New technologies, new pedagogies:

Using mobile technologies to develop
new ways of teaching and learning

Final report

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Project website: http://mlearning.uow.edu.au/

The University of Wollongong

2008

Executive summary

The *New Technologies: New Pedagogies* 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 19 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 knowledgable and confident users of mobile technologies among teachers and students in the faculty of Education at the University of Wollongong.

The project investigated the educational potential of two hand-held, ubiquitous mobile devices: iPods and smartphones (combined mobile phones and PDAs). 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 4-6 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 project enquiry into mobile learning (m-learning):

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 (also known as *development research* or *design experiments*) that involved four phases over four semesters. An action learning framework for professional development was designed and implemented with teachers from the Faculty of Education at the University of Wollongong. Each teacher explored and invented pedagogies that made appropriate use of a mobile device for different subject areas. Resulting pedagogies and professional development activities will be

shared through professional networks, workshops, a dedicated website and an edited e-book.

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 a constructivist epistemology emphasising group collaboration in the creation of further knowledge and understandings.

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.

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 practical implementation and pedagogy of mobile devices, using a theoretical foundation of authentic learning, rather than a transmissive, technology-driven perspective.

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.

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SECTION 1

Definition of outcomes

1.1 Project aims

The aim of this 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: iPods and smartphones (combined mobile phones and PDAs). An action learning framework for professional development was designed and implemented with teachers from the Faculty of Education at the University of Wollongong. Each teacher explored and invented pedagogies that made appropriate use of a mobile device for different subject areas. Resulting pedagogies and professional development activities will be shared through professional networks, workshops, a dedicated website and an edited e-book.

1.2 Scope of the project

The project investigated the educational potential of smartphones (Palm Treo 680 mobile phones), and digital audio players (Apple iPods). To avoid a 'technology-driven pedagogy' (Salaberry, 2001) 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 4-6 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.

SECTION 2

Approach and methodology

2.1 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 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 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.

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.

2.2 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 11 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.

2.3 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 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

2.4 Project team members

The project was launched, and a *project manager*, Ms Jessica Mantei, was appointed. The *leadership team* comprised:

- Dr Jan Herrington, Associate Professor, IT in Education
- Dr Tony Herrington, Associate Professor, IT in Education/Adult Education
- Dr Brian Ferry, Professor and Deputy Dean
- Dr Ian Olney, Faculty Support Manager, IT

A *professional development and IT team* was also created to lead the professional development seminars. This team comprised:

- Dr Geraldine Lefoe, Senior Lecturer, Centre for Educational Development and Interactive Resources (CEDIR)
- Mr Rob Wright, emLab Project Director
- Dr Ian Olney, Faculty Support Manager, IT

Originally 12 teachers or teaching teams committed to the project. With the usual changes over semesters (such as changes in teaching loads, promotions, retirements, study leave, etc.) by the end of the project, 11 projects had been implemented. The teachers who implemented and completed mobile pedagogies and conducted evaluations in their courses (in addition to the project leaders and project manager) were:

- Dr Gwyn Brickell, Mathematics and science education
- Dr Ian Brown, Associate Professor, Visual arts education
- Dr Mohan Chinnappan, Mathematics education
- Mr Greg Forrest, PDHPE education
- Dr Garry Hoban, Associate Professor, Science education
- Dr Lisa Kervin, Literacy and reflective practice
- Dr Irina Verenikina, Early childhood education.

Teachers who completed the professional development but were unavailable to complete the implementations were: Dr Brian Cambourne, Dr Julie Kiggins, Dr Doug Reid and Dr Gregg Rowland.

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 was also invited to be available to the project. The reference group comprised leaders of the international educational technology community:

- Thomas C. Reeves: Professor of IT at The University of Georgia, USA. Former Fulbright Lecturer in Peru. Awarded the inaugural Fellowship Award from the Association for the Advancement of Computing in Education.

- David Jonassen: Distinguished Professor, University of Missouri University. Author of over 20 books and 130 journal articles and 30 book chapters and several hundred conference papers.

- Lynne Hunt: Professor and Leader of the Teaching and Learning Development Group at Charles Darwin University (now Southern Cross University). Winner of the 2002 Prime Minister's Award for Australian University Teacher of the Year. Published widely in the field of tertiary learning and teaching.

- Betty Collis: Retired Shell Professor of Networked Learning, University of Twente. Author of over 600 academic papers and books. Studied changes in organisations related to their use (or non-use) of technologies.

- Ron Oliver: Professor of Interactive Multimedia at Edith Cowan University. Won numerous awards at the national and international level for teaching excellence including the inaugural Australian Award for the use of multimedia in University Teaching in 1997.

- Peter Goodyear: Professor of Education at the University of Sydney. Founding member of the Centre for Studies in Advanced Learning Technology, Lancaster University, UK.

Communication with the team and project reference group was enhanced with the creation of a bi-monthly bulletin (Figure 1). The bulletin kept team members up to date with the project. It was also an important means of maintaining communication with the Reference Group and informing the members on the progress of the project.

Figure 1: Example of the project bi-monthly bulletin

2.5 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 2).

Figure 2: Design-based research (Reeves, 2006)
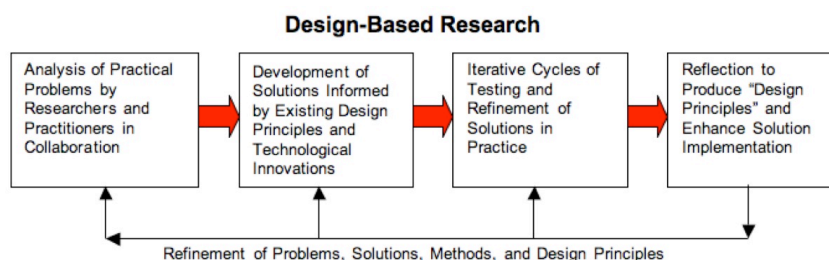
The four phases are described in more detail below.

2.6 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.

A comprehensive review of literature was performed and an EndNote library created (Figure 3).

Figure 3: EndNote library with embedded documents
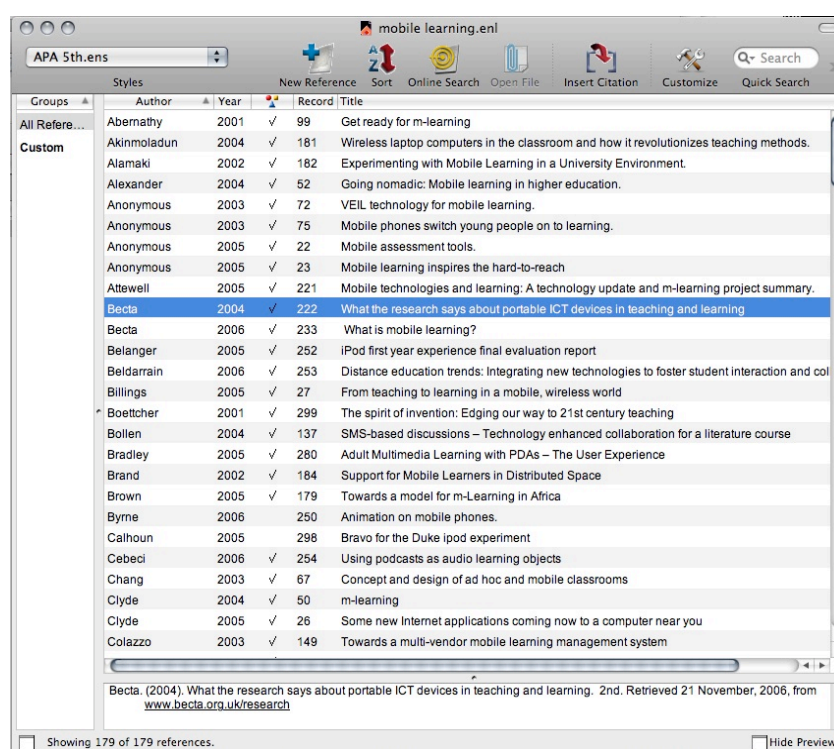
Many electronic resources were collected (in Word or pdf format) and embedded into the EndNote library, and this was updated throughout the life of the project, resulting in a valuable and portable resource for use by team members. This literature review also encompassed primary and secondary capabilities 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 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 headphones and card readers.

All participants in the project were issued with both an iPod and 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 (this was done prior to 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 4 shows the catalogue for the iPod).

Figure 4: Web page of iPod features

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

Phase 1 also saw the commencement of a Master Slide Set for the project (Figure 5). This was a collection of Powerpoint slides that described the aims and methods of the project, the teacher/researchers involved, the devices used, the individual pedagogies, and other general information about the project. This slide set was made available to all participants to select slides as appropriate to use in any presentation of their work on the project.

Figure 5: Master presentation slide set (selection of slides)

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.

2.7 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.

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 the three 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. 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).

Templates and examples were provided to support teachers planning of activities and pedagogies in the workshops. For example, Figure 6 shows a planning template provided to teachers to assist with the design of their authentic tasks.

Figure 6: Planning template for authentic tasks

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.

2.8 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. The pedagogies that were implemented in Phase 3 listed below:

Pedagogies with iPods

Using a games-centred approach to enhance student learning

> **Teacher:** Greg Forrest
> **Target group:** Third and second year PEH preservice teachers
> **Task**: Produce an i-Movie (or equivalent) highlighting elements of the session. Evaluate and reflect on teaching and learning practices from the recorded dialogue. Professionally present the activity as if teaching a class.

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**: Student created a collective of wisdom stories from experienced teachers that was made available to a their peers as podcasts. The students composed and asked two or three questions they felt would encourage teachers to share their stories on any area of teaching, in areas such as curriculum, philosophy, or classroom practice. Interviews with teachers were captured

with iPods, edited in Garageband and podcast for access by others in the subject.

Art on the move

Teacher: Ian Brown
Target group: Fourth year primary pre-service teachers
Task: Students used a public gallery as a resource for interactive visual arts learning experiences presented on the iPods as podcasts.

Using iPods to capture professional dialogue

Teachers: Lisa Kervin and Jessica Mantei
Target group: Fourth year primary pre-service teachers
Task: Using iPods to capture professional dialogue for reflection on emerging professional identity, students recorded their group discussions on literature each week. They were uploaded onto a beginning teacher community of practice website, accessible to all enrolled students. The recordings were available for students to revisit their own conversations and also to gather the ideas and beliefs of others as they listen to the professional dialogue of other groups. 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 created talking books for young children using sound and image to author stories with elements that appeal to young children. Students published the texts using PowerPoint and then transferred them to iPods as podcasts.

Pedagogies with smartphones

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 classroom settings, and prepare a presentation to share with the class. Using the smartphone, students prepare a presentation for beginning teachers or parents on the theme: maths and/or science is everywhere.

Energy management

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

Teaching episodes

Teacher: Anthony Herrington
Target group: Postgraduate adult education students
Task: Students investigated the educational potential of smartphones to facilitate the construction of teaching episodes (digital narratives) for use with their students/colleagues. Short videos explaining or demonstrating concepts/skills were created.

Teacher professional development via Mobile technology: The use of Smart phones 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 educational potential of Smart Phones used with primary teachers to facilitate interactions and reflection about K-6 mathematics concepts and the teaching of these concepts in the classroom.

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.

Slowmation

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.

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 sessions continued on a regular as-needed basis.

The teachers also created for each project a description of the pedagogy, to be uploaded to the project website. Figure 7 provides an example of one of the pedagogies on the website.

Figure 7: 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.

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

In Phase 4, the current phase (extending beyond the two years of the project), 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 are a conference, and the project website. An edited e-book is also planned.

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 conference was held in conjunction with an annual technology in teaching and learning conference at the University, the *Emerging Technologies Conference*. The conference was aimed mainly at post-secondary teachers interested in using innovative new technologies in the learning environments. The conference attracted over 100 registrants mainly from local universities and TAFEs, but including participants from Sydney, Victoria, ACT, South Australia, Hong Kong, Thailand and New Zealand. Figure 8 shows the flyer used to advertise the conference.

Figure 8: Conference flyer
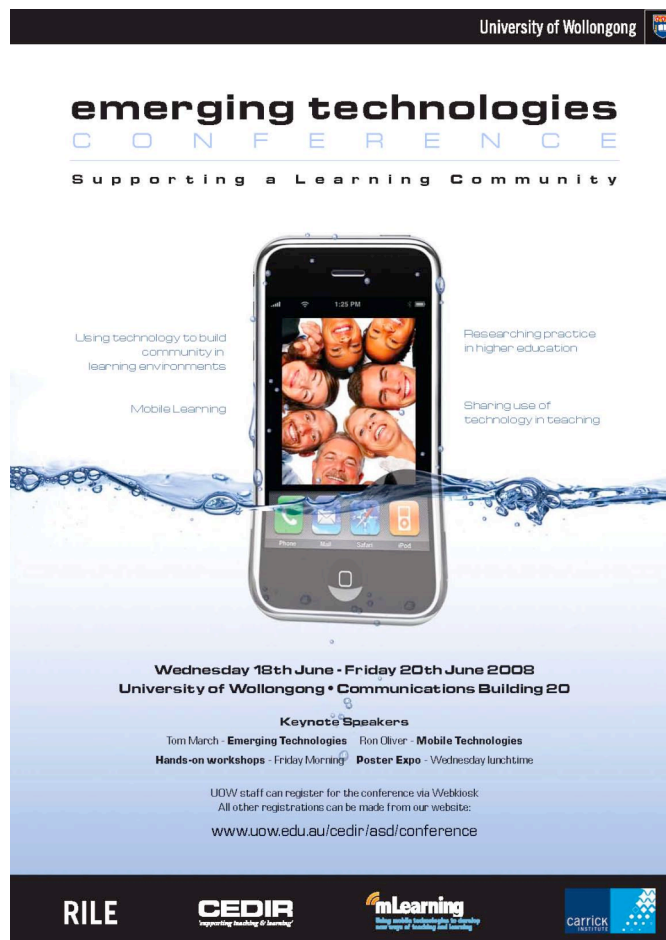
Professor Ron Oliver (a member of the project reference group) was the keynote speaker for the mobile learning day in the conference. His presentation was recorded on an iPod and uploaded to the conference website at: http://www.uow.edu.au/cedir/asd/conference/.

The conference featured refereed conference papers, posters and hands-on workshops. Six projects were featured as refereed papers in the conference, and the papers were published in the conference proceedings at: http://ro.uow.edu.au/etc08/. Workshops included sessions on topics derived from the project such as podcasting, slowmation and digital story telling.

A poster on the project (Figure 9) was created by and featured in the *Spotlight on Learning at Teaching* exhibition in 2007 at the University of Wollongong, including a video clip interview on the project at: http://www.uow.edu.au/cedir/spotlight/index.htm.

Figure 9: Poster of the *New technologies, new pedagogies* project

A practical edited book (currently in preparation and expected to be available online in early 2009 with a link from the project website) will also offer advice and modelling of the practical 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 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.

SECTION 3

How the project advances existing knowledge

3.1 The pedagogical uses of mobile technologies

The use of the mobile devices used in the project—mobile phones and iPods— 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 have permeated the manner and 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.

And yet, the pedagogical use of these powerful devices is not widespread in higher education. Notwithstanding the existence of the 'digital divide', the decreasing cost and increasing social currency associated with mobile devices, means that many university students own one or more such devices. 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 have 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.

3.2 Use of 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 (Winters, 2006) 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 et al., 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. 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 users 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). These devices then allow for repeated listening anywhere, anytime.

A framework for classifying educational uses of mobile technologies provided by Patten, Arnedillo Sanchez and Tangney (2006) 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.

Many research studies and projects have examined mobile learning from an identified theoretical perspective, and Table 2 below summarises some of the studies, and their theoretical foundations (adapted and expanded from O'Malley, et al., 2005; Naismith, Lonsdale, Vavoula, & Sharples, 2004; BECTA, 2006, and the individual studies cited).

Table 2: Example mobile learning projects and their theoretical perspectives

Theory*	Example project/research study
Behaviourist theory *Activities that promote learning as a change in observable actions*	Mobile phones and PDAs for language learning (Thornton & Houser, 2004) Classroom response systems for providing feedback on multiple choice questions (Wood, 2004)
Constructivist *Activities in which learners actively construct new ideas or concepts based on previous and current knowledge*	The virus game (use of PDAs to simulate the spread of a virus) (Colella, 2000) Environmental detectives (students investigate an environmental problem using GPS in pocket PC) (Klopfer & Squire, in press) Issues related to educational media explored through videos, documentaries, animations of educational concepts and news bulletins with mobile phones (Chesterman, nd)
Situated learning *Activities that promote learning within an authentic context and culture*	Ambient wood (use of PDAs to explore environmental habitats) (Rogers et al. 2002) Multimedia tools at the Tate Modern (use of pocket PCs to view videos and listen to expert commentary) (Proctor & Burton, 2003) Role playing to investigate social interactions among family and friends (mobile phone) (Owen, 2005)
Collaborative learning *Activities that promote learning through social interaction*	Mobile computer-supported collaborative learning (dissemination of activities, collaboration, and analysis of results using hand held computers) (Cortez, et al., 2004) Teacher trainers use PDAs to beam questions for a virtual treasure hunt to groups of teachers (Palm Inc., 2005)
Informal & lifelong learning *Activities that promote learning outside a dedicated learning environment and formal curriculum*	Disadvantaged youth (using mobile phones to deliver interactive stories or quizzes) (Attewell & Savill-Smith, 2003) Breast cancer care (delivery of text images and audio-visual materials to patients' PDAs during their course of treatment) (Wood, Keen, Bassu, & Robertshaw, 2003)

Theory*	Example project/research study
Learning and teaching support *Activities that assist in the coordination of learners and resources for learning activities*	Managing teachers' workloads (PDAs to record attendance, marks and organize lesson plans) (Perry, 2003) Supporting computing students at risk (sent SMS messages on appointments, feedback, room changes and study tips) (Riordan & Traxler, 2003) Teachers used 'phone exams' where users' voice print identifies them as the test taker (NMC & Educause, 2006) Duke University used iPods with beginning undergraduate students and staff (Belanger, 2005) Retrieval of information such as e-books, courseware, and timetables with PDAs (Kim, Mims, & Holmes, 2006)

* Categories of theory are as described by Naismith et al., (2004)

Despite the significant potential of mobile technologies to be used 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 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 (2006) argue that the benefits of mobile learning can be gained, through collaborative, contextual, constructionist and constructivist learning environments. 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—to focus on their use as cognitive tools in authentic learning environments.

SECTION 4

Factors critical to the success of the approach and those that impeded the success of the approach

4.1 Success factors in the project

In brief, the project was successful primarily for the following reasons:

- It endeavoured to create innovative activities using interesting and engaging technologies

- It was well managed with excellent project management

- It had access to effective and accessible technical and PD support

- It was generously supported by the Deputy Vice Chancellor (Teaching and Learning), who supplied all the technologies as well as meeting a range of additional unexpected expenses

- It was based on a sound method of professional development that relied on an internal action learning approach rather than buying in outside experts

- It responded to learning needs of participants as appropriate, rather than fixed and inflexible schedules of workshops

- It resulted in sound pedagogies that benefited students in both undergraduate and postgraduate programs in the faculty

- It was collegial, professionally rewarding and enjoyable!

In maintaining momentum throughout, the project manager was invaluable to the success of the project. She 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.

In relation to the technologies used, some interesting lessons were learned. The Office of Teaching and Learning at the University of Wollongong purchased the devices (Smartphones and iPods) for the project. However, it quickly became apparent that further items were required to ensure the devices could be protected and presented in a suitable and safe form for the tasks (e.g., protective cases for the devices, storage cards, sim cards and replacement earphones to meet occupational health and safety standards). Funds were requested to meet this cost and further funds approved, in addition to the funds provided to purchase the devices.

The teacher/researchers in the project were each given both devices for personal use prior to the beginning of professional development.

This allowed them to explore the affordances within the context of their own needs and to consider their use in the teaching learning cycle. The teachers retained the mobile devices throughout the professional development workshop sessions. They brought them to each session had opportunities to develop their skills in using the devices as well as to discuss their potential for teaching.

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.

The teachers were thoroughly familiar with the devices by the time they were implemented in their classes. Students used one of the mobile devices for a period of 5-6 weeks to engage with the tasks set. Collection and collation of the data by the students was submitted as an assessment task in all the projects. University students who used the mobile devices with staff needed access to a small lab of computers to upload and download files, to share files and discuss and display data gathered. In the case of the mobile phones, they also needed access to USB card readers.

All teachers were invited to present their cases at the project conference and for upload to the *New Technologies, new pedagogies* website. These presentations provided feedback from those outside the project, and informed the reporting of the cases as chapters for the edited book.

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 attendance of Professor Tom Reeves, a member of the Reference Group, provided further professional support for the researching teachers. Professor Reeves was also available to meet individually with team members to discuss their projects.

4.2 Factors that impeded success of the project

While there were few factors that managed to actually impede the success of the project, there were challenges that needed to be resolved to ensure that the project proceeded in a timely and effective manner.

Changes in team members occurred throughout the project, the most critical occurring in Phase 3. Two members of the team withdrew from the project in Phase 3 due to changes in course programs, and one withdrew for health reasons. While unfortunate for the team members, this presented few problems for the project as a whole, with teachers quickly volunteering to work with other groups of students on another authentic learning task and undertaking the responsibility to report these extra cases.

The devices themselves also presented some challenges for the project manager and team leaders. There was only one week between implementations to prepare the devices for the next class, and this was quite a time consuming job. It was necessary to check all the components and peripherals, and remove existing data from all the

devices. Fortunately, there were few losses of devices, with only one iPod and one phone stylus lost throughout the entire project.

There were also unforseen technical problems throughout Phase 3 (such as problems with downloading audio files and the difficulties associated with using mobile phone sim cards in students' names because of security concerns) but these were generally dealt with as they presented.

SECTION 5

Implementation in other institutions or locations

5.1 Action learning approach

The approaches adopted in this project are most amenable to implementation in other educational institutions and locations. The rationale for the professional development workshops 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. As such, this was a 'group learning process' in which teaching ideas were discussed, trialled, evaluated 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 drawing on outside experts to advise on 'correct' procedures.

The approach would also be adaptable across a range of discipline areas, as appropriate theoretical perspectives could be adopted accordingly.

SECTION 6

Sharing of project outcomes across the higher education sector

To date, aspects of the project have been shared at the Australasian Society for Computers in Learning in Tertiary Education (ASCILITE), mLearn, and the Australian Association for Research in Education (AARE) conferences nationally, and the International Association for Development of the Information Society (IADIS) 07 and 08 conferences internationally. A presentation on the project was also given to the Australasian Council on Open, Distance and E-Learning (ACODE) meeting in Brisbane in 2007. Project papers were also delivered to a national and international audience at the project conference.

In September 2008, a keynote address on the project entitled *New Technologies, New Pedagogies: Issues in Teacher Learning* was delivered at the Third National ICTs in Basic Education Congress in Cebu, The Philippines.

In October 2008, papers emanating from the project were presented at the *mLearn* a conference in Ironbridge, Shropshire, and the *Handheld* conference in London in the UK.

In December 2008, the project team delivered a dedicated symposium at the Australasian Society for Computers in Learning in Tertiary Education (ASCILITE) conference in Melbourne to showcase the project in its entirety as well as individual projects and their pedagogies and findings. A keynote address entitled *New technologies, new pedagogies: Mobile learning and participatory culture* was also delivered to the Learning Technology Research Symposium at the University of Sydney in December, 2008.

SECTION 7

Links with other ALTC projects

The lesson ideas developed throughout the project have the potential to link into the Carrick exchange as well as the Senior Carrick Fellowship projects *Technology-Supported Learning Database* (TSLDB) developed by Ron Oliver, and Peter Goodyear's *Teaching, technology and educational design: The architecture of productive learning environments* (both Reference group members).

Contact has also been made with leaders of the *Digital Learning Communities Project* to explore possible synergies between the two projects. The newly funded ALTC project *Building leadership capacity for development and sharing of mathematics learning resources… across disciplines and universities* at the University of Wollongong also presents potential opportunities for sharing and links.

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