

New technologies, new pedagogies: Mobile technologies and new ways of teaching and learning

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This paper describes a major development and research study that investigated the use of mobile technologies in higher education. The project investigated the educational potential of two ubiquitous mobile devices: Palm smart phones and iPod digital audio players (mp3 players). An action learning framework for professional development was designed and implemented with a group of teachers from a Faculty of Education. Each teacher or team created pedagogies to implement appropriate use of a mobile device in different subject areas in higher education. This paper describes the project aims, design and implementation in four phases, together with a description of the project management and communication factors that helped to ensure its success.

Keywords: mobile learning, mobile technologies, mobile learning, authentic learning, design-based research, higher education

Introduction

Personal mobile devices such as iPods and mobile phones are now ubiquitous amongst student populations in university, but many university teachers are less than confident in their use. Even if a teacher is a competent and avid user of personal mobile devices, he or she may feel ill-prepared to use them with students in pedagogically innovative and appropriate ways. When these teachers seek to become informed of new technologies through conventional professional sources, such as journals, their efforts are often met with information that is simply too detailed or confusing for their current level of understanding. Technical words, descriptions and acronyms that currently abound in discussions on new technologies are likely to deter rather than facilitate teachers' self-directed learning in new technologies.

An alternative to personal learning is group-based professional development (PD) classes provided by universities. These are often excellent sources of information—and inspiration—for university teachers, but few universities currently provide PD on personal mobile devices, generally preferring to focus on more mainstream educational technologies such as computers, learning management systems, software packages and audio-visual tools. It is only at a surface level that widespread teacher PD appears to provide a solution. As noted by Reimann and Goodyear (2004), lack of procedural knowledge is not necessarily the problem: 'What recent research evidence suggests instead is that we should focus on successes and try to understand how they came about' (p. 12).

Cox and Marshall (2007) listed five important reasons for knowing more about the impact of information and communication technologies (ICTs) on pedagogical practice and student learning, namely: (a) forming government policies; (b) directing teacher education programmes; (c) advancing national curricula; (d) designing or reforming classroom implementation and (e) analysing costs and benefits (p. 59). Few of these functions are addressed if the professional development of teachers focuses principally upon instruction on the utility of mobile devices and how to use them.

Theoretical perspectives evident in mobile technology studies

While there are many exemplars of prosaic uses of mobile devices for communication, few examples currently exist of how they might be used as cognitive tools (Jonassen & Reeves, 1996) to solve complex problems and to engage students in authentic and meaningful tasks.

In an extensive literature review of mobile learning, Naismith, Lonsdale, Vavoula and Sharples (2004) proposed six broad theory-based categories of activity in the field: (1) *Behaviorist theory* - activities that promote learning as a change in observable actions (e.g., Wood, 2004, classroom response systems for

providing feedback on multiple choice questions); (2) *Constructivist theory* - activities in which learners actively construct new ideas or concepts based on previous and current knowledge (e.g., Chesterman, nd, issues related to educational media explored through videos, documentaries, animations of educational concepts and news bulletins with mobile phones); (3) *Situated learning* - activities that promote learning within an authentic context and culture (e.g., Proctor & Burton, 2003, multimedia tools at the Tate Modern art gallery); (4) Collaborative learning - activities that promote learning through social interaction (e.g., Palm Inc., 2005, teacher trainers use of personal digital assistants [PDAs] to beam questions for a virtual treasure hunt to groups of teachers); (5) *Informal and lifelong learning* - activities that promote learning outside a dedicated learning environment and formal curriculum (e.g., Wood, Keen, Bassu, & Robertshaw, 2003, breast cancer care in the delivery of text images and audio-visual materials to patients' PDAs during their course of treatment); (6) *Learning and teaching support* - activities that assist in the coordination of learners and resources for learning activities (e.g., Perry, 2003, managing teachers' workloads using PDAs to record attendance, marks and organise lesson plans).

It is perhaps this last category that has seen the most interest and activity in terms of the use of mobile technologies in universities to date, that is, practical and administrative functions rather than pedagogical purposes. Similarly, in terms of student use of mobile technologies, the focus of the debate has been upon the problematic use of mobile phones in schools (e.g., Campbell, 2005) and the social and cultural shift in communication dynamics through the use of mobile devices (e.g., Ito, 2005).

In this paper, we describe a project that endeavours to investigate the use of mobile technologies from a different perspective, and to discover new pedagogies for the use of these new technologies to enhance the learning experience of students in higher education.

Aims and scope of the project

The project investigated the educational potential of mobile devices, specifically, 'smartphones' (combined mobile phones and PDAs) and iPods, in tertiary education. (Originally, the project was focused on three devices commonly used by university students: mobile phones, PDAs and mp3 players. However, at the time, more and more mobile phones were incorporating PDAs into their functionality so it was decided to use a hybrid of these two.) Specifically, the project aimed to:

1. Investigate the potential uses or 'affordances' of the smartphone and iPod
2. Engage teachers from a Faculty of Education using an action learning professional development framework to explore and invent pedagogies appropriate to their students' 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 3-5 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 in web-based template form to other universities across Australia and overseas.

The following questions framed the research:

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 used a design-based research approach (e.g., Reeves, 2000; Reeves, Herrington & Oliver, 2005) (also known as *development research* or *design experiments*) that involved four phases over four semesters, described in more detail below.

Theoretical perspectives of the study

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 was adopted as the framework for professional development. Both theories reflect a 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 processes
- *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 assessed 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.

Action learning (Revens, 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.

The New Technologies: New Pedagogies project

Funding was obtained from the Carrick Institute (now ALTC) to investigate new and innovative pedagogies related to the use of mobile phones (smartphones with PDA functions) and iPods. 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 12 pedagogies to be implemented with either the phone 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. A conceptual summary of the entire project is provided in Table 1.

Each phase of the project is described in more detail below.

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

Phase 1 of the project focussed 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. The project was launched, a Project Manager was appointed, and a prototype project website was created. The leadership team, together with professional development and IT experts, met fortnightly for planning and monitoring, and communication with the team and project reference group was enhanced with the creation of a bi-monthly bulletin. 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.

Phase 1 of the project also involved the purchase of class sets of mobile devices. Palm Treo 680 smartphones and Apple 30g iPods were purchased by the University from Teaching and Learning funds, 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 head phones and card readers. All participants in the project were issued with both an iPod and

Table 1: Summary of project processes and 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?
	<i>Phase 1</i>	<i>Phase 2</i>	<i>Phase 3</i>		<i>Phase 4</i>
	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 (July 07 on)
	<ul style="list-style-type: none"> Investigation of technology affordances through research literature, experts, and location of best practice exemplars in HE Preliminary planning of workshops 	<ul style="list-style-type: none"> 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		<ul style="list-style-type: none"> 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	<i>Phase 1:</i> Catalogue of affordances of m-learning technologies	<i>Phase 2:</i> Workshop resource (processes and procedures for others to implement)	<i>Phase 3:</i> 12 case descriptions and evaluations Website of exemplars and strategy descriptions	<i>Phase 4:</i> Final conference Edited book Project report Final public website	
Evaluation (Reeves & Hedberg, 2003)	<i>Review</i> of literature and existing initiatives	<i>Formative evaluation</i> of PD workshops	<i>Formative evaluation</i> of learning environments and project website <i>Effectiveness evaluation</i> of 12 learning environments		<i>Effectiveness evaluation</i> of whole project <i>Peer review</i> of chapters by team & reference group

smartphone for use prior to the commencement of the implementations with classes, so that they could experiment and familiarise themselves with the devices. Seminars and brainstorming sessions were also held to create a catalogue of educational affordances to provide a useful reference on the functions and usefulness of each device prior to the design of learning activities. These catalogues are available on the project website.

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, 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.

Twelve teachers in the Faculty of Education, agreed to be involved in the development of pedagogies for subject areas in the pre-service teacher education program. A group-based professional development framework for teachers was developed and implemented. As noted by Collis and Moonen (2002): ‘An individual’s likelihood of voluntarily making use of a particular type of technology for a learning-related purpose is a function of four ‘E’s: the *environmental* context, the individual’s perception of *educational effectiveness* and of *ease* of use, and the individual’s sense of personal *engagement* with the technology’ (p. 219). The workshops were designed to facilitate all of these factors.

Initial planning of the professional development was undertaken by three PD and IT staff in the Faculty and University 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. Some team members have extensive experience in its use (e.g., 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 is situated and to investigate the affordances of the devices and the possibilities that these devices offer 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. As such, the workshops represented a 'group learning process' in which teaching ideas were discussed, and refined through all phases in an ongoing cyclical process. 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.

Each teacher used one or more 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 4-6 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). At all times, teachers were aware of the requirement to create 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. When teachers had designed their learning tasks, they were able to trial their ideas in the PD group during this phase, and plan procedures to evaluate their learning environment when they were implemented in Phase 3.

By the end of Phase 2, the teachers had designed learning environments ready to be implemented in Phase 3, each comprising: an authentic task (to be completed over a period of 4-6 weeks), 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?

One class 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 in Week 7), and each implementation tested a different pedagogical strategy with a different teacher or 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.

Each case was evaluated using an approach or methodology that had been planned in Phase 2 as part of the workshops. For example, 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 implemented. Because these implementations were conducted in regular classes, in many cases the second revised implementation (characteristic of design-based research) had also been conducted prior to publication. Ethical approval was sought and approved not only for the entire project, but also for each individual project. During these implementations, professional development sessions continued on a regular as-needed basis.

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 and beyond)

In Phase 4, the current phase, 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 move beyond the project timeframe of two years, and are currently still underway.

A great deal of knowledge about technology-based pedagogy had been learned in the first three phases of this project. It is important to explore and reflect upon those understandings, and to disseminate them in a freely accessible and customisable manner to teachers in higher education. The principal vehicles for this was the conference, and the project website. A final 2-day conference was held after all cases had been implemented and evaluated at the end of the second year of the project. The project website also includes succinct case study descriptions and exemplars of the pedagogies developed for the m-learning devices. A practical edited book (currently in preparation) will also offer advice and modelling of the implementation and pedagogy of mobile devices, using a theoretical foundation of authentic learning, rather than a transmissive, technology-driven perspective.

The final phase of a design-based approach (after repeat implementations) is 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. These guidelines will be published in the edited book, in conference papers and workshops, on the website and through other means such as listservs and electronic newsletters.

Quality assurance and project management factors

Effective project management and communication mechanisms helped to ensure that the project stayed on track and met critical deadlines. The project manager had a range of roles related both to the people and the products involved, and was critical to the success of the project. The project manager was employed to work with the project leaders (together forming the project management team) for two days per week to follow the guidelines for the project outlines in the grant application approved by the funding body. Through regular meetings, consultation and liaison with the project leaders, the teacher/researchers, members of the reference group and other interested parties, strategies were planned, deadlines set and communicated to all parties.

The project manager was responsible for working with the team leaders in coordinating the establishment of a number of products throughout the project: a project website, literature review created as an Endnote library with embedded papers, a searchable catalogue of educational affordances of the mobile devices, a framework for professional development emerging from the experiences in Phase 1 of the project, bi-monthly bulletins to provide updates and information on the project for all parties, a compilation of the learning tasks ('pedagogies') created by the teacher/researchers, a two day conference showcasing the pedagogies from the project, and an edited book explicating the analysis of these pedagogies.

In maintaining momentum throughout, the project manager also set in place processes such as sending updates for the website to reflect the progress of the project, creating a system to monitor and maintain the mobile devices and to provide teacher/researchers with equitable access for their research, keeping accurate records and updating the team leaders as appropriate and monitoring deadlines. A key role of the project manager throughout the project was effective and sensitive communication with, and between, the project researchers as they investigated their own cases within the context of the *New Technologies, New Pedagogies* project.

The project website served as a focal point for the project activities, schedule and resources. In each phase, the substantive value of the website grew, both as an important communication device and as a repository for relevant resources, and products generated by the project. Figure 1 shows the home page and the technology affordances page for the iPod on the project website.

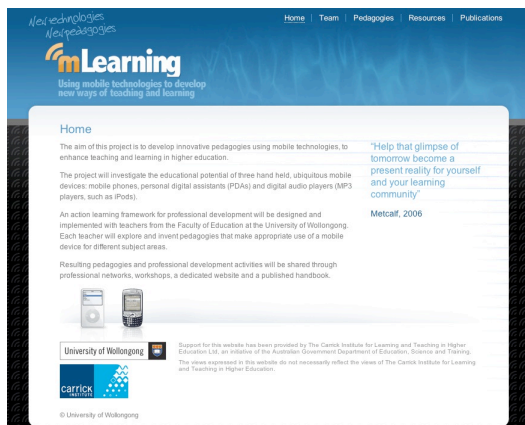


Figure 1: Web pages from the project website

Conclusion

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. When fully completed, projects such as the one described here will be ideally positioned to inform such policy.

The *New Technologies: New Pedagogies* project was a project that 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 19 people including teachers, IT and PD personnel from the university. 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.

The individual projects covered a range of subject—such as physical education, adult education, literacy, teacher professional learning, ICT, science education, visual education—albeit all were within the Faculty of Education. Further information on the projects and their pedagogies can be found in individual publications (such as, Brickell & Herrington, 2007; Kervin & Mantei, in press; Herrington, in press; Olney, Herrington & Verenikina, in press). Processes and findings on the professional development approach can also be accessed in publications (such as, Lefoe & Olney, 2007; Olney & Lefoe, 2007; Lefoe, Olney & Herrington, in press).

While the project itself focussed on only two specialised mobile technologies, the methods developed for the professional development workshops will be 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 (McKenzie, Alexander, Harper, & Anderson, 2005).

The proliferation of mobile devices has proceeded throughout society at such a rate that higher education can no longer avoid exploring the educational potential of these tools. As noted by Collis and Moonen (2002): ‘You can’t *not* do it. The idea whose time has come is irresistible’ (p. 219).

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