of iPods as a tool to bring together the teaching field and the tertiary classroom. We report on two iterative cycles where we have designed and implemented a learning experience to engage our students in collecting, evaluating and reflecting upon knowledge shared by practitioners in the field. The task encourages students to consider the 'teacher wisdom' (Labbo, Leu, Kinzer, Teale, Cammack, Kara-Soteriou & Sanny, 2003) that can be gathered and disseminated through podcasts as they plan, record and edit an oral text to share with their student colleagues through their subject website.

The challenge of moving from preservice to early career teacher

The teaching profession is holder to many 'secrets'. Why does a noisy class of students suddenly become quiet when a teacher enters the space? How do teachers know how to navigate the curricula? How do teachers manage the complex relationships between and among the students? Early career teachers are bombarded with so many questions as they make the transition from student to teacher. This time of transition is identified as crucial for the construction of professional knowledge (Griffin, 2003; Peters & LeCornu, 2006). Relationships, with opportunities for informal and formal interaction, are paramount for the development of knowledge, values and attitudes to support one's professional practice (McCormack, 2004). Such interactions enable a teacher to build relationships, reflect upon practice and to shape deeper pedagogical knowledge (Dettori, 2007; Labbo, Leu, Kinzer, Teale, Cammack, Kara-Soteriou & Sanny, 2003; McCormack, 2004). The sharing of story is promoted as a powerful way to encourage this interaction because often accompanying the story, is the spontaneous sharing of 'wisdom' about the intricacies of the culture (Labbo et al., 2003).

Through interaction with participants within the culture one can 'learn' the profession (Lacey, 1995). Each profession has its own specific knowledge, skills and behaviours; for teachers these are related to curriculum, pedagogical understandings and awareness of how children learn and their role within each of these (Blackledge, 2002). Allen (2005) argues teacher professional identities are not taught; rather they are shaped through critical incidents within the workplace and one's professional and social networks. Having opportunity to examine those critical incidents, with the support and knowledge of more experienced colleagues, makes for powerful learning. Moving from a preservice to an early career teacher requires significant adjustments be made to one's professional identity with specific emphasis on the way people behave and how this defines them as professionals (Sparks & Shepherd, 1992; Stets & Burke, 2000). These perspectives need to be explored and examined to

consider how individual experiences can come together to create shared meanings and understandings.

Through interaction with members of the professional setting, one is able to learn the norms, values and beliefs of the communities within which they operate (Kervin, Mantei & Herrington, 2009). Lave and Wenger (1991) describe that participation in social practices enables '…explicit focus on the person, but as person-in-the-world, as member of a sociocultural community' (p. 52). It is through this process that individuals come to know who they are, what they are, how they should behave and what they still need to know. This, coupled with Billings' (2005) description of quality learning achieved through connections between their study and work contexts and Glickman's (2002) assertion that teachers cannot define, improve, and reflect upon their craft in isolation, presents an interesting challenge. As teacher educators, we believe our primary goal is to support the entry of our students into the teaching profession. To do this, we acknowledge the possibilities mobile technologies (such as iPods) afford educators as we examine how we can contextualise and explicate professional knowledge as we collect and examine the expertise from the field within the tertiary setting.

Technology to support learning

Mobile technologies have the potential to support early career teachers to learn about the culture of teaching (Lacey, 1995) and what it is to be a teacher. The technology affords students opportunities for systematic quality learning through access to audio files and the potential to create such texts as important connections are made between study and work contexts (Billings, 2005).

Research conducted around the use of iPods within the tertiary setting is broadly focused on transmission of information from teacher to learner (For example, Pownell, 2006; McCombs & Liu, 2006; Scott, Nishimura & Kato, 2006; Miller & Piller, 2005). Belanger (2005) identified five categories of iPod use in academic settings: course content dissemination, classroom recording, field recording, study support and file storage and transfer. Saunders and Moore (2003) similarly identify iPods as a useful mechanism for the storage and transfer of files. Such research argues that iPods have the potential to support students who are not part of a face to face learning context for a range of reasons, such as distance learning or a lack of engagement with the traditional tertiary classroom setting. Pownell (2006) identifies benefits for learning supported by iPods as providing opportunities to engage learners outside of the regular learning timetable and the physical classroom setting because subject material and activities can be accessed at the learner's convenience. Further, Pownell (2006) argues that iPods provide opportunities for teacher educators to model the use of technology in education, a perspective which supports Dede's (2005) call for educators to teach in ways that acknowledge the technology rich environment within which most students operate in their out of school lives.

Taking another perspective, Switzer and Csapo (2005) argue that mobile technologies such as iPods are an 'effective tool for encouraging team work and information sharing among students' (p.

133), presenting opportunity for students to demonstrate their own understandings and to learn from the understandings of others. Slykhuis (2006) describes the capturing of audio data as a non-native function of the iPod. We believe that iPods, enhanced by the addition of the audio recorder, have another powerful use in acting as a tool to bring together the teaching field and the tertiary classroom.

Introducing our research context

The Faculty of Education at the University of Wollongong has a total enrolment of undergraduate and postgraduate students of approximately fourteen hundred. A Bachelor of Teaching degree can be completed over a three-year period (full time). Each year two semesters are offered (Autumn and Spring); a full time student can study up to four subjects per semester. Successful completion of the three-year degree qualifies the participant to teach in primary (Kindergarten to Grade 6) schools within the state. Upon completion of a Bachelor of Teaching degree, participants are eligible to apply for a fourth year of study to complete the Bachelor of Education (Primary) or apply for Bachelor of Education (Honours) degree. This qualification enables the participant to teach in most other Australian states and overseas. During this fourth year of study there are compulsory subjects for students, and curriculum elective courses. This structure puts our students in a unique position as many study for their fourth year concurrently with their entry into the profession.

Reflective Practice is a compulsory subject for all fourth year students. The subject builds upon the premise that reflective activity makes a powerful contribution to the learning and professional development of teachers. The capacity to reflect is identified as an important professional attribute. The subject aims to provide practical insights into the day-to-day decision making of teachers and the range of areas within their professional role that they need to be aware of and reflect upon. The subject explores these with opportunity for students to make connections between subject materials and professional experience as they examine the subsequent implications. In 2008, two cohorts of students were enrolled in the subject. Table 1 provides an overview of specific details for each cohort.

Table 1: Participant demographics

	Autumn session	Spring session
Student enrolment	48	29
Scheduled time of the class	Monday 4:30 – 7:30 pm	Monday 1:30 – 4:30 pm
Number of students engaged in part-time or casual teaching positions	32 (67%)	20 (69%)
Number of students engaged in full-time teaching positions	6 (13%)	0 (0%)
Number of students not engaged in any teaching during the session	10 (20%)	9 (31%)

An online community of learners called the *BEST site: Beginning and Establishing Successful Teachers* was developed specifically for primary and early childhood students in the Faculty of Education at the University of Wollongong and is embedded within the *Reflective Practice* subject. The site hosts a range of features including online

mentoring space, opportunity to create and read weblogs, forums and professional reading resources (Herrington, Herrington, Kervin & Ferry, 2006). Figure 1 illustrates the home page for the BEST site.

Figure 1: The BEST site
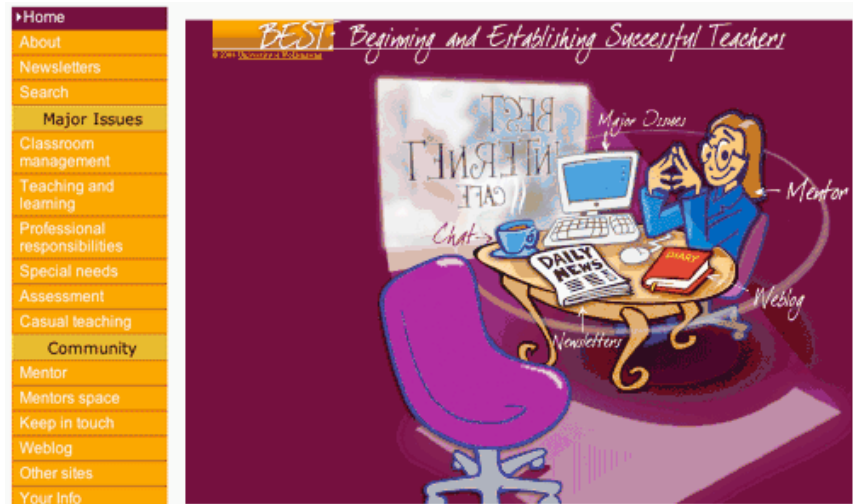
Engaging with Design-based Research to develop, refine and implement the task

Design based research is focused on 'research, design and pedagogical practice' as the researcher engages with an identified practical problem (Joseph, 2004, p. 235). Collins, Joseph and Bielaczyc (2004) describe the aims of this research approach as to refine both theory and practice as researchers develop plausible solutions to complex theoretical problems (Reeves, 2006). In the research reported herein, design based research was selected to guide us in the development of the 'teacher wisdom' learning task and to help us as researchers and teacher educators to better understand the potential of mobile technologies when used as a medium between learning contexts. The four phases of design based research are now described in connection with this inquiry.

Phase 1: Analysis of practical problems by researchers and practitioners in collaboration

During this phase the researchers articulated the problem for investigation. In this research, the problem identified was focused on ways that our students as early career teachers can gather and evaluate knowledge from the field and communicate this to their peers in the tertiary classroom environment. To guide the research, the following questions were posed:

- How do opportunities to collaborate with colleagues (both peers and practitioners) inform the pedagogical knowledge and understandings of participants?
- What processes do the students move through as they collaboratively evaluate and communicate knowledge using iPods, the BEST website environment and their tertiary classroom?
- How can iPods support students to gather, reflect upon and share knowledge from the field?

Phase 2: Development of solutions informed by existing design principles and technological innovations

The researchers moved between the first and second phases through recursive cycles as we investigated ways to support the students make connections between the university and school contexts. The phase finished with the design of the intervention - a learning task for students underpinned by the guidance identified and explored in the literature and from our own analysis of our previous experiences working with early career teachers both in school and tertiary contexts.

Phase 3: Iterative cycles of testing and refinement of solutions in practice

Over the course of 2008, two cohorts of students were enrolled in the *Reflective Practice* subject; one during Autumn semester, one during Spring semester. Each cohort made up an iteration of the research as data were collected and analysed to inform the teaching task. Interviews, observation and analysis of work samples comprise the data collection procedures during this phase. We built upon the BEST site to also include a link entitled *Professional Dialogue* within which the 'wisdom stories' could be housed for other students to access. The analysis of data from the first iteration informed the changes and refinements we made to the task as we reflected upon what the students were asked to do and how it supported their professional understandings. The recursive nature of data collection and analysis in this phase allows us to observe the interactions between and among the participants with the task from two distinct cohorts.

Phase 4: Reflection to produce 'design principles' and enhance solution implementation

This final phase provided us with opportunity to examine collected data and subsequent analysis to articulate deep and comprehensive understanding of guiding principles to support students to work in collaborative teams to gather, evaluate and communicate knowledge and the role of mobile technologies within this.

The 'teacher wisdom story' task: Iteration 1

Description of the task

In collaborative groups of two to three over a five week period, the 48 students were provided with an iPod and microphone and were asked to identify a focus for a 'teacher wisdom story'. Once a focus was determined, they then planned, recorded and edited an oral 'wisdom' story to be shared. Drawing upon their own emerging professional networks, and our more established ones, groups identified and made contact with practitioner/s who could share their 'wisdom' in response to the focus. Informed consent was obtained prior to any recording. Groups devised a series of questions to guide their discussion with practitioners and recorded the interview/s using the iPods. These recordings were then edited with either GarageBand or Audacity to include the practitioner/s wisdom and the group's synthesis of this. A 10 to 15 minute audio file was then uploaded to the subject website with an accompanying 100 word abstract summarising the focus of the 'wisdom story'.

Analysis of collected data

The students (with the informed consent of the participating teacher) were able to capture the story 'in the field', reflect on the connections

they made to their own understanding and share it for the benefit of fellow students through their online and physical communities. The opportunity to identify a topic of interest appeared to support their professional identities with sustained time and focus on something that was connected to their context. Students justified their selection of topic based on 'interest', 'appropriate to our situation', 'a particular teacher that we knew', 'what had been happening in my class', and 'a focus that directly impacted and informed our current practices'. The authentic nature of the task made for a powerful learning experience.

Students identified a range of learning gains from the task; some of which were related to the opportunities for collaboration with peers, some were related to professional knowledge, others to technological knowledge. 15 students identified professional relationships as a particular strength of the task, describing that these either emerged or were consolidated through the process. One student wrote about 'the kudos' he felt the task afforded them as emerging professionals. Another participant described her perceived value in being able to engage someone she respected in a sustained professional conversation. Another student described the 'confidence' she now felt in talking about her focus to other teachers and parents.

Overwhelmingly the students reported that the use of the mobile technologies supported their collection and sharing of the wisdom stories; only 3 from the cohort of 42 identified that their experience in using the technology for the purposes of the task was negative. Interestingly, 36 students described a sense of anxiety about using the iPods at the beginning of the task. In the initial instance students described feeling: 'threatened', 'nervous', 'daunted', 'overwhelmed', 'little experience', 'forced', yet also 'curious' 'motivated' and 'challenged' with the possibilities. One student explained 'at first glance I almost had a panic attack', and went on to talk about the experience being 'a roller coaster ride'. Of the 36 students who expressed initial negative feeling, only one reported that they felt the same way at the end. Our own observational data revealed that the majority of the students had little to no exposure to iPod technology before the project. They did need significant support through demonstration, encouragement and feedback during the process.

From the cohort, 38 students reported some kind of learning gain with the technology. Some students identified that using the software to edit the audio text presented a significant learning curve. One student described as 'extensive' the text they had collected in an 'elaborate and lengthy' 45 minute interview which needed to be edited into 10 minutes. While not directly related to the iPod, this example provides evidence of the complex decision making the students engaged with as they made professional decisions about what to keep and what to disregard to enable them to provide 'wisdom' about their topic. Another student described 'I was forced to experiment and through trial and error discover the best way to use this piece of technology to assist me'. One student described, 'I also feel I can approach my colleagues at school … without feeling embarrassed … I now know I don't have to figure everything out on my own'. Many students were able to examine their own experiences to identify subsequent classroom implications for their own use of the technology with their own students.

Changes and refinements to the task

While the task appeared a positive experience for most participants, we did identify some areas for further refinement. Our analysis of the work product created by the students provided clear evidence of their gathering of the 'wisdom' from the field, but showed little evidence of how the students had reflected upon and internalised their meanings. We felt there was a need to give stronger emphasis to their role, and indeed their voice, within the stories they shared.

Most of the collaborative groups spoke only with one teacher. Upon reflection we could attribute this to the time given to the task and the limited professional networks the students may have had to draw upon. While the wisdom they obtained from the one teacher was interesting, it didn't allow opportunity to compare and contrast stories to build a consistent line of discussion. We felt it was necessary to increase the number of practitioners incorporated by each group and in doing this, provide more time in terms of the length of the final product.

The physical manipulation of the iPods and editing software was a barrier for some students. While we had alerted them to software that was available, we had assumed that they would have the resources to be able to explore and operate this for the purposes of the task. The time this took in student consultation and trouble shooting during class time was considerable and something we wished to avoid in future iterations. We decided that scheduled time to model and scaffold strategies to use the technology would support the focus of the task being on the learning rather than the technology. Further, while the majority of the students enjoyed the task and reported significant learning gains, there were some who did not respond to this particular style of learning. As teacher educators we felt it necessary to look at this task as one pathway to the achievement of our outcomes.

The 'teacher wisdom story' task: Iteration 2

Description of the task

In collaborative groups of two to three over a six week period, the 29 students decided to create either a teacher wisdom story or a teacher professional journal. Those that decided to create a wisdom story (19 of the 29 students) were provided with an iPod and microphone and were asked to identify a focus for a 'teacher wisdom story'. The same process was then followed as in Iteration 1.

Analysis of collected data

Again, the students demonstrated they found the opportunity to capture the wisdom stories and engage with these through both online and physical communities to be a positive learning experience. While not all students opted to participate in this task, our monitoring of the BEST website revealed that most students accessed the range of stories provided by their peers. This cohort presented significant range in the stories offered with themes focusing on issues such as special education, entering the teaching profession, resilience, indigenous education and strategies for the beginning of a school year. Some of these are represented in Figure 2. Students again justified their selection of topic based on interest, however they also identified that their focus was derived from 'who we knew' in their own professional networks.

Figure 2: Incorporating professional dialogue on the BEST site
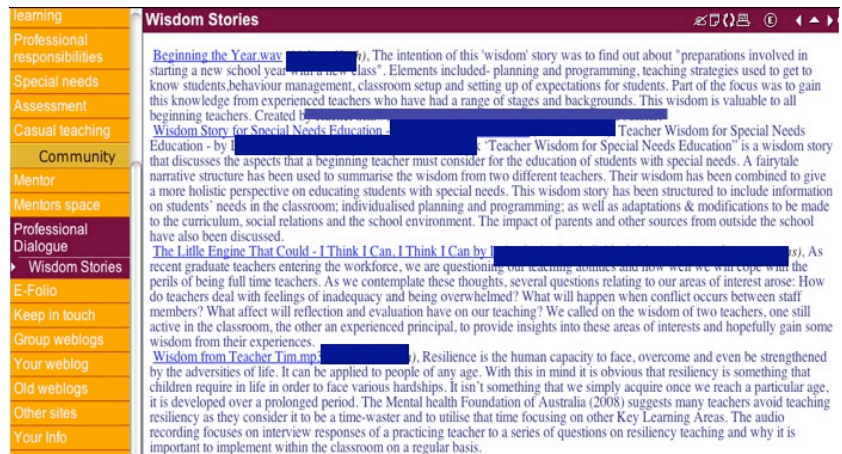
Building in our expectation that students would annotate their 'wisdom story' to help advance their line of discussion proved to be a powerful addition to the task. One student described the process her group went through to do this:

> The teachers responded to a series of questions … the digital audio recordings were then transcribed, analysed and edited … this process involved identifying key themes in the data, parsing excerpts of the interview that best captured these themes, then scripting and recording a commentary to 'stitch together' the themed excerpts from the interview … such a complex task necessitates reflection to enhance the learning process.

As our understandings of the task improved so too did the expectations we set for the students. This addition increased the complexity of the learning gains we were able to observe as we talked with the students and examined their work product.

Again the majority of the students identified themselves as having little to no experience using mobile technologies. However, for 17 of the 19 students, our inclusion of specific input focused on how to use the iPods and editing software was identified to be supportive and alleviated much of their anxiety about the technology. Interestingly, 6 of the 19 students identified that the reason that they had selected the 'teacher wisdom story' task, as opposed to the other more traditional task, was to increase their awareness and capabilities with the technology.

All 19 students who engaged with the task reported learning gains associated with the technology and indicated that the task was useful in demonstrating the ways that they could use technology in their own teaching contexts. One student described 'a reduced learning curve' with the technology due to increased familiarity with iPods and their capabilities. Another described that 'time spent learning how to use audio editing software is invaluable … teachers are using audio clips and editing software more frequently in the classroom'.

Reflective comments about mobile technologies from the perspective of this learning task

Our analysis of the two iterations presents us with principles to guide processes of collaboratively gathering, evaluating and communication of knowledge through mobile technologies.

Access

Mobile technologies allow students to gather information from places not accessible in traditional tertiary education structures as the students took their iPods into their professional settings. This access could then be transferred between and among other students as they each shared their stories from the field.

Learner directed

This task empowered students as they selected an appropriate focus, designed an interview and worked within pre-determined parameters to create a product that could be shared. The task allowed learners to prioritise their needs and then meet them supported by the portability and flexibility of mobile technologies.

Responsibility

The expectation that students would annotate their stories heightened the reflective processes as they made sense of, accounted for, made connections between and among their existing knowledge and this new information and internalised the viewpoints they recorded.

Audience

Knowledge that the product would be shared in physical and virtual communities produced a heightened sense of responsibility for the quality of the product; the need to visit and revisit different stages within the process revealed the authors' awareness of their peer audience and their desire to be considered 'professional' in presenting the wisdom they had sought.

Enriching and building new networks

For our students, the task broadened their professional standing as they were able to engage in and capture focused, purposeful talk about an area of professional interest. Their prior research in designing the interview and drawing on experiences in the classroom equipped them to contribute to the dialogue knowledgeably with a more experienced practitioner.

The task valued the connections students had already made in the professional context, facilitated the deepening of those connections and encouraged the establishment of new ones as the students drew on relationships built throughout preservice teacher training and early teaching placements. These connections were shared between group members as they collaborated to create one product. Connections were further made as one student's professional network was opened to the rest of the class (and us!) as stories were disseminated through the BEST site.

Conclusion

The task we have developed to engage our students in the processes of gathering and evaluating evidence has informed and guided their emerging professional practice. This chapter provides example of how

iPods can be used as a tool to bring together the teaching field and the tertiary classroom. We believe our use of technology is one where the technology is adequately fulfilling a much needed role, yet is transparent as the focus remains on the learning of important curricula content.

The two iterative cycles we have described have enabled us to design, implement and reflect upon how we can engage our students in collecting, evaluating and reflecting upon knowledge shared by practitioners in the field as they consider the 'teacher wisdom' (Labbo et al., 2003) that can be gathered and disseminated through audio files. The benefits of this learning task are three-fold. The students were able to: begin building a repository of teacher experiences, gain confidence approaching other teachers for guidance and assistance, and gain confidence using technology tools. The archive of wisdom stories that have been created through the two iterations will serve as a valuable resource made accessible to future cohorts. The skills students acquired during the task as they interacted with other teachers will service them throughout their career, as will increased technological confidence. We believe this learning task has significant potential and replication of this project would be an asset to any teacher education program.

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CHAPTER 11

Using mobile phone cameras to capture images for slowmations: Student-generated science animations

Garry Hoban

Abstract:

A common phenomenon in many countries is that science is often poorly taught or not taught at all in primary school classrooms. 'Slowmation' is a new yet simplified form of stop-motion animation that encourages school or university students to create their own animations of science concepts. Even though this process of creating an animation is relatively simple, there is still a need for teachers and students to have access to basic equipment such as a digital still camera, a tripod and a computer with relevant software. This chapter presents a study of a group of preservice primary teachers who guided their school classes in creating slowmations of science concepts using the camera in mobile phones to capture the images. Using a mobile phone camera improves the accessibility to a camera, but the quality of photos taken by mobile phone cameras needs to be improved to make it a worthwhile use of the technology for creating animations.

Introduction

The teaching of science in Australian elementary schools is a national priority (Committee for the Review of Teaching and Teacher Education, 2003). Yet science is one of the least taught subjects in the primary curriculum in Australia (except for Languages other than English) averaging 41 minutes or 2.7% of teaching time each week (Angus et al., 2004).

One way to address this concern is to encourage preservice teachers to teach science in new and engaging ways whilst undertaking their university courses. Using technology can be a motivation for preservice teachers to implement science especially when using a popular medium such as digital animation.

However, nearly all uses of digital animation involve learners using expert-generated animations. An alternative way for preservice teachers to implement science is to encourage them to make their own animations to represent their understanding of science content. According to Bransford, Brown, and Cocking (2000) technology is a powerful tool for learning especially as 'learners might develop a deeper understanding of phenomena in the physical and social worlds if they could build and manipulate models of these phenomena' (p. 215).

Empowering learners to make their own animations of science concepts is consistent with the theoretical framework of 'constructionism' promoted by Seymour Papert (1980, 1991). He contended that students engage in deep learning when they have to research, design and construct an artifact or model with technology to represent their knowledge. Constructionism draws on both the Piagetian notion of constructivism, whereby learning occurs when individuals construct models or artifacts to represent their own understandings of concepts, and Vygotskian social influences when the artifacts are shared with a wider audience. However, most attempts by students to create animations involve using complicated

software such as Macromedia's Flash which is usually beyond the expertise of most learners, especially in primary school.

Slowmation: A new form of stop-motion animation

'Slowmation' (abbreviated from 'Slow Motion Animation') is a new form of stop-motion animation that simplifies the usually complex process of making animations so that they can be created by learners (Hoban, 2005, 2007, 2009). Similar to other forms of stop-motion animation such as clay animation, Slowmation involves the manual manipulation of materials with a digital still photo taken at each change in position of the materials. The digital photos are then uploaded into a computer program which plays the photos in a sequence to create an illusion of movement and is seen by the human eye as moving by itself because of a phenomena called 'persistence of vision'. The process involves students researching information, scripting, storyboarding, making models, photographing digital still images of small manual movements of the models and using a computer program such as Apple's QuickTime Pro or Window's Movie Maker to create the animation. Slowmation, however, is different from clay animation in six key ways as shown in Table 1. These differences mean that slowmation is simpler and less time consuming to make than clay animation and so becomes a feasible teaching approach in school classrooms.

Table 1: Comparative features of Slowmation and Claymation

Feature	Claymation	Slowmation
Purpose	To tell a narrative or story	A resource to explain a science concept
Content	English	Science
Orientation	Models are made in 3-D to stand up vertically and are moved incrementally as they are photographed with a digital still camera mounted on a tripod looking across at the models.	Most models are made in 2-D flat on the floor or a table and moved in the horizontal plane as they are photographed with a digital camera mounted on a tripod looking down at the models (this is not always the case, however, as existing 3-D plastic models can be photographed in the usual way).
Materials	Clay or plasticine	A wide variety such as soft play dough, plasticine, 2-D pictures, drawings, clip art, existing 3D models, leaves, rocks, paper, fruit, felt, cardboard cut outs and many everyday classroom materials.
Learning Prompts	The art of telling the story explains the experience	Prompts are included to help explain a scientific concept such as narration, music, authentic photos, diagrams, models, labels, questions, static images, repetitions and characters.
Timing	20-24 frames/second to simulate real movement	2 frames/second to explain a science concept in slow motion hence the name 'Slow Motion Animation' which is abbreviated to 'Slowmation'

Making a slowmation usually results in a short 1-3 minute video explaining science concepts. Because slowmations are usually made flat on the ground and are played 10 times slower (2 frames/second) than traditional animations (played at 25 frames/second), they are much easier to make. Learners can therefore represent *their own understandings* of science concepts in very comprehensive ways (Hoban & Ferry, 2006).

Over the last two years over 500 slowmations have been made by preservice elementary teachers at the University of Wollongong in primary science education classes demonstrating many concepts such as day and night, seasons, lunar cycles, life cycles of various animals, particle motion, magnets, fungi life cycle, plant reproduction, weather, movement of the planets, water cycle, simple machines, mitosis, meiosis and phagocytosis. One example, created by a preservice teacher is called 'The Earth and its Surroundings,' has 600 digital photos and goes for 5 minutes. It explains the concepts of day and night and phases of the moon, commences with moving 2-D images of day and night using cut out felt that is moved manually and then progresses to moving 3-D polystyrene models. Features called learning prompts are added such as narration, music, diagrams and to help explain the science content. In all, it took a preservice teacher 20 hours to create at home in a room with a dimmer to simulate effects of changing light on the earth and moon. However, slowmations made by school children are usually much shorter and simpler.

Using mobile technologies

A possible problem with student-generated animations, however, is that the required technological tools such as a computer, tripod and digital still camera are often not accessible in terms of the restricted resources in schools or teachers do not have the confidence to use them. With the increasing presence of mobile technologies, it is possible that it may be simpler to create animations using handheld digital tools (Heath, et al., 2005). Researchers (Corlett, Sharples, Bull & Chan, 2005; Gado, Ferguson & van 't Hooft, 2006) have argued that various hand held electronic tools in the form of mobile technologies will make learning more accessible and feasible for students to use in classrooms. In this study preservice teachers on practicum were encouraged to use mobile phones for taking photos instead of regular digital still cameras to capture digital images for slowmations. The purpose of the study, therefore, was to ascertain if taking photos with the camera in a mobile phone was feasible and accessible for preservice elementary teachers whilst teaching in schools.

Methodology

In 2008, twenty four preservice teachers were enrolled in a 13 week science method course in the third year of a four year Bachelor of Education degree at a university in Australia. The elective course was 'school-based' meaning that a key component of the subject was spent in schools such that for five weeks the preservice teachers went into classrooms instead of coming to university. The course was designed in three parts: (i) *Planning*: in weeks 1-5 the preservice teachers were

placed in pairs and allocated to contact a teacher in one of two schools.

A range of classes were selected so the preservice teachers were allocated to classes from Kindergarten to grade 6 in a primary school. The preservice teachers telephoned their teacher at the beginning of the subject to request a topic to cover 5 science lessons that were suitable to teach the class. The preservice teachers then spent five weeks planning the lessons; (ii) *Implementing*: in weeks 5-10, the preservice teachers went to the elementary school and taught a lesson each week for 5 weeks; (iii) *Reflecting and Evaluating*: in the final three weeks of the course the preservice teachers reflected upon the implementation of their teaching and gave presentations to the other students to share their experiences.

One of the key aspects of their implementation was to teach a science lesson using the slowmation approach and to use the camera in the mobile phones to take the photos. In most cases this was the fifth lesson so that the children created a slowmation to represent their understanding of a science concept as an assessment task. In the final three weeks of the subject the preservice teachers gave a presentation to their peers on the strengths and weaknesses of implementing their lessons including the value of using mobile phones for taking photos for their slowmations. After the presentation, several preservice teachers were interviewed about the value of using the mobile phone cameras for taking photos for animation and their slowmations were copied as evidence of the school children's representations of science concepts.

Results

There were 12 pairs of preservice teachers involved in the study and all were able to use the camera in a mobile phone to take the images for their slowmation. In most cases the preservice teachers held the phone in their hand to take the photos whilst the children made the small manual movements for the animation. Some of the topics prepared for teaching were Electricity for Year 4, Life Cycles for year 3, Garden Animals for Kindergarten, Back to Nature for year 1, Magnetism for year 3 and Living Things for year 6. Examples of slowmations from kindergarten and Year 4 classes will be presented highlighting their use of the mobile phone cameras followed by a case study showing the use of the phones for taking photos in more detail.

Example 1

Teaching Kindergarten about garden animals (spiders)

Two preservice teachers were asked to teach 5 lessons about garden animals to a kindergarten class. The fifth lesson was about spider webs and the teachers guided the kindergarten children in creating a slowmation of the making of a spider web on a blackboard placed flat on the floor. As a child drew a line on the blackboard with chalk to represent a part of a spider web, the preservice teachers took a photo with the camera in a mobile phone.

One of the interesting aspects of using the mobile phones was the challenge of keeping it still enough to take a photo of something that

was being manually moved. To help keep the phone stable they taped the phone to the back of a chair as shown in Figure 1. In this way the phone was positioned to look down at the blackboard that was laid flat on the floor and so enabled the kindergarten children to draw the spider web on the blackboard laying down flat on the ground.

Figure 1: Mobile phone mounted on the back of a chair looking down

A sequence of several photos in the slowmation of produced representing the creation of a spider web can be seen in Figure 2.

Figure 2: Sequence of photos from the Slowmation showing construction of the spider web

It should be noted that this animation was created by five and six year old children in kindergarten over a period of 30 minutes. Once the teachers had the phone taped to a chair they were able to take the photos using the phone (this would be beyond the manipulative abilities of kindergarten children) but the children moved the spider and mapped its web creation with chalk. The photos were then uploaded into a software program to create the slowmation after the class.

Example 2

Teaching *Magnetism* to Year 4

In this Year 4 class the teacher was asked to teach 5 lessons on magnetism. In the fifth lesson, the teacher used a mobile phone to take photos for an animation that the children made to show how like poles repel when placed together as shown in Figure 3.

Figure 3: Sequence of photos from the Slowmation showing repulsion by the similar poles of a magnet

Two south poles come together

The similar poles repel each other

The two south poles push each other apart
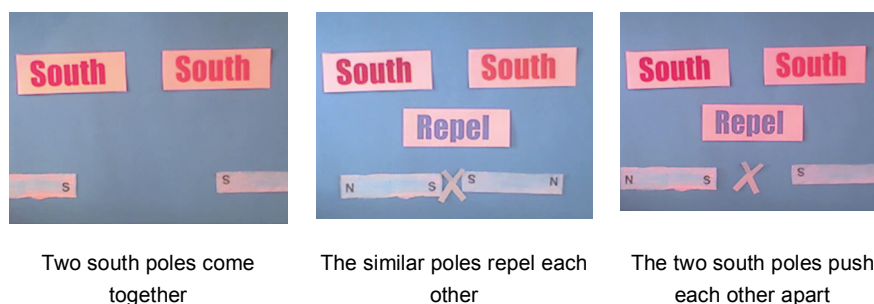
In this situation, the mobile phone was held in the hand of the teacher and the children were able to manipulate the magnets in small movements to show the force of repulsion by two like magnets. The following case study gives more detail about how two preservice teachers Jessica and Melissa (pseudonyms used) organised the class to create a slowmation and how they used the camera in the mobile phone to capture the images. In particular they were creative in designing a technique to keep the phone camera still to provide continuity for the slowmation.

Example 3

Case study of Jessica and Melissa teaching *Seed Germination* to Year 4

The teachers had taught the Year 4 children about the life cycle of plants and in the last of the five lessons they intended their students to create a slowmation that summarised the plant life cycle. Because they only had one lesson to teach the children about how to make and do a slowmation, they introduced several scaffolds to enable the animation to be created and completed within one lesson. One of the challenges for the preservice teachers is that they needed to overcome the need to hold the mobile phone still to enable continuity and focus between the photos (normally a digital still camera is mounted on a tripod looking down at the materials to be photographed). To overcome this problem of a need for steadiness, the students constructed a paper template with a border so that the camera in the phone could focus on this frame for each photo. This meant that as long as the frame was in the same position relative to the viewer in the camera, there would be some control over the relative movement of the camera.

Another innovation was that for the animation to be completed within one lesson, they thought that it would be too difficult for the Year 4 students to create models of different parts of the plant life cycle. For this reason, they gave a template that they had created to each child. Each child had to draw their particular part of the plant life cycle using the template with the seed within a rectangular frame in the same place to give the students a basis for drawing their part of the plant. However, this was still a challenging task as the children in the class of 24 were divided into 6 groups and each group was allocated one particular part of the plant life cycle to represent. Hence the organization for the lesson, which took 90 minutes in total, was like a jigsaw with 6 groups creating a part of the life cycle of a plant, and within each group, a child had to draw one part of their allocated cycle. Hence each group had four pictures each showing a movement in growth of the plant and it was like each child creating a frame of a cartoon which then showed movement within their group and across

the six groups as well. Melissa explained in an interview how they organised the class:

> We divided the class up into six groups so that each group would represent a part of a life cycle of a plant so it became a class animation. I had drawn up a picture that showed the main thing in each phase as a guide because we had to do it in one lesson. But each group of students had to plan their own four movements and work out what to do. We also talked about the sun moving so that it progressed in the animation. I think the whole scaffolding bit before helped them to understand it. So the students drew their pictures first like a storyboard and also had to work out their narration.

They explained why they made the template with the frame to try to keep the photo steady:

> And we made up a frame with a bean seed drawn in the middle so that all the students would make their drawings with the same perspective so that we could get some continuity across the groups and the diagrams would fit together. And I had drawn one picture that represented their stage as a model and the children had to draw their own pictures … the students drew their pictures first and then worked on their narration. Most of the groups picked one person to do the narration. So after we took the pictures then we got the children to do the narration. It did not exactly match the photo sequence so then we changed some of the photos.

When asked about the classroom organization of different groups doing different parts like a jigsaw this was their response:

> We thought it was easier than trying to get the whole class engaged and doing the one thing. So each of the six groups had four different frames so that each student had a frame and were responsible for drawing their part of the animation. Once each group organised their drawings they came out and we took a photo of each of the four movements in a group and then we moved onto the next group. So for example each of the four students in a group changed the position of the sun and had one picture to draw of the movement of their plant.

Figure 4 shows a sequence of photos showing different parts of the plant life cycle.

Figure 4: A sequence of frames showing seed germination and growth
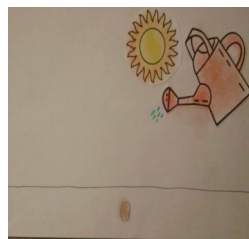
Seed is watered   Seed germinates   Plant grows in the sun

When asked if the student enjoyed making the animation the preservice teacher's response was:

They loved it. The hardest thing was getting the six different groups to do a different part of the plant life cycle and then putting it together like a jigsaw. So when the groups were all finished I called them out one at a time into the art area and took the photos. Meanwhile the students who were waiting while the photos were being taken worked on their narration.

When asked if they would use the mobile phones again for taking photos, they replied:

It depends on the quality of the camera in the phone. Some of them are not very clear and when you download them to the computer they are pixillated. We held the phone with our hands but we had the frames on the paper so that we just had to line up the camera with the frame. So the students just turned the pages over and we could take the photos. It was important that they were taken in order to get the sequence right. If we had plenty of time it the groups would be able to make their own from start to finish.

Discussion

This study shows that it was feasible for preservice primary teachers to create slowmations about a science concept with their classes of primary school children using the cameras in their mobile phone to capture the images. Hence there is potential for mobile phones to be the handheld tools to support the creation of animations (Heath, Herman, Lugo, Reeves, & al, 2005; Corlett, Sharples, Bull, & Chan, 2005; Gado, Ferguson, & van't Hooft, 2006). However, only three of the 12 pairs of preservice teachers were able to complete their slowmation in one lesson including adding a narration. Clearly more time is needed such as several lessons. Most of the other pairs were able to take photos with the mobile phone and upload to a software program to create the slowmation, but did not get time to get the students to complete the narration. Hence the use of mobile phone cameras provides an accessible technology for creating photos, however, the quality of the photos could be improved in many cases.

The case study example of Melissa and Jessica was the best slowmation produced by the different primary classes, but they were very well organised and introduced some innovations to make the creation of a slowmation in one lesson achievable. This included using a pre-drawn template for each child with a fixed seed and line to provide a base framing for the camera as well as have each child draw one frame rather than making models. The class was also well organised into six groups with each group of four being responsible for one part of the plant life cycle and one child responsible for one drawing within a group. So the way it was organised was like creating a class comic. Nonetheless, the preservice teachers were able to get a Year 4 class to make a 2 minute slowmation from start to finish never having made one before.

Conclusion

The main insight from this study is that the Slowmation approach greatly simplifies the normally complex process of creating student-

generated animations and using mobile phone cameras provides an accessible technology. However, the clarity of the photos is not satisfactory at this stage. A limitation of this study was that there was no research conducted as to whether the creation of slowmation to represent a science concept was beneficial for the children's learning. In this study the slowmation was created in the last of five science lessons and was intended to be an assessment task for the children. However the focus of the study was exploring the feasibility of using mobile phone cameras for creating slowmations rather than ascertaining the influence on student learning.

In the not too distant future, every child in a school may possess a mobile phone camera, and the quality of the cameras will improve meaning that slowmation could become a commonplace teaching approach in classrooms. One of the preservice teachers in this study predicted that a mobile phone will not only have improved cameras but will also have a recording facility for a narration as well as the software for uploading and creating the animation. This leaves the door open for every school child to possess a tool for hand-held animation creation. The implication is that it may be possible for children to create slowmations of different educational concepts at their own school desks. This use of mobile technology means that each child may become a more active knowledge creator as opposed to a knowledge receiver as is the case in many science lessons in school classrooms.

Note

In 2006, Slowmation won two 'Technology Leadership Awards' presented by the international *Society for Information Technology and Teacher Education* (SITE). Free examples, software and information about Slowmation can be accessed at www.slowmation.com.au which is has been funded from an ARC Discovery Grant

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Art on the move:
Mobility – a way of life

Ian Brown

Abstract:

Mobile technologies are a recognised piece of our lives and a necessary attachment to our bodies. As educators we need to understand and consider the advantages of mobile technologies to education and exploit their use. This chapter presents two innovative case studies which use a mobile technology as the basis for an educational experience, through the exploration of the visual arts education. The mobile technology highlighted, involved the use of the iPod as a resource for learning. The experience resulted in a motivating and engaging experience for the learner through the true sense of a mobile learning experience

Introduction

Quicker, faster, more accessible…this is life as we know it today. As technology advances users expect and demand a level of instant accessibility within the confines of the environment in which they work, live and play. Expectations are that instant responses from mobile technologies can be had from local urban street corners to remote jungles and deserts. A study by the British Henley Management College in 2003 discovered that 46% of 25 to 34 year olds 'could not live without their mobiles'. The study described this phenomenon as akin to 'bereavement' (BBC, News, 2003).

Harkin (2003, p. 9) claims that 'mobile technologies are folding themselves into the fabric of our economies, social lives and communities'. Mobile technologies are a recognised piece of our lives and a necessary attachment to our bodies. Be it a mobile phone, an iTouch or an iPod, for many, life as usual, would cease to exist if they were not readily available. As educators we need to understand and consider the advantages of mobile technologies to education and exploit their use. Academics such as Gerard Goggin (2006), view cell phones and mobile technologies from a cultural viewpoint and argue that the mobile phone can be viewed as a species of popular culture. Understanding mobile technologies from a cultural viewpoint, Goggin (2006) suggests that the mobile technology culture fits into a broad cultural field and relates specifically to the social, through cultural studies such as sociology, anthropology and other disciplines. This culture maintains the ability to 'reclaim the sense of rich wonder and importance of the ways that people do make meaning in their everyday lives' (p. 203). Art and art education plays a major role in reflecting culture.

Through the exploration of the notion of the use of mobile technologies in learning, case studies will be provided that demonstrate the development, implementation and evaluation of mobile technologies in art education specifically. Accepting the premise put forward by Vavoula and Sharples (2002) that the nature of learning is closely linked to the concept of mobility and the suggestion that there are three ways in which learning can be considered mobile. That is, learning is mobile in terms of space;

mobility between different areas of life and mobility in respect to time.

The *Horizon* project, launched in 2002 as the centerpiece of the New Media Consortium (NMC), charts emerging technologies for teaching, learning and creative expression that are likely to have a large impact within learning focused organisations globally. Mobile technologies, in relation to learning and education have featured each year since its inception. The *Horizon Report* (2008, p. 6) documents the scope and influence of these emerging technologies by reminding us that each year more than a billion new mobile devices are manufactured including mobile phones, PDAs and similar devices. That is, a new phone for every six million people on the planet. The Horizon report clearly supports the pervasive nature and accessibility of mobile technologies:

> Capabilities are increasing rapidly, and prices are becoming ever more affordable. Indeed, mobiles are quickly becoming the most affordable portable platform for staying networked on the go. New displays and interfaces make it possible to use mobiles to access almost any Internet content—content that can be delivered over either a broadband cellular network or a local wireless network. (2008, p. 6)

According to the NMC the way we work, collaborate and communicate is evolving as boundaries become more fluid and globalisation increases. Students now have access to and portability of content which is increasing as smaller and more powerful devices such as iPods or Amazon Kindles are introduced. Students today rely or expect a much more complex schema to find and collect this knowledge.

Students are not the only learners to demand new forms of knowledge attached to new forms of delivery. The average user now demands anywhere, anytime access. We become frustrated if our wireless connection is not instantly available in hotels, airports and classrooms. The ubiquitous wireless has enabled learning, social computing and social networking to sky rocket.

Students now have unprecedented access to visual and verbal learning through social networking tools such as YouTube, or Google Videos. Video has undergone a profound transformation. Millions of videos are just a click away. World events (and not so worthy events) are captured on mobile phones and distributed to the world. In one month in 2007, 7.2 billion videos were viewed online by nearly 123 million Americans (Lipsman, 2007).

According to the *Horizon Report* the application of mobile broadband and data mashups are evident now in learning organisations that are at the leading edge of technology adoption. (2008, p. 5) The ability to 'mash up' data from a variety of sources offers new ways for students to look and interact with data. The convergence of open programming interfaces for social networking will transform the way knowledge is understood and represented (2008, p. 4). An example of successful educational mashups is where Google Earth has integrated YouTube, allowing users to view videos from specific locations around the world. Ostrow (2007) sees this as a clever integration between

products, as YouTube videos are plotted according to geotags that YouTube users have placed on their content. Google is yet again providing a new social network tool for their users.

There is little debate that the use of mobile technologies will enhance learning if properly harnessed and exploited. While current research exists that identifies exponential growth in the use of mobile technologies globally it appears that little research exists that provides best case models and case studies of where and how mobile applications are being used in the educational sector.

Naismith, Lonsdale, Vavoula and Sharples (2006, p.1) predict that the challenge for educators and designers is 'one of understanding and exploring how best we might use these resources to support learning'. Naismith, et al (2006) succinctly express the opinions and views of many educators in relation to the future of mobile technology in education. They state:

> Mobile technologies are becoming more embedded, ubiquitous and networked, with enhanced capabilities for rich and social interactions, context awareness and internet connectivity. Such technologies can have a great impact on learning. Learning will move more and more outside of the classroom and into learner's environments, both real and virtual, thus becoming more situated, personal, collaborative and lifelong. The challenge will be to discover how to use mobile technologies to transform learning into a seamless part of daily life to the point where it is not recognized as learning at all (p.5).'

While mobile technology education can be different things to different people, in this chapter the term mobile follows the definition offered by Naismith et al (2006) that mobile means 'portable' or 'movable' and/or 'personal'. Klopfer et al., (2002) as cited by Naismith et al., (2006) identified five properties when looking at mobile PDAs that produce unique educational affordances. Properties include 'portability' (the ability to be taken to different sites due to small size and weight); 'social interactivity' (data exchange and collaboration with other learners); 'context sensitivity' (the ability to gather and respond to real or simulated data; 'connectivity' (shared network) and 'individuality' (scaffolding for difficult activities).

Theories of learning relevant to learning with mobile technologies

To appreciate the ability of a mobile device as a support to learning it is important that the educational experiences are embedded in sound educational practice and the 'mobility' of the device is exploited to its potential. The area or theory of learning which best describes the following case studies tend to be from a hybrid of areas. Constructivist and situated learning probably best describe the type of learning developed for the users. According to Naismith et al., (2006, p. 10) constructivist learning is where experiences are developed which allow learners to actively construct new ideas or concepts based on both their previous and current knowledge. While situated learning

involves experiences that promote learning within an authentic context and culture.

According to Naismith et al., (2006):

> In order to transform learners from passive recipients of information to active constructors of knowledge we must give them an environment in which to participate in the learning process, and the appropriate tools to work with that knowledge. Mobile devices give us a unique opportunity to have learners embedded in a realistic context at the same time as having access to supporting tools. (p.12)

Based on the work of Lave and Wenger (1991) the second area of learning most applicable to the case studies presented is the area of situated learning. Naismith et al., (2006) suggest that in relation to the use of mobile technologies:

> Situated learning requires knowledge to be presented in authentic contexts (settings and applications that would normally involve knowledge) and learners to participate within a community of practice. By developing appropriate context-based teaching strategies with mobile technologies, we can fulfill both of these requirements (p. 13).

The iPod –truly mobile

The Apple iPod was chosen as a mobile device to explore learning in the context of visual arts education. The iPod is arguably the most popular portable media device produced today. Originally developed to store and play digital music it has increasingly become more sophisticated as new models emerge, with features such as touch screens, video capability, image storage and flash memory. The latest iTouch allows transfer of music, numerous audio file formats, wifi connectivity, photo storage and display, game, contact information transfer, emails and calendars. By September 2007 more than 150 million iPods had been sold world wide (Gaba, 2008).

Apple through their Learning Interchange (2008) claim that the 'iPod enables learning on the go, meeting the mobile and media-rich learning styles of today's students.' Michael Bull (2007) argues that the Apple iPod is the first consumer cultural icon of the twenty-first century. Bull contends that the iPod represents a sublime marriage between mobility, aesthetics and functionality. Bull reminds us of the user in terms that 'the iPod puts them in tune with their desire to eke out some aesthetic, cognitive and social control as they weave through their day' (p. 3).

Approach

Twenty two undergraduate students enrolled in the Bachelor of Education course at the University of Wollongong were involved in the study. Focusing particularly on one academic subject, Visual Arts Education, students were invited to participate in the study which would explore the use of mobile technologies (the iPod in particular). The students were required to develop, implement and evaluate a series of learning experiences that exploited the affordances of mobile

technologies by embedding them into an educational experience. Students then provided peer evaluations of each other's assignment. Students were required to use an external site, the Wollongong City Art Gallery to implement their program of work. Within the subject students were required in groups of three to complete the following assessable task:

Task: Art on the move

Exploring the on-site use of mobile technologies for innovative teaching and learning in visual arts education

Students in groups of three (3) will develop an innovative, interactive visual arts learning experience using a mobile device (iPod) to deliver the experience for students K-Tertiary. Through research, exploration and invention students will develop an age appropriate learning experience which uses or culminates on-site at the Wollongong City Gallery.

The task will consist of three phases:

A. The Design Stage
    i.   Visit the Wollongong City Gallery and the surrounding area to be used a stimulus material
    ii.   Consolidate the area of study and the age of the students for the experience
    iii. Design the learning experience
    iv.   Identify the teaching and learning outcomes. (Note: the experience should be designed for a maximum of one hour duration and must be in the confines of walking distance of the gallery).
    v.   Allocate the roles of the group members where necessary

B. B. The Development Stage
    vi.   Develop and construct an iMovie/podcast/videocast to be used by students on-site, which may include interviews, downloads, still shots, scanned images, audio clips, etc.
    vii. Students may provide some written support for the experience, e.g., pamphlets, worksheets. (Remember: the mobile device is to be the predominant pedagogy).

C. The Implementation/Reflection Stage
    viii. Students will be involved in downloading and undertaking one of the learning experiences developed by their peers
    ix.   Students will be required (individually) to use the resource on-site, evaluate and reflect on the experience providing useful critical feedback to the developer.

Areas of Exploration

Students could explore any of the following areas for the development of their experience:

- The gallery (its role in the community, curating…)
- Artistic practice (the way art is created…)
- Artforms (the media and forms artist use in their practice…)
- Artists
- Artworks

- The audience
- Analysing art
- Artist studios (artist in residence)
- Places and spaces (public art, architecture, galleries)
- Idea and representations (art periods, ideas, themes such as Aboriginal art, feminist perspectives, spirituality, popular culture, social and cultural contexts, symbolism)
- Exhibitions (the notion of a body of work)

Seven groups were formed and seven projects were developed. To demonstrate the diversity of the projects two cases were selected and highlighted for this chapter.

Through a project entitled *aRtitecture,* Year 10 students were challenged with the use of video and audio, to view the existing architecture of the Wollongong City Gallery. By exploiting the mobile nature of the iPod, students were provided with a learning experience which both motivated and engaged them. The *aRtitecture* project is described in detail below.

Case one: 'aRtitecture'

Three preservice teachers, Lisa, Kristen and Luke (pseudonyms used), described their task and outcomes as:

> The aRtitecture Challenge is an interactive iPod visual arts learning experience designed to engage Year 10 students in the appreciation of architecture and art. The purpose of the experience is to challenge the more traditional perceptions of art by encouraging students to understand that architecture is an art form in its own right.

Learning experiences

The challenge was for Year 10 students to create two new gallery spaces by evaluating the role, aesthetics, form and function of the existing spaces. Students explored spaces within the gallery looking at the entrance and with the support of a worksheet noting main features. Students were given the opportunity to sketch various areas of the gallery including the exterior. Students were encouraged to wander through the gallery, prompted at times to stop the tour and answer a number of questions or reflect on their findings. Specific architectural features were discussed and students were required to provide feedback. Students were encouraged to sit within spaces, immerse themselves in the surroundings and share their thoughts with friends. Aspects of the architecture were discussed in relation to the place of art and artworks. At the end of the visual verbal experience students were encouraged to design their own 'space'. Another important aspect of the learning experience was listening to an interview with the gallery's curator. From the interview students were able to learn about the history of the gallery and how the gallery was transformed from the old city Council Chambers.

Peer reflections

The feedback or evaluation phase of the task allowed peers to provide constructive criticism and reflect on the experience. The preservice teachers were specifically required to comment on the effectiveness, the innovative use of the device, the creativity in the design of the task and exploitation of the mobility of the device.
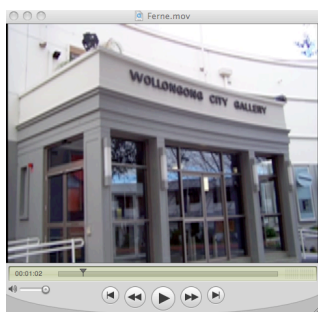
On reflection by peers it appears that the task was extremely effective in achieving the assigned outcome of engaging the Year 10 students. The use of the iPod as a mobile technology allowed the users to pace their learning which stimulated the learner by providing visual and oral clues. Students also commented on the ease and enjoyment of listening to the comments while wandering through the space. On the whole, the teachers found the learning experience innovative, exciting and engaging. While recognizing the compact nature of the device and ease of use, some teachers did comment on the many hours taken to produce the one hour learning experience. On the whole the comments were extremely positive and they reflected the teachers' views of the device as a way of scaffolding learning.

Case two: Case of the Missing Artwork

A second project entitled *Case of the Missing Artwork* is presented to demonstrate the diverse nature of the projects developed. In this case, art appreciation is explored for Stage Three students where art terminology is encountered and taught. Using a 'secret agent' metaphor, students developed an interactive and engaging learning experience to motivate the primary aged children.

Three students Nicole, Kate and Debbie (pseudonyms used) described their task and outcomes as:

> This learning activity was designed for Stage Three students (age 10-12) and aimed to further students' understandings of artistic terminology and appreciation of art. The task was designed with the Wollongong City Gallery in mind as a platform for an engaging activity designed to cultivate a deeper understanding of local and international artists. The activity takes the form of a quest in which the students needed to collect clues from a particular artwork. The clues aimed to develop knowledge of artistic concepts as developed through relevant syllabus documents. The task was designed to develop critical thinking and evaluative skills. The clues focus on artistic techniques, media, cultures and time periods.

Learning experiences

Using an authentic task the iPod experience was designed to appeal to a variety of learning styles. For example, there were written clues, audio only clues as well as video clues. Clues collected related to the concepts of adaption/adaptation, focal point, art periods, perspective/viewpoint, art media, subject matter and the gallery space. By providing this range of experiences the task enabled the learners to engage and interact with the content presented. Using authentic style activities such as 'Secret Agent' terminology, fonts, graphics and the inclusion of 'real' community members, all adding to the motivation and engagement qualities of the task. Supporting case note files were included following the look and feel developed for the mobile technology task. The case file notes supporting documents also served to scaffold the learners through the provision of separate sections for each clue. The task included post visit activities that could be undertaken in the gallery or back in the classroom. In summary, the secret agency (CIA) has discovered that an artwork is missing and the user has to find clues to solve the mystery of the Missing Artwork.
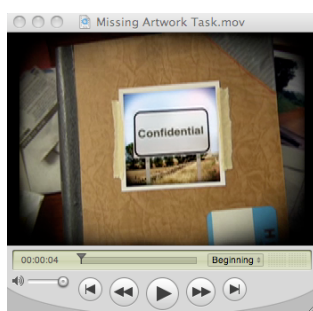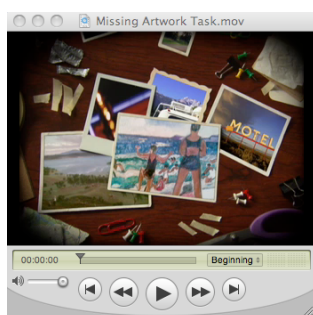
Students were assigned an identity to complete the task, such as, Agent 913.

Students were required to complete peer reflections as an assessable task at the conclusion of the tasks. Generally, the teachers, after undertaking the tasks, commented that the experience was 'highly motivating and engaging'. The use of the iPod was both a novelty as well as motivating to the learner. Positive comments could be found using words such as 'brilliant', 'engaging' and 'encouraging'. Teachers highlighted that the authentic locations and their ability to use the gallery as a stimulus provided an 'important connection between the virtual reality and actual reality of the activity'. In relation to the inquiry process presented, one teacher commented:

> The problem solving, deductive reasoning and critical thinking skills built into this learning experience position the learner to evaluate their clues.

Creativity engagement and mobility

Why bother with mobile technologies? As one preservice teacher's reflection stated, it took them twenty hours to develop a learning activity that engaged learners for only one hour. Mobile technologies are now part of our lives and are not going away. Whether it is Gen X, Y or Z… they are wired up and fundamentally attached socially, culturally and educationally. The challenge for educators is not whether they will exist in education but how we can best understand and exploit their use. What makes them different from traditional forms of learning is their ability to engage, motivate and be mobile. Naismith et al., (2006, p. 1) challenges educators today by asking the question 'how much sense does it make to continue to exclude from schools, powerful technologies that are seen as a normal part of everyday life?'

In the case studies presented, overwhelmingly the students were able, through their experiences with mobile technologies, to construct knowledge, think critically and engage with learning. The iPods acted as a catalyst for motivation, innovation and support. The technology allowed for self paced learning, scaffolds to support the task, visual and audio to motivate and engage. Obvious well constructed learning experiences initiated the task and I thank the teachers of these activities for sharing them with the readers. The mobile technologies turned the educational learning task into an educational learning experience. The iPod can act merely as an information delivery device but must be 'pushed' further. Importantly, the devices have the ability to immerse students both visually and verbally with the up to date specific knowledge required.

Challenges for educators will be how to use the devices to their advantage. That is, exploit the mobility and turn the learning experience into a rich learning experience. Mediocrity and sameness should not sit beside innovation and creativity. For example, audio guides currently exist for tours of major art galleries and exhibitions… teachers of the 21st century need to exploit the ability for the mobile devices to afford additional knowledge through video and audio using well designed authentic experiences.

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CHAPTER 13

Design principles for mobile learning

Anthony Herrington, Jan Herrington and Jessica Mantei

Abstract*:*

*The **New technologies, new pedagogies** project used a design-based research approach in the creation and evaluation of pedagogies and their use in a range of higher education classes. This chapter describes the findings of the project as a whole, and presents principles to inform the design of innovative learning environments employing mobile technologies in higher education learning environments.*

Introduction

The *New technologies, new pedagogies: Using mobile technologies to develop new ways of teaching and learning* project used a design-based research approach to frame the design, implementation and evaluation of individual pedagogies for the use of mobile devices in higher education classes.

Teachers in semester courses in a Faculty of Education created pedagogies appropriate to their subject areas, using the affordances of mobile devices (iPod mp3 players and Palm Treo smartphones). Each innovative m-learning activity was designed, implemented, assessed and evaluated over 4-7 weeks of the semester unit. The findings of the evaluations enabled the analysis of 'lessons learned' to inform design principles for the use of mobile technologies in higher education classes.

From the outset, the project aimed to conclude with the production of guidelines or principles for the use of mobile technologies in higher education—a natural and logical outcome from a design-based research approach. This chapter describes the project findings and presents principles to inform the design of innovative learning environments employing mobile technologies in higher education learning environments. These principles can be used as practical guidelines or heuristics for the design of learning tasks using mobile technologies. Such design principles are an important outcome of design-based research studies.

Design-based research

Design-based research has its focus on real world problems, and the overall goal of improving learning, rather than proving that one pedagogical approach is more effective than another.

In the first phase of design-based research, a problem is analysed in depth in consultation with the practitioners or teachers involved. A solution is then designed according to theoretical principles and with knowledge of recent technological affordances. The proposed solution (or *intervention* as it is sometimes known) is then implemented in two or more iterations, with adjustments and improvements made between

implementations, so that the emphasis remains on finding the best way to present the subject in the particular pedagogical context. The last phase is the creation of design principles based on the knowledge gained from the theory, practice and reflection of the previous phases. The focus of the approach is always upon *improving* the learning design, rather than *proving* that one approach works better than another.

One of the most powerful aspects of using design-based research is its emphasis on sharing and disseminating findings and principles (Wang & Hannafin, 2005). The value of design principles lies in the contribution they make to the professional community.

The output of any research framed in the form of principles, ensures that, firstly, the findings of the research are presented in a form that is readily adaptable to other contexts, and secondly, that the knowledge created is not lost to the professions (Herrington, McKenney, Reeves & Oliver, 2007; Reeves, 2006).

Design principles both emerge from, and connect to, theories of learning and instruction (Design principles database, n.d.). They advance both practical and theoretical understanding of the focus area, and as noted by Barab and Squire (2004) must move beyond local conditions to contribute to theory:

> Design-based research requires more than simply showing a particular design works but demands that the researcher (move beyond a particular design exemplar to) generate evidence-based claims about learning that address contemporary theoretical issues and further the theoretical knowledge of the field. (pp. 5-6)

What are design principles?

In a practical sense, design principles can refer to characteristics of a planned learning design (what it should look like), or its procedure (how it should be developed) (van den Akker, 1999). Above all they must be expressed in a way that can inform practice (Wang & Hannafin, 2005).

Design principles are best expressed in active terms that enable their ready use by teachers and designers presented with similar contexts and problems. Van den Akker advised that design principles usually take the form of heuristic statements such as:

> If you want to design intervention X [for the purpose/function Y in context Z], then you are best advised to give that intervention the characteristics A, B, and C [substantive emphasis], and to do that via procedures K, L, and M [procedural emphasis], because of arguments P, Q, and R. (p. 5)

Design principles are often presented in a form that lists criteria of particular learning environments and outcomes, and when presented this way, often start with a verb. For example, Jonassen (1994) proposed that knowledge construction may best be facilitated by constructivist learning environments that:

- provide multiple representations of reality, which avoid oversimplification
- focus on knowledge construction, not reproduction
- present authentic tasks (contextualising rather than abstract instruction)
- provide real world, case based learning environments rather than pre-determined instructional sequences
- foster reflective practice
- enable context- and content-dependent knowledge construction
- support collaborative construction of knowledge through social negotiation, not competition (p. 35).

In another example, Boud and Knights (1996) proposed that the following principles are important in introducing and establishing a productive educational climate for reflection:

- articulating an educational rationale for the process
- introducing a simple exercise to illustrate reflection
- providing an opportunity for students to clarify their understanding of the idea
- introducing a framework or model to aid thinking about elements of reflection
- modelling a reflective approach in one's own presentation of the idea
- identifying areas of the process that students can make their own
- providing time
- treating reflection as a normal activity (p. 30).

Such design principles are not fixed, and are offered as advice on how others might benefit from the findings of a particular development and research endeavour. As noted by Reeves (2000): 'Instructional technologists engaged in [design-based] research are above all reflective and humble, cognizant that their designs and conclusions are tentative in even the best of situations' (p. 11).

Findings from the *New technologies, new pedagogies* project

The 'tentative' conclusions and principles from the overall m-learning project have been derived from a review of each of the individual projects, and a summary of both their substantive and procedural emphases.

To assist in establishing the design principles, Table 1 below provides a summary of the purpose of each of the projects presented in the chapters of this book, together with a list of the *characteristics* of each pedagogy (the substantive emphasis) and the *method* that was employed in instantiating the pedagogy into classroom activities (the procedural emphasis). The method section has been further refined to indicate the roles of *teacher* and *learners* as implemented and observed in each learning environment.

Table 1: Summary of substantive and procedural elements of projects

Purpose of mobile pedagogy	Substantive emphasis CHARACTERISTICS	Procedural emphasis METHOD
Adult educators used smartphones to create a digital story for use as a teaching resource (described in CHAPTER 3: Herrington, A.)	• Real world relevance • Integration of technology • Blended technologies • Collaboration • Sharing of outcomes • Owning the technology • Opportunistic data gathering	The teacher: • Introduces an authentic workplace task • Provides initial instruction and demonstration The students: • Familiarise themselves with the devices • Plan the task • Capture media that exploits the affordances of the technology • Create a digital story using computer based software • Produce a curriculum resource • Give collaborative feedback • Share with others via a social networking site
Preservice teachers in groups created digital story books for young children, using sound and images to author stories with elements that appeal to very young children. Students created their stories using PowerPoint and then published them to iPods as podcasts (described in CHAPTER 4: Olney, I., Herrington, J., & Verenikina, I.)	• Real world relevance • IT as a cognitive tool • Blended technologies • Collaboration • Reflection • Sharing of outcomes • Opportunistic data gathering	The teacher: • Sets an authentic language and literacy task • Models IT content and pedagogical knowledge The students: • Plan and write the story • Capture audio using an iPod • Create a digital story using computer based software • Share with others via a presentation and podcast • Reflect on the process in an electronic journal
Using the features of mobile phones, third year preservice primary teachers prepared, implemented and evaluated a unit of work that supported the waste, water and energy management programs of classes in five host schools. (described in CHAPTER 5: Ferry, B.)	• Real world relevance • Professional development • Blended technologies • Collaboration • Sharing of outcomes • Ownership of technology	The teacher: • Introduces an authentic environmental education task • Enables familiarisation with phone through peer discussion and teacher instruction • Establishes action learning sets The students: • Prepare, implement and evaluate a unit of work about waste, water and energy management for a class of year five or six students • Record, share and reflect on teaching events individually and with peers • Blend mobile technology with PowerPoint • Produce a curriculum resource
Using a constructivist perspective, postgraduate students designed a resource for teachers/trainers that exploits the affordances of mobile technologies (described in CHAPTER 6: Herrington, A.)	• Real world relevance • Modelling of processes • Constructivist learning theory • Educational affordances of mobile technologies • Technology integrated curriculum	The teacher: • Introduces an authentic curriculum development task • Demonstrates an appropriate activity using a mobile device The students: • Create a learning resource based on constructivist principles • Choose the most appropriate technology for the task
iPods were used to create audio files of professional dialogue captured during workshops and uploading them to a repository for teachers to access as needed. (described in CHAPTER 7: Mantei J., & Kervin, L.)	• Mobile context • Knowledge management • Blended technologies • Professional development • Collaboration • Reflection • Sharing of outcomes	The teacher: • Introduces an authentic professional development activity • Demonstrates and scaffolds the task The students: • Capture audio using an mp3 player • Analyse professional knowledge • Use computer based software for collation, editing and uploading of completed files • Share professional knowledge via a website

Purpose of mobile pedagogy	Substantive emphasis CHARACTERISTICS	Procedural emphasis METHOD
Second year primary preservice teachers investigated the use of Smart phones to facilitate interactions and reflections about K-6 mathematics concepts and the teaching of these concepts in the classroom (described in CHAPTER 8: Chinnappan, M.)	• Professional development • Collaboration • Reflection • Modelling of processes	The teacher: • Introduces an authentic curriculum development task The students: • Discuss and negotiate a focus topic, resources and activities • Capture images and video for teaching purposes using a mobile phone • Share and reflect on content and pedagogical content knowledge • Modify understandings emerging from reflection and discussion
iPods were used by pre service physical education and health teachers to enhance their understanding of questioning methods, the development of dialogue and the pedagogical use of Game Centred Approaches in physical education lessons. (described in CHAPTER 9: Forrest, G.)	• Mobile context • Game centred approaches (GCA) • Blended technologies • Professional development • Collaboration • Reflection	The teacher: • Introduced GCA and the method of capturing audio data for reflection The students: • Plan a lesson using GCA with a focus on questioning from developing understanding • Record dialogue during the lesson and the ensuing discussion about the effectiveness of questioning techniques • Create a personal reflection • Use computer-based software to store files and create permanent records of the lessons
Fourth year primary preservice teachers used iPods to create a collective of wisdom stories from experienced teachers that was made available to their peers as podcasts (described in CHAPTER 10 : Kervin, L., & Mantei, J.	• Mobile context • Professional development • Knowledge management • Exploring aspects of the profession • Reflection • Blended technologies • Sharing of outcomes • Opportunistic data gathering	The teacher: • Provides initial input and literature The students: • Identify and research the topic • Plan the interview questions • Capture interviews using an ipod • Create teacher wisdom stories using computer based software • Share professional dialogues via a weblog
Students used the multimedia capabilities of the smartphone to create slowmation videos for primary aged children in order to develop understanding of scientific concepts. (described in CHAPTER 11: Hoban, G.)	• Mobile context • Constructionist • Professional development • Blended technologies • Collaboration	The teacher: • Science content and pedagogy The student: • Plan the task • Capture video using a mobile phone • Create a slowmation • Use computer-based software to combine audio and video data into a movie file • Share with others via a presentation
Fourth year primary preservice teachers used a public art gallery as a resource for interactive visual arts learning experiences. The students created presentations on their findings that were presented and submitted on the iPods as podcasts (described in CHAPTER 12 : Brown, I.)	• Real world relevance • Mobile context • Collaboration	The teacher: • Introduces an authentic site based task The students: • Plan a learning activity utilising community and environmental resources • Create content for mobile device • Develop and construct an iMovie/ podcast/ videocast • Produce supporting documentation • Produce a curriculum resource • Peer assess

Despite each activity having a unique purpose in relation to its curriculum area and task, a number of similar elements and patterns emerge from this analysis. These elements are synthesised below in the form of *design principles*.

Design principles for mobile learning

From analysis of the data, the following characteristics are recommended for the incorporation of mobile learning into a higher education learning environment:

1. Real world relevance: Use mobile learning in authentic contexts
2. Mobile contexts: Use mobile learning in contexts where learners are mobile
3. Explore: Provide time for exploration of mobile technologies
4. Blended: Blend mobile and non mobile technologies
5. Whenever: Use mobile learning spontaneously
6. Wherever: Use mobile learning in non traditional learning spaces
7. Whomsoever: Use mobile learning both individually and collaboratively
8. Affordances: Exploit the affordances of mobile technologies
9. Personalise: Employ the learners' own mobile devices
10. Mediation: Use mobile learning to mediate knowledge construction.
11. Prod*use*: Use mobile learning to produce and consume knowledge.

Each of these principles is described in more detail below:

Real world relevance: Use mobile learning in authentic contexts

Mobile learning occurs in authentic contexts. Problems, challenges, investigations, and explorations that mobile learners engage with are situated in real world contexts that have personal meaning and relevance, allowing deeper understandings to be achieved. The contexts may be commercial, educational or purely lifestyle, and will often involve characteristics of collaboration, reflection, and articulation, (Herrington & Herrington, 2006). For example, adult learners studying in (Herrington, Chapter 3) made real connections to their workplaces as they created instructional 'how to' videos for their colleagues.

Mobile contexts: Use mobile learning in contexts where learners are mobile

Mobile technologies such as mobile phones, smartphones, personal digital assistants and mP3 players support learners on the move, whereas technologies such as laptops, digital cameras, desktop computers do not (Traxler, 2007). Sharples, Taylor and Vavoula (2007) contend that mobile learning is situated in contexts where the learner is mobile across topics, space and time. Commuters engage in mobile learning as they travel to and from work accessing different information and engaging in different tasks, returning to these tasks at different times throughout the day. Clear evidence of mobile learning in this project is seen where early career teachers created audio files of teacher wisdom stories (Kervin & Mantei, Chapter 10) for use as a tool for reflection on teaching.

Explore: Provide time for exploration of mobile technologies

While it is apparent that many higher education students have a greater familiarity with technology than their predecessors it is also clear that some do not. Providing time for students to explore the technological features and educational affordances of devices can be done in a variety of ways. Sharing knowledge, peer tutoring and engaging in introductory authentic tasks appear to be useful approaches to developing in students the important understandings of how and when to use the available tools on offer. Evidence indicating the benefits of providing time for students to 'play' with the technologies is provided in Chapter 6 (Herrington)

Blended: Blend mobile and non mobile technologies

Mobile learning can be enabled by technological tools and infrastructure. Mobile technologies are portable, personalised, and increasingly convergent. People always have them on hand and populate them with personal profiles and playlists, performing a multiplicity of functions. Wireless and telephone networks provide the infrastructure for mobile learners to access and remain networked and connected. There are learning tasks that benefit from a blending of mobile and non mobile devices. The capacity to sync information and download media adds to the versatility of these devices. For the cases in this project, the blending of mobile and non-mobile technologies enriched the final outcome of the learning task, for example, in creating electronic books for young children discussed in Chapter 4 (Olney, et al.), where preservice early childhood teachers used a combination of mobile technologies and computer software to develop, publish and share their texts.

Whenever: Use mobile learning spontaneously

Mobile learning can be spontaneous, unanticipated and opportunistic. Being in the right place at the right time to capture significant events provides invaluable knowledge for individuals as well as communities, witnessed by the current reliance of news services on opportunistic recordings made by mobile learners and their technologies. Preservice teachers in this project were able to capitalise on the spontaneous events occurring in their classrooms in order to capture perspectives of pedagogical approaches for later exploration, for example, when learning about game centred approaches to teaching in physical education, the iPod afforded opportunities for the preservice teachers to capture the dialogue as it occurred spontaneously in the lesson (Forrest, Chapter 9).

Wherever: Use mobile learning in non traditional learning spaces

Mobile learning can occur wherever people find a need. Traditionally learning is seen to occur in formal settings like classrooms and lecture theatres whereas informal learning occurs as we wait for a bus, converse with a colleague over lunch, or engage in work experience. Research by Vavoula indicates a surprising diversity of contexts in which learning is located (Vavoula, 2005). Products created in the art gallery by preservice teachers (Brown, chapter) take learning about art and architecture beyond the classroom and into the location where it resides. The ubiquity of mobile devices and the widespread coverage

of wireless and telephone networks enables learning to occur independent of location.

Whomsoever: Use mobile learning both individually and collaboratively

Mobile learning can occur individually and collaboratively. Listening to a podcast can provide an individual with the knowledge he or she is seeking. Creating and sharing a podcast or audio file requires reflection on knowledge (as does any teaching) and an opportunity to work with others in the process. Using a focus on teaching within an environmental education subject (Ferry, Chapter 5) required the teachers to individually select and reflect on aspects of their teaching that were also relevant for peer discussion and collaboration as the pre service teachers identified areas for pedagogical change and growth.

Affordances: Exploit the affordances of mobile technologies

In some circumstances it is better to choose one technology over another. A digital camera for instance may provide higher resolution images than those taken with a mobile phone. However, being ubiquitous and portable, there is a greater chance that the mobile phone will enable the user to capture spontaneous events. While a number of teachers in this project (Hoban, Chapter 11; Ferry Chapter 5; and Herrington, Chapter 3) acknowledged the inferiority of the camera in the smartphone for capturing high quality images, they indicated portability and convenience as overriding factors because the camera produced images that were sufficient for the task.

Personalise: Employ the learners' own mobile devices

Using a learner's own device ensures that many of the features of the devices are well known and practiced, although some students may not have used or been aware of all features (Oliver & Goerke, 2007). Students using devices other than their own require time not only to familiarise themselves with the device, but more importantly to 'play around' with the technology and personalise it for their own use. For example, following teacher demonstration and time to explore the 'new' smartphone, preservice teachers creating slowmation movies to demonstrate science concepts (Hoban, Chapter 11) had the option to use the device provided by the University or their own, allowing them to make informed choices about the uses and functions available when capturing the relevant material for their movies.

Mediation: Use mobile learning to mediate knowledge construction.

In educational activities it is common for educators and learners to engage in processes such as recording, representation, sharing and reflection to support knowledge construction and co construction, as happened as mathematics preservice teachers negotiated the construction of a curriculum resource (Chinnappan, Chapter 8). Mobile learning provides many opportunities where these processes can be mediated using mobile technologies. As well as being motivating for students the use of mobile technologies blended with web based technologies can provide resources that aid knowledge construction that are reusable, sustainable and scalable to a wide group of students. For example, early career teachers engaged in professional dialogue, described a sense of obligation to ensure a high

quality product for this broader audience beyond their own small group (Mantei & Kervin, Chapter 7).

Prod*use*: Use mobile learning to produce and consume knowledge

The predominant use of mobile learning has involved people consuming knowledge by way of podcasts, e books and accessing web sites. However, the active construction and co construction of content through media capture and subsequent content creation will increase as students and teachers adopt less transmissive and more constructivist approaches to teaching and learning. The proliferation of educational web 2.0 applications such as wikis and blogs that rely on the construction of content to be shared with others is an expanding area that exemplifies this trend. In this project, for example, the adult learners in Herrington's digital narrative task (Chapter 3) were initially consumers as they explored the genre of a digital narrative, but became creators of knowledge as they gathered and manipulated content for the creation of their own narrative and shared these via social networking sites for the consumption of others.

Conclusion

As Litchfield, Dyson, Lawrence, and Zmijewska, (2007) observed:

> A body of knowledge of learning and teaching principles and strategies is urgently needed to inform teachers wishing to utilise innovative mobile technologies and also to inform the development of national policy and pedagogical approaches about emerging mobile devices. (p. 591)

This project has gone some way to achieving this goal. In establishing a set of design principles for mobile learning in higher education, based on the experiences of teachers and learners in a Faculty of Education, the authors are mindful that not all principles may be relevant or necessary in all tertiary learning contexts. Nevertheless, these principles can provide useful guidelines for teachers, instructional designers and educational developers as they plan and develop curriculum resources for learners in the 21st century.

However, while much has been learnt about the capabilities of the devices and appropriate designs for teaching and learning through this project, these 'first generation' studies may well be insufficient to prompt the widespread uptake of mobile learning in higher education institutions (Traxler, 2005). According to Traxler we are now at a point where we should be looking more strategically at the implementation of mobile learning in higher education on a broader scale arguing that 'mobile learning will require 'second-generation' pilots or large-scale trials across institutions and across subjects if its wider potential is to be realised.' The *Mobile Learning Network* (Attewell, 2008) project is one example where large-scale trials are currently being conducted across the Further Education sector in England. The project has established a community of practice website providing, technical and pedagogical support, resources, professional development, mentoring and support for research and evaluation for over 30 action research projects at individual sites. A similar large scale endeavour appears justified in higher education if the lessons learned from this project are to gain widespread adoption.

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