

# **Conference on Mobile Learning Technologies and Applications (MoLTA)**

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# PREFACE

The first international conference on Mobile Learning Technologies and Applications (MoLTA 2007) was held at Massey University, Auckland, New Zealand, on February 19<sup>th</sup> 2007. MoLTA was conceived as an opportunity for researchers, not only in New Zealand but across the Asia Pacific region, to share their experiences in what is an increasingly important field of research and a core theme of Massey University's Centre for Mobile Computing.

We received nineteen research papers from five countries. Of these, twelve were accepted for publication. The papers included in the conference were: K. Fielden and P. Malcolm –“Cell phones in New Zealand secondary schools: boon, banned or biased”; K. MacCallum and Kinshuk –“Practical issues when viewing discussions on a mobile device”; A. Hafeez-Baig and P.A. Danaher –“Future possibilities for mobile learning technologies and applications at the University of Southern Queensland, Australia: Lessons from an academic focus group”; H. Ryu, R. Brown, A. Wong and D. Parsons –“Personal Learning Organiser: A Design of Mobile Learning Experience for University Students”; T. Cochrane –“Mobile Web2 Pedagogies”; D. Parsons and H. Ryu –“Software architectures for mobile learning”; E. Scornavacca, S.L. Huff, and S. Marshall –“Developing a SMS-based classroom interaction system”; S. Chan and N. Ford –“mLearning and the workplace learner: Integrating mlearning ePortfolios with Moodle”; R. Biswas – “Answering individual patient and health professional information needs utilizing user driven innovation in M- learning”; T. Bell, A. Cockburn, A. Wingkvist and R. Green –“Podcasts as a supplement in tertiary education: an experiment with two Computer Science courses”; B. Mackay –“M-Support for nursing students in primary health care nursing”; M. Mustafa, M. Yazid, and W. Aezwani –“SmartChecker: Real Time Monitoring and Tracking Student's Class Attendance Using Wireless PDA”.

The International Organising Committee comprised Yacine Atif (Massey University, Wellington, New Zealand), Mark Cranshaw (Southampton Solent University, U.K.), David Erbach (Purdue University, Ft. Wayne, U.S.A.), Kay Fielden (Unitec, Auckland, New Zealand), Ken Hawick (Massey University, Auckland, New Zealand), Kinshuk (Athabasca University, Canada), Hans Lehmann (Victoria University, Wellington, New Zealand), Masood Masoodian (Waikato University, Hamilton, New Zealand), Peter Mellow (Auckland University of Technology, New Zealand), Tony Norris (Massey University, Auckland, New Zealand - *Program Chair*), Scott Overmyer (Baker College, Michigan, U.S.A.), David Parsons (Massey University, Auckland, New Zealand - *Conference Chair*), Beryl Plimmer (University of Auckland, New Zealand), Hokyoung Ryu (Massey University, Auckland, New Zealand - *Review Chair*), Hossein Sarrafzadeh (Massey University, Auckland, New Zealand), Eusebio Scornavacca (Victoria University, Wellington, New Zealand), Rosemary Stockdale (Massey University, Auckland, New Zealand) and Sue Stoney (Edith Cowan University, Perth, Australia).

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**David Parsons and Hokyoung Ryu** (February, 2007)

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## SESSION I: ISSUES IN M-LEARNING

*Cell phones in New Zealand Secondary Schools: Boon, banned or biased,*  
by K. Fielden and P. Malcolm

*Practical issues when viewing discussions on a mobile device,* by K.  
MacCallum and Kinshuk

*Future possibilities for mobile learning technologies and applications at  
the University of Southern Queensland Australia: Lessons from an  
academic focus group,* by A. Hafeez-Baig and P.A. Danaher

# CELL PHONES IN NEW ZEALAND SECONDARY SCHOOLS: BOON, BANNED OR BIASED

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In this qualitative research study conducted in twelve New Zealand secondary schools data was gathered on policy formation on a range of issues including: cell phone usage at school; mobile technology incorporated into learning; staff development; curriculum development; assessment, school and class management; and registration and enrolment. Participants included: school principals; deans; heads of department; guidance officers; teachers; and prior students. Main findings from this study suggest that: there is limited use of mobile technologies for school-related learning, training and management activities; there exists a complex array of differing responses from school staff ranging from those who classify themselves as 'digital dinosaurs' to 'as-if natives'; and there needs to be at least one champion of mobile learning technology within a school for inclusion into formal learning and management activities.

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## **1 Introduction**

This qualitative research study on cell phone policy formation has been conducted in twelve New Zealand secondary schools. Six constructs that have been explored are: role, power, cell phone knowledge, social acceptance, technical acceptance and impact knowledge. An interpretive model that is an extension of Prensky's (2001) digital citizenship metaphor has been applied across these six constructs.

The structure of this paper is as follows: literature is discussed that establishes scope for this research including finding relevant gaps. A starting point for constructing an interpretive model is also described. A discussion on the qualitative research method utilized for this study follows including research questions, data gathering techniques and analysis. The paper concludes with a discussion section on the findings from this project.

## **2 Literature Review**

Students take connectivity for granted. The NZ Internet Safety Group (anon, 2005) conducted a survey at a decile 4 high school with 1528 students (schools are ranked on a socio-economic scale of 1-10 with 10 being the highest socio-economic level). 73% of the students owned a cell phone and 66% of the students had one with them in class when the survey was conducted. It was considered that this was typical of most high schools. Educational institutes have the option of embracing the technology or banning the use of mobile phones. Examples of educational institutes that have used the technology to create a more active, relevant learning environment for their students or to form closer alliances with the outside community are discussed by

authors Alexander(2004), Eadie (2004), Farmer (2003) and Maddison and Lorincz (2003).

Many authors have however discussed the negative aspects of connectivity which include addictive behavior (Kamibeppu & Sugiura, 2005) and (Roos, 2001); aggressive behavior (anon, 2002); and safety (Fox, 2001; Haddon, 2000; Henderson, Taylor, & Thomson, 2002; Hope, 2002; Kamibeppu & Sugiura, 2005).

There is a body of academic literature on the use of cell phones and the positive and negative impacts of cell phones by young people. For this project the challenge was to identify a gap in the literature for cell phone usage. This appeared to be the fact that the use of technology by young people was not aligned with the way in which policy makers in schools were viewing cell phone usage.

The NZ Internet Safety Group (anon, 2005) has published guidelines for school policies regarding the use of cell phones. However the authors did not discover any research that was being conducted in this field. The Principal of the private girls' school interviewed said that her school had adopted the internet safety policy for the use of the internet but had not specifically referred to cell phone usage.

Table 1: Digital Classes (based on Prensky, 2001)

Category	Description
Alien (1)	Totally against ICT – feared, never uses
Immigrant(2) <sup>1</sup>	Learned to adapt, will only use ICT if there is no other alternative
Immigrant(3) <sup>1</sup>	Learned to adapt and will use ICT - as a 'second language'
Permanent Resident(4)	Grew up with old ICT (eg land lines phones) will use new ICT – but prefers old ICT
As If Native(5)	Not born with or grew up with ICT. Relates well to natives – on the same wavelength
Native(6) <sup>1</sup>	Grew up with ICT, can parallel process and multi-task. Views "ICT as friend"
<sup>1</sup> (Prensky, 2001)	

Prensky (2001) describes how the current generation of students have grown up with modern technologies such as computers and cell phones. He refers to today's students as "digital natives" (p1) and those of us who were not born to modern technology but who have become enamored of it during our lifetime as "digital immigrants" (p3). The authors have extended Prensky's metaphor to the five categories indicated in Table 2 below. The extensions to Prensky's metaphor are the classes: alien, permanent resident, as if native and a split in the immigrant class to differentiate between those who use ICT as a 'second language;' and those who have learned to adapt but will only use ICT of there is no other alternative.

Data was gathered from a representative sample of staff members (principals (2), heads of information technology (1), heads of department (2), teachers (6 and a dean of students (1). Data was not gathered directly from current secondary school students (because of ethical constraints). Data was gathered from 10 students who left school the previous year, however. Six constructs were considered for each role. These were: role within a school, positional power; cell phone knowledge; technical acceptance of cell phones; social acceptance of cell phones; and knowledge about the impact of cell phones in schools (Table 1). Each construct and role was scored in a

range from one to six based on the categories described in Table 1. These categories are an extension of those proposed by Prensky (2001) (digital native/digital immigrant).

### 3 Research Method

Table 2: Research Design Steps

Step	
1	Source ideas
2	Literature review
3	Design interpretive model
4	Formulate research questions
5	Design data gathering instrument
6	Establish feasibility
7	Conduct pilot study
8	Evaluate results from pilot study
9	Refine data gathering instrument
10	Contact participants for research project
11	Gather data
12	Analyze data
13	Interpret data with interpretive model
14	Report results

Table 2 outlines fourteen research design steps starting with sourcing the ideas that generate a research project. The research design process usually starts well before any formal process is recorded. For the cell phone study the ideas arose from listening to the car radio on the way to work by one of the researchers. The topic for the interview was the use of cell phones on a school campus in South Auckland in which crimes were being committed. The principal at this school responded to this situation by banning cell phones at the school. This seemed to the researcher that this was only one use of cell phones at school and that there must be many more uses that could contribute in a positive way to learning, administration, governance, culture and acceptance both socially and technically. The very recent publicity gained by text bullying resulting in a teenage suicide, gave even more impetus for this study (O'Rourke, 2006).

After the researchers discussed this as a possible research project they both searched the literature to find what the situation in New Zealand was with respect to cell phone usage in schools. This helped to scope the project, find gaps in the literature and to spark further ideas for an interpretive model (Table 3). This was based on an extension of Prensky's (2001) digital citizenship metaphor applied across six categories: role, power, cell phone knowledge, technical acceptance, social acceptance and impact knowledge. This particular research project epitomizes the fast-moving nature of technology and the manner in which schools can capitalize on cell phone technology to improve learning outcomes within secondary schools. Rather than capitulate to the media-driven fears about use of cell phones in schools, this study aimed to gain a deeper understanding of all possible benefits as well as the negative impacts on school culture. Mobile technology is growing rapidly. For teenagers, cell phones have become an essential way of life. To deprive a teenager of a cell phone results in major social trauma. This study explored how school policies aligned with the rapidly changing nature of mobile technology and how these technologies impacted on both the social and technical acceptance within school culture. In order to establish feasibility for the project, interviews were conducted at two schools: a

private boys' secondary school in Auckland and a private girls' secondary school in Wellington. Whilst the researchers realized that the full demographics of cell phone usage within the school system in New Zealand would not be captured by such a small pilot project, the knowledge that was gained provided valuable input into the feasibility process for the project.

The researchers decided that conducting interviews was better than sending a questionnaire to participants. This was confirmed by one of the pilot study participants who said that she was most unlikely to ever fill out a questionnaire no matter how it was delivered to her. Feasibility was established by contacting known people within the secondary school sector who then suggested ways in which schools could be approached to take part in the project.

Table 3: 4-way/6-point Maturity Model

Role	Power	C/Phone Knowledge	Tech Acceptance	Social Acceptance	Impact Knowledge
Principal	5-6	1-3	1-3	1-3	1-5
Head IT	4	4-5	4-5	1-5	1-5
HOD	4	1-4	1-4	1-3	1-4
Counselor	3	2-4	2-4	3-5	3-5
Teacher	3	1-4	1-5	1-5	1-5
Tech Support	2	4-5	4-5	3-4	3
Admin Support	2	1-3	1-3	1-4	1-3
Students	1	4-6	4-5	4-6	1-2
	Known	Assumed	Unknown	Unknown	Unknown

1-6 scale (1 lowest - 6 highest) (alien = 1, immigrant = 2-3, permanent resident = 4, 'as if native' = 5, native = 6) (described in Table 2)

This appeared to be a better method than 'cold calling'. To test this assumption, participation in the study was invited from members of an ICT listserv of secondary school educators. There was a nil response to the request which is an indicator that the method chosen of personally contacting a representative sample was appropriate for this study. The pilot study was then conducted. The data gathering instrument was then refined before the participants for the whole project were contacted. The data was entered into a spreadsheet for coding manually. This method was chosen to allow the researchers to immerse themselves in the data. Data gathering took place over a period of 6 months and experience from prior research projects suggests that this is indicative of this type of project. Having an established evaluation framework and having written the literature review prior to data gathering meant that the data analysis, interpretation and final reporting were relatively straightforward.

### 3.1 Research questions

The main research question considered for this project was: What factors influence cell phone policy making and usage within New Zealand secondary schools?

### 3.2 Data Gathering

Data was gathered in a variety of ways: by interview; from participants at a national conference on applied computing to which information technology teachers from



around the country had been invited; and by email from contacts gathered through an IT school cluster coordinator. Data was also gathered through social networking from students who had just completed their secondary schooling. As this was a qualitative study gathering data in a variety of ways was appropriate. Qualitative research does not attempt to provide unbiased and generalized results, but rather, rich data from a small sample. Therefore it is important to consider findings for this research as adding to the existing knowledge pool.

#### 4 Analysis

When the data was analyzed according to the constructs: role, positional power, cell phone knowledge, technical acceptance, social acceptance and impact knowledge it was discovered that clustering the constructs: positional power, impact knowledge and social acceptance with attitude towards the use of cell phones provided an acceptable measure. It can be seen from Table 4 that schools A and B scored 20/20 for this combined measure. However their scores for technical knowledge (A=6, B=1), digital citizenship (A=5, B=3) and decile ranking (A=10, B=3) were quite different. It seems therefore, for this limited sample that these factors do not influence policy making as much as would have been expected.

It was discovered that school decile ranking was less important than the combination of positional power, impact knowledge and social acceptance of cell phones in schools. For instance, in School B, the principal interviewed described himself as a ‘digital dinosaur’ who did not know how to use the school-supplied cell phone. However, he did have a full understanding of the importance of new technology and its impact on school culture and policy making.

It can also be seen that whilst decile ranking appears to have little influence on policy making with respect to cell phone usage in schools, it is interesting to note that the for the four top scoring schools two are decile 10 and two are decile 2 – at opposite ends of this socioeconomic scale. The other common factor for the top scoring schools is the positive attitude of the participants interviewed.

Table 4: Interpretive model applied to school data

School	A	B	C	D	E	F	G	H	I	J	K	L
Participant attitude	2	2	2	2	2	-2	2	0	0	0	-2	-2
Positional power	6	6	4	5	5	5	4	4	4	3	3	3
Impact knowledge	6	6	6	5	5	5	3	3	2	2	2	3
Social knowledge	6	6	6	5	4	5	3	3	2	2	3	2
<b>Total P+I+S + attitude</b>	<b>20</b>	<b>20</b>	<b>18</b>	<b>17</b>	<b>16</b>	<b>13</b>	<b>12</b>	<b>10</b>	<b>8</b>	<b>7</b>	<b>6</b>	<b>6</b>
Tech knowledge	6	1	6	5	5	3	3	2	2	3	2	2
Digital citizenship	5	3	5	5	5	3	4	3	3	2	2	1
Decile	10	3	10	3	5	5	9	6	3	5	8	5

One school with a decile ranking of 5 was adversely affected in the way in which policy was formed within the school because of the participant's negative attitude towards cell phones who state that he/she 'hates the things at school and they should be banned'.

The dean of students at provincial urban school (D) scored 5/6 on all constructs and who had a positive attitude to the use of cell phones in schools (but not highest positional power) stated that it was vital for a school to have 'a champion for ICT use' within the school. At School F the head of department's (HOD) negative attitude was the main influence on policy making and enforcement for cell phone usage. This HOD stated that:

'First offence is a warning and confiscation until the end of the period - second is confiscation until the end of the day with the phone being deposited in the office - subsequent offences confiscation and parent/guardian rung to come and collect the phone or the phone is confiscated until the student has been seen by the principal. Trouble is that when the parent comes for the phone the student is there and the parent promptly hands the phone to the student. Then the parent usually has a go at the office staff over having to come in to the school for such a silly reason (in their eyes). I actually had a student's phone go off in my class and it was the parent ringing! I took the phone and asked the parent not to ring her daughter in class time. The parent couldn't see anything wrong with doing it. That student didn't last very long at school after that.'

## **5 Findings**

Data from participants with a negative attitude and low scores suggests that any policy will be rigorously applied further widening the digital divide between students and school. The social constructs of positive attitude, social acceptance, technical acceptance and impact knowledge appear to outweigh technical knowledge and digital citizenship in the ability to form and apply school policy on the use of cell phones at school. Past students interviewed agreed with school staff, in the main that cell phones, as social communication tools should not be distracters in formal school time. Only 6/10 of the students interviewed would have like to have been consulted on cell phone usage policy making when they were at school.

There were some surprising outcomes from two top scoring schools (A and B). Rather than just seeing negative outcomes from cell phone usage within schools (as has been reported widely in the general media) the participants interviewed were happy to use whatever advances mobile telephony had to offer – as long as a positive outcome for student learning was achieved. For school A digital citizenship and technical knowledge scored high on the scale used. For school B this was not the case. Positive attitude, positional power, impact knowledge and social acceptance were the main factors for effective use of cell phones in schools for other uses. Both schools were well equipped technically with one school using PDAs within the classroom and for administrative support. In this particular school 95% of students owned a cell phone. This was viewed as an advantage because it offered yet another means of communication and even access to the internet to augment other technology in the school. It was also noted that students appeared to be in much closer communication within their own circle of friends and could use their cell phones to encourage each other and to offer motivational support. The mixed blessings of advances in technology have been addressed according to these 'as if natives' by training for all

staff and students, and a set of principles adapted from the Netsafe guide (Hope, 2002) for the ethical and proper use of all IT including cell phones.

Limited use is being made of cell phones for formal school activities. Whilst most schools in the small sample considered have a cell phone policy in place, this covers social communication by students and in most cases policies are formed in a punitive manner, rather than from a means of ensuring the best learning outcome for students.

## **6 Future Directions**

This research project is ongoing. It is envisioned that recommendations from this project will be reported back to the secondary education sector for policy making at all schools, not only for students' social communication, but also for formal school activities. It would be advantageous to extend the Netsafe guide for schools to all ICT technologies, especially as forms of technology merge and connectedness with the world can be maintained in a variety of ways.

Mobile telephony has changed radically the way in which teenagers communicate, so much so that learning styles, communication patterns, social interaction, attention span, and teen status in the world have been irrevocably redirected. Mobile telephony has widened the gap between teens and school staff. It is important that researchers in the secondary school sector investigate how mobile telephone could be used to maximize learning opportunities – for both students and staff.

## **7 Conclusion**

This qualitative research study on cell phone policy formation has been conducted in twelve New Zealand secondary schools. Six constructs that have been explored are: role, power, cell phone knowledge, social acceptance, technical acceptance and impact knowledge. An interpretive model that is an extension of Prensky's (2001) digital citizenship metaphor has been applied across these six constructs. Surprisingly, digital citizenship and technical knowledge score lower than positional power, social acceptance and impact knowledge. The importance of a positive attitude towards cell phone usage and policy formation within schools is a vital factor that emerges from the findings for this project.

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# PRACTICAL ISSUES WHEN VIEWING DISCUSSIONS ON A MOBILE DEVICE

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Mobile and wireless computing technologies have influenced how students learn and interact with each other. For the first time, mobile technology and student lifestyle choices are converging to allow mobile learning (m-learning) to be a viable choice for delivery and execution of coursework material. This paper looks at the initial practical issues of allowing students to interact with a discussion board on a mobile device. A discussion of the benefits of using mobile devices, such as a PDA, for interaction is examined along with some early issues identified when interacting with a text based discussion board on a mobile device.

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## **1 Introduction**

The world we live in is increasingly fast-paced and communication is ever-present. In this world, students require the ability to learn anywhere at anytime. The mobility of education is achieved with the use of mobile devices such as personal digital assistants (PDAs), smart phones and tablet PCs. The aim of this technology is to utilise the portability which mobile devices offer, combining it with a rich interaction enabling students to learn at a level previously unattainable.

Tools used in learning that offer collaboration between students are of great interest to educators, as their effectiveness tends to be interaction-dependent and thus sensitive to limits of face-to-face accessibility among educators and students. Discussion boards, characterised by long response lags, allow students to develop more articulate and critical responses (Salmon, 2000). Conversely, these long response lags may also adversely affect the level of interactivity of the participants. Long delays between messages limit creativity and motivation of students to continue interacting. The speed and level of interaction within a collaborative group are therefore associated and often reliant on the technology used to facilitate the collaboration (Hill, 2001).

Online threaded discussions seem particularly well suited to mobile enhancements given that their effectiveness depends heavily on active participation and timely posting/response cycles (Hill and Roldan, 2005). Mobile technology provides a vehicle for involving threaded discussions that better emulate face-to-face discussions by enabling interaction, in device-scaled form, between the participants in real time wherever they are (Hill and Roldan, 2005). Thus, discussions are not confined to the desktop, allowing dynamic and immediate communication that can take place anywhere, taking the paradigm from 'pull', beyond 'push', to a 'reach' orientation (Hill, 2003).

Allowing students to interact with a mobile device has many advantages but existing discussion boards are designed to be viewed with a larger screen and with familiar input devices offered by a traditional desktop computer. Therefore the discussion boards need to be designed to better support students no matter the device they choose to interact with in order not to limit students' interaction with the discussion but benefit and enhance their learning. This paper will detail some of the initial design issues that this interaction brings.

## ***2 Collaboration and learning***

The asynchronous discussion mechanisms, such as discussion boards, draw on group interaction to encourage collaborative learning styles. Students learn through interacting with other students to help develop and confirm their understanding of the information. The role of the teacher is to help facilitate this interaction to help students build their own knowledge. Communication between students is more transitive in nature; communication is two-way, active and dynamic, therefore knowledge is conducted rather than just received from the teacher (Pea, 1994). This type of collaborative style can be helped through the use of a computer-mediated discussion board.

Studies in this area have shown that there are two main arguments supporting collaborative learning (Benbunan-Fich & Hiltz, 2003; Cross, 1998; Webb, 1982). The first argument for the use of collaboration in learning is that students, who learn within groups, be it a small group or the whole class, have less anxiety and uncertainty. Students are able to verify and cement their learning through communication with other students. This, in turn, helps improve motivation and satisfaction of students and helps the general learning process (Benbunan-Fich & Hiltz, 2003).

In addition to the above argument, collaborative learning helps students develop an active learning environment over a more passive teacher driven environment (Cross, 1998). Communication and learning is created and developed by students who bring new views and opinions and students are able to develop their own understanding through this sharing of ideas. Learning is therefore an individual responsibility and students are accountable for their own learning (Johassen, 1994; Jones & Issroff, 2005).

## ***3 Traditional Discussion Board***

Computers enable easier collaboration between students, enabling them to interact without constraints to time or place. This is especially important for students who are physically distributed (Benbunan-Fich & Hiltz, 2003; Harasim, Hiltz, Teles, & Turoff, 1998).

Asynchronous online interaction such as discussion boards leads to new paradigms for learning. Students are allowed to collaborate and communicate with each other more easily than would be possible in an offline environment (Harasim, Hiltz, Teles, & Turoff, 1995). Studies have shown that students may achieve a higher level of understanding compared to more traditional methods, such as in-class discussions (Benbunan-Fich & Hiltz, 2003; Hoyt, 2000; Sheard, 2004). This may be due to the fact that students do not need to respond immediately to messages, which they would have to in a synchronous environment either online or offline. Students are able to think about the queries and even utilise the wider resources that are available online to respond with answers that are better thought out and add more value to the discussion than they would be able to if the replies were needed to be given straight away (Mason & Kaye, 1990).

Asynchronous communication also allows for an equal foundation for all students no matter if they are physically handicapped, are less dominant and tend to be introverted, or have low language ability, which may affect face-to-face or synchronous communication (Benbunan-Fich & Hiltz, 2003). Students may feel more comfortable presenting information than they would in a face-to-face situation (Swift, 2002).

Tools such as discussion boards enable additional feedback for teachers and allow them to monitor and track student's discussions (Swift, 2002). Discussions are therefore more robust and thoughtful, as students know that the discussion is recorded and teachers have a better idea of students' understanding of concepts (Swift, 2002).

One of the major issues with the use of discussion boards in learning is that often participation among the students is low. Even though access to the discussion board is available to students for interaction it is often not utilised or the quality of participation is minimal (Hoyt, 2000).

#### ***4 Benefits of mobile technology in interacting with discussion boards***

The main idea behind collaboration is that it is based on interaction that is dynamic and of a high quality. Students are busy and usually have a high workload and many other commitments. For students to use a discussion board they first need to see it as a beneficial tool for the completion of their studies and it should be easy to use and not taking a large amount of student' valuable time. Enabling students to interact with a mobile device allows them to communicate anytime and anywhere no matter their schedule and where they happen to be located; students are no longer tied to the desktop computer but are able to get valuable, timely information when and where they need it.

Enabling students to interact with mobile devices allows them to access messages as they are posted; the messages do not get old and students are able to keep up-to-date with the current discussion. This, therefore, helps in maintaining momentum in the discussion (Hill and Roldan, 2005). Facilitating students with the ability to check messages easily and more frequently, a mobile device eliminates the accumulation of unread messages. Students no longer need to wade through large volumes of unread messages that are not crucial as they are not relevant any more.

Giving students the facility, which enables them to interact more conveniently, should increase participation. Increased participation should then directly influence the level of learning on the discussion board (Sheard, 2004). Since students will be able to access posts as they are posted, this should in turn decrease the time that they take to respond and increase interaction. Having said this, the discussion board will not lose the advantage that students still have a chance to take time preparing a well thought out response that traditional discussion boards offer (Hill and Roldan, 2005).

Interaction between students can be instantaneous. Students can choose to interact immediately if they are available and willing to engage. If the timing is right, a critical mass can develop a sparking lively synchronous debate (Hill, 2003). Therefore mobile devices offer the advantages of allowing communication that can be both asynchronous and synchronous.

Allowing the discussion to have the flexibility to take place synchronously in addition to asynchronously offers the following additional benefits for students: immediate feedback and increased motivation (Chen, Ko, Kinshuk and Lin, 2005). Immediate feedback allows students to strengthen their learning by being able to immediately correct wrong or ill thought out

assumptions, which are needed in group decision-making, brainstorming, and analysis. In addition, synchronous discussion motivates students to participate as there is a compulsion to be present and participate, which in turn would increase students' involvement in learning activities, hence resulting in better learning experiences.

The responsiveness of participants in the discussion will impact on the overall success of the discussion board. Low response will lead to a decline in use as users develop a "responsive image" (Tyler and Tang, 2003, p2). This means that students develop an impression of the overall responsiveness of the discussion and mirror the level. A minimal level of activity eventually leads to minimal levels of postings. Students who post regularly may be discouraged by the slow rate of participation and may be less inclined to check posts regularly; if a reply is posted quickly it may not be checked till later, further impacting the level of interaction. Interaction on mobile devices should eliminate this problem as students will be notified of new posts to questions and they will be able to access new posts immediately with the option of also replying immediately (Hill and Rolan, 2005).

The use of mobile technology can also be used to help generate critical thinking. Intelligent agents can be used to prompt users to stimulate and enhance the discussion (Hill and Rolan, 2005). The higher activity of students along with wider participation, and decreased time between posts should better allow for a more enhanced learning experience.

## ***5 Design issues when using mobile technology***

The benefits of interacting with a mobile device are apparent, but the design of the existing discussion board is a serious issue, as interaction with a mobile device is very different than interacting with a desktop computer. Guidelines for developing mobile Internet applications are emerging (Nokia, 2005; Sprint, 2002), but these guidelines are useful as a basis for the design of many applications, but they can be hard to relate to specify instances, such as the design of discussion boards. The following discussion identifies various initial issues in developing discussion board system that allow students to interact with their mobile devices as well as, if preferred, access with a traditional desktop computer. These issues are identified from extensive literature review and past experience, they relate to the use of discussion boards on mobile devices, such as PDAs and Smartphone's that can view XHTML web pages.

Many of these issues discussed relate to the constraints placed on the designers when a discussion board is viewed on a small screen.

1. Due to the lower brightness level of the backlight and low resolution on mobile devices, smaller text can be hard for some users to see. It is suggested that the size of the font used should be bigger than typically seen when viewing the discussion board on a desktop computer. In addition the contrast in the colour between background and text should be optimised to allow for easier viewing (Hayhoe, 2001).
2. Also because the device is smaller than a typical desktop, a typical webpage that can be seen easily with minimal scrolling on a desktop computer can have a very different display on a mobile device. Long web pages cannot be avoided (if not preferred, see point 1 of next section) but vertical scrolling should be avoided. Content that is placed across the screen where users need to scroll across to can often be overlooked.
3. By focusing on more horizontal scrolling than vertical scrolling the layout of the discussion board needs to be considered. There have been a number of studies looking at different ways discussion messages can be arranged (Dave Wattenberg & Muller, 2004; Donath, 2002; Popolov, Callaghan and Luker, 2000). However, the findings of these studies are mostly at the research level and are not widely used.



Besides, many of these findings are not practical when viewing discussions on a mobile devices. Related to this, frames should not be used as a basis to the design of the discussion board as the mobile browser does often not support them (W3C, 2006).

4. Unnecessary content should be avoided, such as decorative images. Essential images, that offer added understanding, can be used but should be automatically resized to fit within the screen. By resizing the images this may make it hard for users to view, especially if the image contains text, so users should also be able to zoom in to images if needed.

A user can access the Internet in a number of ways on their mobile device. The download speed and cost associated with mobile Internet will also influence how the discussion board will be designed.

1. Due to limited download speeds images can take a long time to download, therefore users often turn off the option for downloading images when surfing the internet on their mobile device, therefore all necessary images should include descriptive alt tags.
2. Discussion boards can often result in many pages of text so the design of the layout should help limit the number of page-to-page navigation. Navigation between pages can often be costly as most mobile plans charge the customers based on how much they download and not on how long they view the webpage. Although increasing the number of messages on the screen will lead to increased vertical scrolling, this additional user effort has been found to affect performance to a lesser extent than the page-to-page navigation.
3. Due to the cost of navigation the initial page of the discussion board should provide sufficient detail regarding what each message topic will contain, so as to avoid unnecessary page navigation (IBM Corporation, 2005). In addition to this, students should be able to access as much functionality as possible, such as writing a new message, seeing new postings or viewing a topic, within as few clicks as possible from the initial page.

How the mobile device is designed and how they work also influences how discussion boards are designed.

1. Pop-ups are not viewable on most mobile devices as most devices only allow one web page to be opened at one time. Discussion boards must be designed to be viewable within single page at one time. All messages, such as error messages, should be integrated within the page (Jones, Buchanan and Thimbleby, 2002).
2. PDA's and Smartphone also cannot display more than one program at a time. In the case of a student using the discussion board they cannot easily open another program, such as an attachment. This needs to be kept in mind when designing the discussion board, and therefore attachments should be able to be saved to the device.
3. In relation to the attachments, it must not be assumed that supporting media will be available on the users' devices. Therefore attachments should be limited to popular applications.
4. Some mobile browsers do not support uploading files via a web form. This is a significant limitation, but as investigated by Cheung, Stewart and McGreal (2006) this may be overcome by a simple change to some of the code of the web form.
5. How viewable a web page is largely relies on the device being used therefore some devices are easier to read than others. This is largely due to resolution and level of backlight, the environment will also play a big part in readability. Reading the device outside will need a strong contrast of colour used in the interface.

## 6 Conclusions and future work

The above guidelines should form the initial steps to developing discussion boards that are flexible and allow interaction regardless of the device used for interaction. This paper is by no means intended to answer all design issues but to be a starting point for research in this area. This paper intends to help form an initial understanding of the issues that must be encountered for enhancing interaction within discussion boards.

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# FUTURE POSSIBILITIES FOR MOBILE LEARNING TECHNOLOGIES AND APPLICATIONS AT THE UNIVERSITY OF SOUTHERN QUEENSLAND, AUSTRALIA: LESSONS FROM AN ACADEMIC FOCUS GROUP

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Several constraints and opportunities underpin the future possibilities for mobile learning technologies and applications at the University of Southern Queensland, Australia. Drawing on the work of Virilio (1986; Virilio & Lotringer, 1983), the authors analyse a focus group with five Faculty of Education academics as a microcosm of implications for broader policies and strategies at the university. These policies and strategies will not be effective without imaginative and sustained engagement with mobile learning pedagogies at both institutional and individual levels.

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## **1 Introduction**

The early 21<sup>st</sup> century has seen an unprecedented growth in mobile learning technologies, ranging from handheld personal digital assistants (Finn & Vandenharn, 2004) to mobile telephones to mobile gaming (Finn, 2005). The impact of these technologies on contemporary Australian society has included school-level education (Goggin, 2005) and preferences for SMS text messaging or telephone calls in initiating romantic relationships (Byrne & Findlay, 2004).

At the same time, technology refusal by educational institutions (Hodas, 1993) demonstrates that those organisations are often slow to embrace the potential pedagogical applications of new technologies. Reasons for such refusal vary from individual conservatism to a concern about possibly lowered standards of achievement to competing financial and political priorities.

These varied institutional responses to the potential of mobile learning technologies and applications in promoting student learning can be seen at the University of Southern Queensland (USQ) in Australia. On the one hand, the university has moved quickly to develop integrated processes and systems to support learning in multiple sites (Smith, 2005). On the other hand, policy-making around teaching and learning, particularly concerning student assessment, reveals a more cautious approach, influenced by issues such as academic integrity and competing understandings of knowledge construction and communication (see also Moore, Harreveld & Danaher, 2005).

Informed by some key ideas of Virilio (1986; Virilio & Lotringer, 1983) about contemporary technologies, the authors synthesise these institutional challenges and opportunities by means of an analysis of selected elements of a focus group conducted with five academic staff members of the Faculty of Education at USQ. This synthesis reveals a current disjuncture between the academics' lived experiences of using mobile technologies to enact informal learning and their institutionally framed formal teaching and learning based on less mobile technologies. Despite this disjuncture, the authors present the case for bringing the technologies and the pedagogies into closer and more systematic alignment, thereby strengthening the prospects of maximising the pedagogical potential of mobile learning technologies and applications.

## **2 Conceptualising the Social and Educational Uses of Mobile Technologies and Applications**

The conceptual framework informing this account of the social and educational uses of mobile technologies and applications is taken from the French architect and theorist Paul Virilio. The critique by Luke and Tuathail (2000, pp. 364, 366) of some of Virilio's thinking notwithstanding, we find persuasive two key statements associated with his conception of the mobility of both technology and power. Firstly, space "is no longer in geography...it's in electronics" and "The distribution of territory is outmoded, minimal" (Virilio & Lotringer, 1983, p. 115). Secondly, "Territory has lost its significance in favor of the projectile. *In fact, the strategic value of the non-place of speed has definitely supplanted that of place*, and the question of possession of Time has revised that of territorial appropriation" (Virilio, 1986, p. 133; *emphasis in original*).

While Virilio's focus was on warfare, we take from these two statements some important implications for understanding the educational and social uses of mobile technologies and applications. Firstly, there is an explicit binarisation of place and time, with time supposedly becoming more significant as place becomes less so. Secondly, there is a simultaneous politicisation of place and time, so that political interests are advanced and/or threatened by this changing relationship between place and time. Thirdly, a crucial factor in that changing relationship is mobility – the capacity for people and/or objects to move across places at considerable speed.

These various elements – technology, mobility, power, place, time – are also inextricably linked in any contemporary understanding of mobile technologies and applications. For example, Goggin (2005) made the following claim about mobile telephones:

Mobile phones offer new ways of constructing one's identity and belonging to a group, new ways of organising and conducting one's life, new ways of keeping in touch with friends, romantic intimates, and family, new ways of conducting business, [and] new ways of accessing services or education. (p. 35)

We are not arguing that these mobile technologies and applications are completely independent of, or dislocated from, place; the notions of community and culture associated with place are still very important in these "new ways" of constructing identities and making connections. Nevertheless these new technologies and

applications have significantly changed, and in some cases transformed, the ways in which people live, work – and learn.

In that context, it is timely to note the recent identification by Grohmann, Hofer and Martin (2005) of advantages and disadvantages of mobile learning as viewed from multiple perspectives. They listed as advantages:

- Independence from location and time
- Personalised adaptive learning
- Changes in the culture of learning
- Integration into the course of work
- Mobile learning in the context of integrated, blended learning
- Cost reduction.

On the other hand, they listed as disadvantages:

- Lack of automatic competence
- Lack of social contact
- Loss of privacy
- Lack of profitability
- Lack of acceptance
- Lack of standards.

Despite these identified advantages and disadvantages, as Goggin's (2005) question "...why are we not focussing on the possibilities of mobiles for learning...?" (p. 35) signifies, there is an evident 'time lag' between informal and social take-up of these mobile technologies and applications and their deployment in educational settings. As both Goggin's response to that question and Virilio's (1986; Virilio & Lotringer, 1983) analysis of contemporary technologies make clear, there are several possible explanations of this time lag. The technology refusal noted by Hodas (1993) reflects a certain conservatism in educational institutions; there is a potential privileging in such institutions of 'high culture' texts such as canonical books over 'low culture' texts such as SMS messages; and there is also a tendency in such institutions to seek to defend and protect the political authority attending the teaching, assessment and certification of a curriculum. The deterritorialisation of mobile technologies and applications leads to their potential role as agents of democratisation (at the same time that they help to promote capitalism [Goggin, 2005, p. 35]) that is not always welcome in political structures such as educational institutions.

Yet both Goggin's (2005) and Virilio's (1986; Virilio & Lotringer, 1983) analyses highlight also the potential educational impact of contemporary technologies. Technology refusal (Hodas, 1993) notwithstanding, technologies have a tendency of 'spilling over' from the social into the educational domains, and they often have enthusiastic champions in the form of educators, managers and/or technicians. This tendency is consistent with an understanding of educational futures as impinging simultaneously on multiple arenas of living, learning and working.

### ***3 Findings of an Academic Focus Group at USQ***

The focus group reported here was conducted in October 2006 and with two other focus groups (one with students, the other with academics from a different faculty) was part of the first of two data gathering phases in a qualitative case study conducted by the authors at USQ. The aim of the first phase was to elicit participants' perceptions and experiences of using mobile technologies and applications in formal and/or informal teaching and learning.

The five participants in this focus group were all academic staff members of the Faculty of Education at USQ. This approach was used partly for convenience and partly in order to obtain an in depth understanding of a single faculty whose representatives on this occasion exhibited considerable diversity in terms of discipline, experience and mode/s of teaching. Only a small selection of the participants' words can be analysed here; that selection has been made on the basis of its articulation with the conceptual and substantive issues identified earlier and its potential significance for implications related to future possibilities for mobile learning at USQ.

There was evidence in the focus group of varied levels of experience and expertise with using mobile technologies and applications informally. One participant stated, "I learn a lot from my sons..." (Academic 2); another referred to working at home and in meetings on campus and asserted that "...it means you can work on the run" (Academic 4); and yet another revealed that at home he had two computers, with his three daughters using the main one: "It really is quite fascinating" (Academic 3). He used the "Inspiration" concept mapping program because "I think that way" and he used his personal digital assistant as a calendar and to provide alarmed reminders about forthcoming meetings: "I'm experimenting with it at the moment" (Academic 4). Not all technologies mentioned were mobile and the participants were not equally well-versed in using contemporary technologies; at the same time, the potential educational and social utility and impact of such technologies were clearly of interest to all participants.

The focus group participants identified a number of institutional barriers to the more systematic implementation of mobile technologies and applications in teaching and learning at USQ. One participant noted that, whereas "Students...[have] grown up with these things", "These things are quite costly...in time as well as money" (Academic 5). Likewise "You do have to be a sophisticated consumer [of technologies] today" (Academic 3). On the other hand, there was a generally implicit acceptance that individual academics were sometimes slow to pursue the pedagogical opportunities afforded by such technologies: "More time to digest the information" (Academic 5) would help at least one participant to do so.

A number of comments in the focus group related to broader educational and social issues, with concerns about access and equity to the fore. For example, in relation to the digital divide between the 'haves' and the 'have nots', "I'd hate to think we are actually widening the gap" and "We don't necessarily...take into account the needs of people – [of] everyone –" (Academic 1). Moreover, "I think location has a lot to do with this" (Academic 2), and academics deal "with ever increasing difficulty" (Academic 1) with geographically remote students.

There was a lively discussion of the future pedagogical possibilities of using mobile technologies and applications more formally and systematically to promote teaching and learning at USQ. “If I was a student, I would appreciate being able to take my laptop to a lecture” (Academic 3) in order to refer to something online related to the content of the lecture. Furthermore, “My vision would be...” where students could pull down the desk and “have access to all aspects of what we’re talking about” in the lecture (such as access to the online version of the course being studied) “...because it has to be right there – it has to be accessible in digital form” (Academic 3) by being embedded in digital documents. “You could even have discussion groups going while you are having the lecture” as an effective way of connecting students during lectures “...and actually adding things in for discussions later on” (Academic 3).

Finally, the focus group participants elaborated a number of pre-requisites to these kinds of pedagogical possibilities becoming realities at USQ. One participant noted, “Administratively it becomes very difficult for me to manage...” (Academic 5) assignment submission choice in large courses; “So that prevents us from trying different things and being creative...” (Academic 5). The comment that “I don’t think we know” (Academic 2) about students’ access to technologies indicated that more extensive and robust data were needed about this issue; this concern was shared by the Student Equity Network, which had “...a social justice responsibility and an access and equity responsibility” (Academic 1). This linked with the contention that “You can’t divorce technology from its social context” (Academic 3) and also with the hope, if not the experience, that “Technology should make...[teaching and learning] easier, not harder” (Academic 3). Overall there was agreement that “We’d be foolish not to run with technology – whatever it provides” (Academic4).

At one level, this necessarily selective analysis of the focus group participants’ voices demonstrates both the diversity and the depth of their experiences with mobile technologies and applications, with at least some having sufficient informal knowledge to incline them to explore the pedagogical possibilities of a more formal and systematic implementation of such technologies and applications for teaching and learning at USQ. There was therefore a foundation of goodwill that suggested that they would be prepared to explore specific policies and strategies more thoroughly, despite or because of their concerns about the potential marginalisation for some students arising from that implementation. There was also a preparedness to become pedagogical innovators and pioneers in pursuing mobile learning – up to a point.

That point of the outer limit of tolerance evokes the other focus of concern in this paper: the institutional. The participants’ voices about mobile technologies and applications were filtered through their concerns about workload intensification, increasing demands from students and supervisors alike, multiple teaching modes and scarce resources. Thus, while the participants’ discourse manifested a number of the themes arising from the work of Virilio (1986; Virilio & Lotringer, 1983) – technology, mobility, power, place, time – and while that discourse also reflected explicitly or implicitly the advantages and disadvantages of mobile technologies and applications elaborated by Grohmann, Hofer and Martin (2005), there was countervailing evidence of the difficulties attendant on extrapolating this individual interest and enthusiasm to a whole-of-institution adoption. Yet if such an adoption does not eventuate it is likely that the individual commitment will wither under the larger pressure of competing priorities. This would be an unfortunate outcome, given



the potential educational and social benefits of a broader institutional and individual engagement with mobile learning technologies and applications.

#### **4 Conclusion: Implications for Future Possibilities for Mobile Learning at USQ**

The preceding analysis of selected elements of the focus group conducted with five academic staff members in the Faculty of Education at USQ presents a challenge to university decision-makers in relation to mobile technologies and applications. On the one hand, there is the opportunity to bring teaching and learning policies and practices into closer alignment with these academics' and their students' lived experiences of such technologies being embedded in their daily lives, thereby taking a proactive approach to fostering the development of effective pedagogies and engaging with the potential for speed and unpredictability represented by these technologies (Goggin, 2005; Virilio, 1986; Virilio & Lotringer, 1983). On the other hand, the focus on security and stability (while laudable from an institutional perspective) and the discursive dissonance (Harreveld, 2002) in policy and other statements about teaching and learning at USQ highlighted in the authors' previous paper (Danaher & Hafeez-Baig, 2006) suggest that this opportunity might not be perceived as such and therefore might not receive the attention and priority that we argue that it warrants. Indeed, we contend that imaginative and sustained engagement with mobile learning pedagogies at both institutional and individual levels is crucial if such a regrettable outcome is not to eventuate. These were some of the lessons that we have learned from an academic focus group.

Technology is one of the main drivers of the existing mixed mode and flexible learning environment in universities today. There is a need to develop pedagogies that marry most effectively traditional approaches to teaching and learning with more contemporary concepts of e-learning, flexible and online learning and virtual campuses. Drawing on this paper, the authors are currently preparing to conduct the second phase of data gathering in this research project, which is to design, test and apply a survey questionnaire instrument in order to discern wider community views of the relevance and utility of mobile technologies and applications. From this it is hoped to generate evidence-based policy recommendations whereby these technologies and the associated pedagogies can underpin the enactment of teaching and learning that are technologically enhanced, socially responsive and institutionally engaged – and that are in addition secure and stable but also speedy and unpredictable.

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## SESSION II: TECHNOLOGIES FOR M-LEARNING

*Personal learning organiser: Designing a mobile learning experience for university students*, by H. Ryu, R. Brown, A. Wong, and D. Parsons

*Mobile Web2 pedagogies*, by T. Cochrane

*Software architectures for mobile learning*, by D. Parsons and H. Ryu

# PERSONAL LEARNING ORGANISER: DESIGNING A MOBILE LEARNING EXPERIENCE FOR UNIVERSITY STUDENTS

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This paper reports on the design of a mobile learning experience that aims to assist university students to organise their learning activities. The development of the system applied an M-learning design framework to identify appropriate design requirements in practice. Preliminary usability testing on the system revealed the usefulness of the M-learning environment for university students. A practical account of this exercise is also described.

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## **1 Introduction**

As mobile technologies have begun to cost substantially less than a conventional desktop machine, we have seen increasing opportunities to apply these mobile or wireless technologies to the learning environment, particularly for accessing pedagogical applications on hand-held devices in any location, even on the move (Kukulska-Hulme & Traxler, 2005). The benefits that mobile learning (M-learning) can provide would be firstly that learners can take learning opportunities directly in the situation where they occur. For instance, if you visit the Sky Tower in Auckland, you may be interested in who designed it, how long it took to build and so forth, but it is very unlikely that you will make a note to research it when you get back home. With mobile devices there is an opportunity to put virtual post-its on the object, read post-its from others, and suddenly you are part of a location aware community (see more details of this example at [www.mobilearn.org](http://www.mobilearn.org)). The Ambient wood project carried out by Sussex university (Rogers *et al.*, 2004) also showed a more practical value of mobile devices, moving teachers and learners from a classroom setting to group-work, through to individual work and back to a following classroom discussion. While there are many different levels of engagement proposed for this new learning environment, as described above, most M-learning applications still make use of mobile devices to deliver the same learning content that is currently being provided by electronic learning (E-learning), an approach that which may undermine the development on M-learning in its own right. Kukulska-Humes and Traxler (p.14, 2005) puts it:

“Mobile learning is certainly concerned with learner mobility, where learners should be able to engage in educational activities beyond the classroom... However, to some extent, learners outside a classroom have nothing more than the motivation to do so wherever the opportunity arises”

That is, they claim that there is a major tension that comes from the fact that most mobile devices in current use are not designed specifically for education or training but rather for personal information management or personal communication, largely

within work contexts or home. This conception of mobile devices might prevent both educators and learners from seeing them as a future learning medium. Indeed, it is also true that we may not develop an independent pedagogical application without traditional learning activities (e.g., face-to-face learning), because M-learning has some unique characteristics that differentiate it from the traditional learning context (Kukulka-Hulme & Traxler, 2005; Leung & Chan, 2003; Liu & Khooshabeh, 2003; Liu et al., 2003).

What we intend to explore in this article is extending the concept of the personal organiser (i.e., diary or reminder systems on mobile devices), which has already been a huge success, into an M-learning environment, by reviewing university students' contexts and requirements. Of course this is not a new idea. A previous M-learning application in a university context showed some of the potential benefits of the approach we are taking in this paper. Portable Help Desk (PHD: Smialagic & Kogan, 2002) demonstrated the usefulness of context-awareness support, providing appropriate information to support students' school life at the right time and in the right place. Also, the student learning organiser project carried out by Sharples *et al.* (2005) explored how a mobile learning organiser could help students manage their studies and assist their learning activities further. However, an early test of both PHD and the student learning organiser revealed that there was either a lack of functionality related to learning activities or little contextualised information for illustrating the potential of M-learning experiences. This paper replicates the approaches of both PHD and the student learning organiser project, but provides a versatile mobile learning environment using a task-centred design approach (Taylor, 2004), so as to ensure that the system meets university students' requirements.

## **2 First Stage: Understanding the work and work contexts of university students**

We began by interviewing ten university students to identify what types of work contexts, tasks, information and design features would suit university students' expectations. The interviewees were Massey University students, aged between 18 and 32. The data collected were mapped to a mobile-learning design framework developed by Parsons *et al.* (2006). This framework serves to specifically identify the design requirements of M-learning in terms of four perspectives: Generic mobile design issues, Learning contexts, Learning experiences, and Learning objectives. Firstly, 'Generic mobile design issues' examines four sub-features: *User role and profile*, *Mobility*, *Interface*, and *Media*. At this level, one is mainly concerned with the reliable and supportive functioning of software and hardware and with a design that is based on good practice for the user's role and profile (see Table 1.) The interview data revealed that new students had little idea of where the classrooms and laboratory facilities were located in a widely distributed campus (actually, there are three separate precincts at Massey University in Auckland). Because of this, new students are often unsure of where their next meeting or lecture is to take place. In contrast, senior students are already aware of this type of information, but require more in-depth information about their personal studies. Their concerns during "school life" revolve around the organisation of their studies, such as being aware of assessments, while also being up to date with messages and resources from lecturers and/or other students involved in their programme of study. The new students' requirements were relevant to aspects of interface design, such as map support (visualisation software)

for the new students, while the requirements of the senior students related to the personalisation of their learning environment. The design of the prototype of Massey Mobile Helper in Stage 2 (as described in Section 3) follows these different generic design concerns.

**Table 1. Summary of the interview data, in conjunction with Parsons *et al.*'s M-learning design framework**

Generic Design issues	Learning contexts	Learning experience	Objective
<p><b>User roles and profiles</b></p> <ul style="list-style-type: none"> <li>○ New students - few ideas of where the classrooms, facilities etc. are located</li> <li>○ Senior students - aware of locality information, but require more depth into personal studies, and assistance in multi-tasking.</li> </ul> <p><b>Mobility support</b></p> <ul style="list-style-type: none"> <li>○ Students roam the campus to attend all their different learning activities</li> </ul> <p><b>Interface design</b></p> <ul style="list-style-type: none"> <li>○ Visualisation software (Map)</li> <li>○ Mobile software</li> <li>○ Avoid information overload</li> </ul> <p><b>Media</b></p> <ul style="list-style-type: none"> <li>○ Images, Sounds, Text</li> </ul>	<p><b>Identity</b></p> <ul style="list-style-type: none"> <li>○ Junior students</li> <li>○ Senior students</li> </ul> <p><b>Learner</b></p> <ul style="list-style-type: none"> <li>○ Students</li> </ul> <p><b>Activity</b></p> <ul style="list-style-type: none"> <li>○ Navigation of the campus</li> <li>○ Obtaining contextual knowledge</li> <li>○ Social communication</li> </ul> <p><b>Spatial-temporal</b></p> <ul style="list-style-type: none"> <li>○ Location awareness, so the information given on the PDA is really relevant to their current location.</li> <li>○ Morning: the lecture or tutorial information that they must attend; Afternoon: more individual study organisation</li> </ul>	<p><b>Organised contents</b></p> <ul style="list-style-type: none"> <li>○ Lecture, tutorial, and lab information</li> <li>○ Assignments, assessments, library, and recreational information</li> </ul> <p><b>Outcome &amp; Feedback</b></p> <ul style="list-style-type: none"> <li>○ Locational references</li> <li>○ Various sound alerts</li> <li>○ Images and text in particular parts of the campus</li> <li>○ Web links to the current learning modules</li> </ul> <p><b>Goals and objectives</b></p> <ul style="list-style-type: none"> <li>○ To discover the locations of lecture, tutorial, and laboratory rooms (Junior students)</li> <li>○ To be aware of the information that is relevant to organising their school life (Senior students)</li> </ul> <p><b>Social Interaction</b></p> <ul style="list-style-type: none"> <li>○ Discussing the current learning module (Senior students want to discuss directly with lecturers)</li> </ul>	<p><b>Improving learning situations</b></p>

The next consideration is the students' 'learning context', and how it would be supported by the generic mobile design issues described above. This aspect stresses the needs and intended outcomes of specific learning activities. For this, the interview data identified four sub-features: *Identity*, *Learner*, *Activity*, and *Spatio-temporal*. The first three of these would establish the situational contexts of M-learning, and the last would be associated with the environmental context. In particular, spatial awareness is very important for the junior students, but temporal issues were more relevant to the senior students, for example relating the time of day to their study schedules. Some of the interview data showed that when a senior student arrives on the University campus, the contextual information that they are searching for may be related to their course schedule for the day, room changes, or important messages from lecturers. Towards the end of the day, when the senior student leaves the University, the context may change. Their need to be aware of assessments that are due will take priority over their class schedule in helping them to organise their studies. These different activities define different design requirements. As noted above, the junior students want more navigational support on the campus, but the senior students require more contextual knowledge and social interaction.

We also obtained information relevant to users' learning experiences. This supports the pedagogical approach, such as the content of a course, relationships to other media

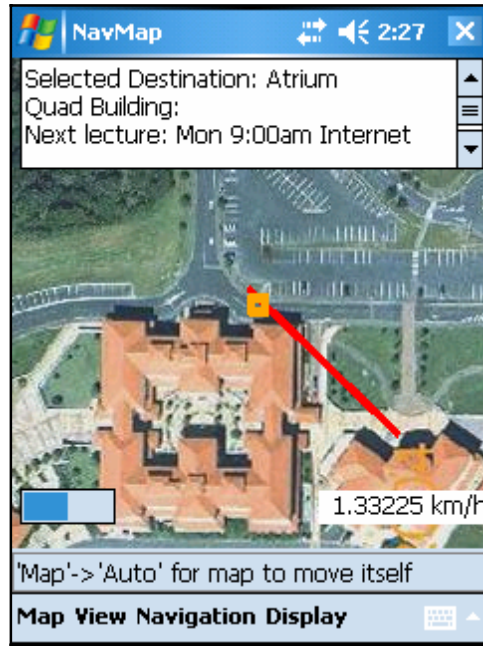
and expected learning experiences. The interview data reported the four aspects of expected learning experience within the framework; *Organised contents*, *Feedback*, *Goals and objectives*, and *Social interaction*. The data demonstrated that the users would expect information such as lecture or laboratory locations in the case of the new students, while the senior students would prefer assessment information with links to in-depth data, library records, and the ability to communicate with others. Table 1 summarises the findings from the interview along with the framework proposed by Parsons *et al.* (2006).

The key point to note from Stage 1 is that the success of any M-learning application relies on taking into account the contexts of use for different learner groups, who have different expected learning experiences, as we have identified from the responses above.

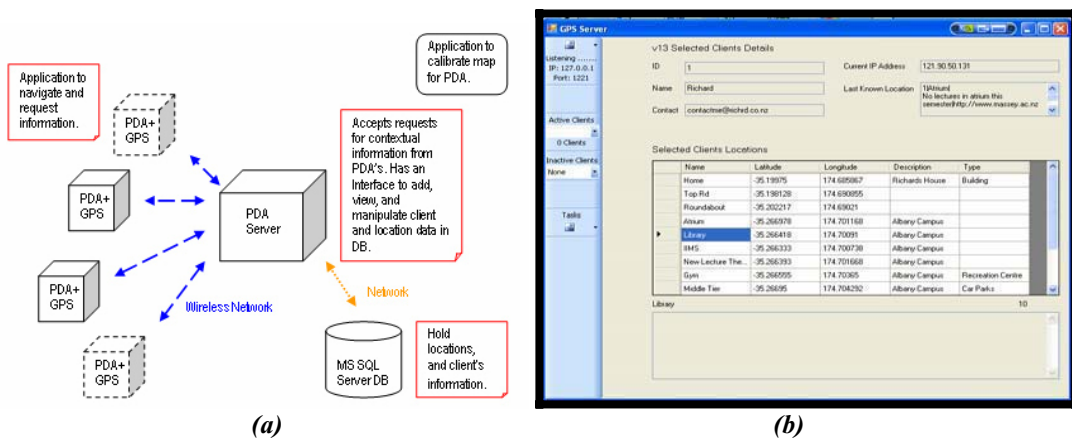
### **3 Second Stage: Design of the Massey Mobile Learning Organiser**

To address these design requirements, the Massey Mobile Learning Organiser (MLO) was developed on a PDA phone (HP™ IPAQ 6700) with a Bluetooth GPS device (GlobalSat BT-338). The system is able to locate the current position of each learner on the university map, and to access the server using a mobile network (Vodafone New Zealand). The aerial photos of the campus were obtained from the North Shore City Council, and calibrated for use with a GPS device by constructing software for the task. Microsoft™ SQL server was used to relate the contextual information and the location data. Each component of software was built using Microsoft™ Visual Studio 2005.

The assumptions of typical users and the physical environment for the development of MLO were that a student was concurrently studying four or more courses and that activities related to their daily study routine included accessing learning content and returning books to the library. In terms of their coursework, most courses include lectures, tutorials, and/or laboratory sessions. In terms of the physical environment, the Massey University campus consists of three separate areas, presenting spatial-temporal issues related to a student's locational context. For instance, most lectures take place in theatres in the upper precinct of the campus, while many of the tutorials and laboratory sessions are some distance away in the lower precincts. Therefore, students need to be constantly aware of the spatial contexts of their learning activities. Figure 1 illustrates a screenshot from the MLO system. There are indicators representing the user's current position, and a path to their selected location. The map is synchronised with the users' location, moving and rotating in line with their movements. This type of feedback provides the user with the necessary navigational information. In addition, the user can select their next destination from the course calendar, and the path to the location appears on the map.



**Figure 1. Screenshot of navigation software for a user who wants to get to the Quadrangle building for her or his next lecture**



**Figure 2. Mobile Helper system architecture (a). The system receives the user’s query and matches it to an appropriate contextual help, accessing the SQL server database (b)**

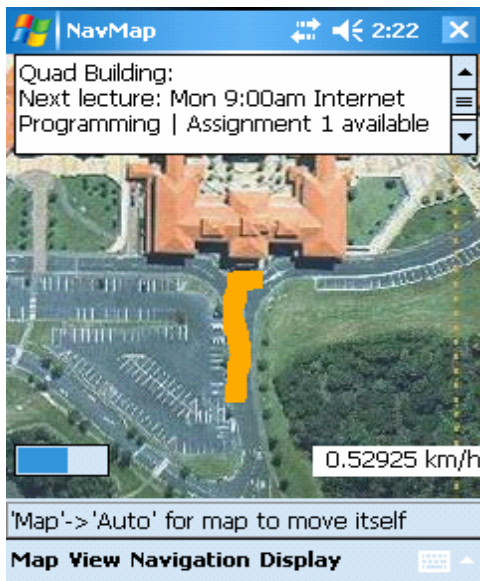
Figure 2(a) shows Mobile Learning Organiser’s system architecture. Mobile Learning Organiser sends the user’s request for information, with their current location, to the PDA server. The server builds the query for the SQL server (as shown in Figure 2(b)), which retrieves the client’s information from the database. The PDA server returns the information to the user’s Mobile Learning Organiser. As users move through an area, the PDA server delivers contextual information relating the current position with the predefined user’s profile. Therefore the user can request information, providing new knowledge and assisting their activities related to study at University.

Because Mobile Learning Organiser knows the user’s current location, and the server holds user profiles, the system can answer questions such as “what is my next lecture and where is it? Mobile Learning Organiser delivers information to the user in both a



proactive and user-driven manner. A user receives proactive information when important notices are available such as new assignments or a cancelled lecture.

In terms of user-driven information, a user could use Mobile Learning Organiser to find what books have been placed on reference in relation to their course of study. As the user walks past the library, they can request this type of contextual information. Figure 3 demonstrates the type of contextual information a user may receive while walking close to a lecture theatre. In addition, if the user clicks the 'Assignment 1 available' link to their learning environment (see Figure 3), they can see what the assignment is. Also, they can access the whole M-learning module as shown in Figure 4.



**Figure 3. Contextual information presented to the user. If a user clicks 'Assignment 1 available' on the system, they can access the M-learning module.**



**Figure 4. Learning module design for Massey Mobile Learning Organiser. It provides their current location and additional learning modules students can download**

#### **4. Third Stage: Evaluation**

To see the benefits and usefulness of Massey Mobile Learning Organiser, we evaluated it with four representative users. For the contextual help information, participant's profiles such as their interests, coursework, and library information were collected before the evaluation. Based on these profiles, contextual information for each participant was added to the system database. To evaluate the system in use, the participants roamed the campus for fifteen minutes, where they experienced the two major functions of Mobile Learning Organiser, finding the location of their classrooms, and contextual help. The first function is user-driven information, and the latter is proactive information by the system. Each user was first asked to find the location of their next lecture with Mobile Helper, and then get to that location. As they approached the location, relevant contextual information appeared. For instance, if the students were passing the library, the system proactively displayed library

information, for example if there was a new book based on their interests or books due for return.

**Table 2. Results from initial evaluation with four students**

Statement	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7
Using the device would help me find unknown areas of Massey.					50%	50%	
Learning to use the device was difficult	25%	25%	50%				
Interacting with the device requires a lot of mental effort	25%	25%	50%				
I think the device would be very useful in my university life						75%	25%

Table 2 presents the perceived usefulness and ease-of-use data collected. It showed the students efficiently utilised the system to discover new locations while feeling confident in themselves using the technology. They were also attracted to the contextual information. However, the small sample size made it hard to identify any behavioural differences between the new university students and the senior students.

To explicitly see how the students would interact with the system, we further assessed the system using the think-aloud technique. Three students were recruited from the campus, and the same task procedure was applied. Verbal protocol results concurred with Table 2, placing emphasis on ease of use and the ability to learn from contextual information. All the participants were able to complete the tasks in a straightforward manner. They would create an objective to either find a location, acquire some contextual information while moving around, or a combination of the two. In each occurrence the participants interpreted new contextual information, assisting in their purpose of studying at Massey. Also, they appeared to find the contextual information both useful and informative in relation to their goals of being at the location, such as “library books due” messages when they were near the library. The participants with specific information appeared to feel more satisfied with the system, and its abilities. Therefore they were more likely to have a positive attitude to and respect for the system, gaining and learning more.

## **5. Conclusion and future work**

There have been recurring questions raised about the applicability of M-learning from a pedagogical perspective, such as; is it really possible to learn with such small device? What sorts of people use mobile device for teaching and learning? and what sorts of subjects and situations are appropriate for mobile learning? Following from these concerns, we assumed that a more informal learning activity support, such as the Mobile Learning Organiser described in this paper, would be more situated, experienced, and contextualised within specific domains. Of course, we are beginning to witness significant adoption of mobile technologies in further and higher education, in schools and the community, and in training and upskilling. They are having an impact on teaching, learning, and on the connections between formal and information learning. However, it seems to be slow on the uptake. That is why this paper sees the informal aspects of learning activities or experiences as the base-line for mobile learning activity.

The authors are planning to further extend the Massey Learning Organiser to identify a particular pattern of requests, and location sequences to enhance the degree of contextual information provided by the system. Indeed, this paper is not the final result of this research activity; the main objective here is to foster a wider discussion of M-learning design practices, based on an analysis of current research and future challenges.

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# MOBILE WEB2 PEDAGOGIES

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This paper argues that the success or failure of mobile technologies within tertiary education pivots upon the successful modeling and integration of the technology into the delivery and assessment of a course. Mobile implementation choices must be based upon a sound pedagogical framework, and supported by a 'technology steward'. This paper outlines a pedagogical framework for mobile teaching, and its alignment with web2 social software. Lessons are drawn from two mobile trials, and example web2 applications are briefly outlined.

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## **1 Introduction**

When attempting to use technology to engage today's learners, there is often a disconnect between the techno-savvy of the learners and the lecturers. This is illustrated by the following description of today's learners and comments from a selection of lecturers:

### **1.1 Today's learners**

A junior at the university, Eric wakes up and peers at his PC to see how many instant messages (IMs) arrived while he slept. Several attempts to reach him are visible on the screen, along with various postings to the blog he's been following. After a quick trip to the shower, he pulls up an eclectic mix of news, weather, and sports on the home page he customized using Yahoo. He then logs on to his campus account. A reminder pops up indicating that there will be a sociology quiz today; another reminder lets him know that a lab report needs to be emailed to his chemistry professor by midnight. After a few quick IMs with friends he pulls up a wiki to review progress a teammate has made on a project they're doing for their computer science class. He downloads yesterday's chemistry lecture to his laptop; he'll review it while he sits with a group of students in the student union working on other projects. After classes are over he has to go to the library because he can't find an online resource he needs for a project. He rarely goes to the library to check out books; usually he uses Google or Wikipedia. Late that night as he's working on his term paper, he switches back and forth between the paper and the Internet-based multiplayer game he's trying to win (Oblinger & Oblinger, 2005).

### **1.2. Today's Lecturers**

The following is a selection of anonymous comments from lecturers regarding their comfort levels with integrating technology into their teaching:

Lecturer 1: “When people talk IT stuff, for me its like a foreign language – I don’t even know if IT is the label I should be using”.

Lecturer2: “In my Diploma programme we need more flexibility, we have a lot of students who want to come in at odd hours and are working, and this technology stuff should offer my students a lot. However I’m scared of it. I don’t want to just dive in. In the past I’ve always hung back because I always think there’s going to be bugs in the system”.

Lecturer3: “I guess I feel a burning desire to learn about this stuff, but I’ve never created the space to do it, and I suppose that’s an excuse”.

Lecturer4: “I just feel totally out of touch with the technology, particularly when I see what my kids can do, and I haven’t really had any motivation to go about updating myself. But I guess for me one of the issues is whether the technology overshadows good pedagogy, and I want to be absolutely sure that technology enhances pedagogy rather than gets in the way of it”.

## **2 Developing a Mobile Pedagogical Framework**

Overcoming the technology disconnect between learners and lecturers/teachers requires intentional planning and staff development, and forces a rethink of traditional pedagogies used in tertiary education. This is particularly important with the growing use of mobile devices by today’s students.

Mobile devices are inherently social, enabling rich social interaction, and the potential for enhancing group work and communication within educational settings. Today’s learners are constantly connected to their social networks via their wireless mobile devices. How can educators harness the educational potential of such an environment?

Content delivery to mobile devices may well have a useful place in m-learning, however, there is an imperative to move from a view of e- and m-learning as solely delivery mechanisms for content... Handheld devices are emerging as one of the most promising technologies for supporting learning and particularly collaborative learning scenarios. (Hoppe *et al.*, 2003)

### **2.1 Creating collaborative mobile learning communities**

Various approaches to integrating mobile technologies into education have been explored, including:

- Pushing information (via SMS)
- Pushing content (via synchronization)
- Repurposing content for smaller screens (video, enhanced podcasts...)
- Development of mobile Learning Objects (Flash Lite, Java...)
- Creation of test & drill exercises - concept reinforcement
- Communication tools
- Creative (get the students creating the content and sharing it)
- Collaborative (supporting group/team work)

- Connected (implies wireless)

## 2.2 Informing pedagogy with theory

Teaching and learning innovations are best implemented when informed by learning theory. A pedagogical framework for implementing social software tools via wireless mobile devices can be developed by drawing on concepts from: constructivism (Bruner, 1966; Piaget, 1973), social constructivism (Vygotsky, 1978), communities of practice (Wenger, 2005), a conversational model of learning (Laurillard, 2001), and the social construction of technology (Bijker, 1995).

Thus a mobile (m-learning) pedagogical model will focus upon enhancing communication, collaboration, and will be student-centred.

“New mobile and context-aware technology can enable young people to learn by exploring their world, in continual communication with and through technology” (Sharples, 2005).

Two issues that do not appear to have received much attention in mobile educational case studies are the role of the technology steward, and the impact of the social construction of technology on the adoption of mobile devices in education.

## 2.3 The importance of the Technology Steward

Communities of Practice can be enhanced with the use of appropriate communications technologies when under the guidance of a Technology Steward. The Technology Steward (Wenger *et al.*, 2005) is a member of the community with a grasp of how and what technologies can enhance the community. They act as a guide to the rest of the community as the community learns to utilize and benefit from technology. In education, the technology steward role would most beneficially be that of the teacher. However when the teacher is not up to speed with the technology utilized by the community, or does not engage with it, then the technology steward role defaults to someone else within the community or class. The problem then is the potential for the community or class to go off on a tangent from lack of pedagogical guidance. The technology steward thus forms a pivotal role in the successful integration of mobile teaching.

One of the biggest challenges in taking this approach is the changing role of the teacher. This includes the need to become techno-savvy in order to model the educational use of the technology, particularly if the teacher is also the technology steward for the class/community. Support structures to aid the teacher's technology development can be created utilizing the concept of communities of practice. A community of practice can be based around the course/class: incorporating the teacher, technical support (if outside the class), and students. A community of practice that provides teacher support can also be created from a group of like-minded teachers.

An example of the establishment of an educational community of practice is illustrated by the authors YouTube video presentation (Cochrane, 2006a).

## **2.4 Social Construction of Technology**

Technologies (hardware and software) should be chosen according to their fit with the underlying pedagogies guiding the course delivery. However, often there are more factors influencing the ultimate choice of technologies used in a learning situation than those that present the best pedagogical fit. Often the 'best' technology for a particular situation does not become the mainstream choice. For students the decision to purchase a mobile device is influenced by their peer network and the perception of how cool the device is. The affordability of data charges is also important to budget conscious students. The social construction of technology (Bijker, 1995) is one approach to analyzing issues influencing technological development and survival.

In summary, a social-constructivist pedagogy needs to be put into practice, and contextualized for student learning and technology preferences. Mobile devices, activities and software that align with a social constructivist approach to teaching and learning should be targeted. This leads to the potential partnership between mobile wireless devices and web2 social software. Historically mobile educational case studies have focused upon creating mobile applications and rich media content suitable for small screens, requiring high levels of specialized expertise. Meanwhile a revolution has been underway with the convergence between web2 social software and mobile devices. These mobile web2 services enable constructivist collaborative environments with very little technical overhead required by the lecturer or students.

## **3 Web2 Social Software**

'Social Software' (interactive collaborative software) is one of the key features of what has been termed 'Web2' (O'Reilly, 2005). Examples of current and emerging social software tools include blogs, wikis, RSS, instant messaging, podcasting, social book marking, etc... (Farmer, 2004; Glogoff, 2005; Kaplan-Leiserson, 2004). The key characteristics of social software fit well with the mobile pedagogies described above, making the combination of mobile web2 a natural and relatively simple approach to creating collaborative learning communities.

Web2 is about:

- \* Moving beyond CONTENT
- \* Ease of use
- \* Interactivity
- \* Collaboration & sharing
- \* Customization
- \* Personal Publishing

Wireless Mobile Devices coupled with open-source Social Software tools potentially provide the basis for enhancing teaching and learning in virtually any discipline, providing an environment that stimulates reflection, critique, collaboration, and user generated content – i.e. a social constructivist environment.

### 3.1 Examples of Mobile Web2

Mobile web2 tools that can be utilized with minimal technical support, and that support a wide range of mobile platforms include:

- Mobile blogging
- Mobile Google Maps
- RSS aggregators (online or via downloadable client applications)
- Mobile photo blogging
- Mobile video blogging
- Instant messaging
- Mobile bookmarking
- Podcasting (Student generated)
- QRcodes for camera phones

The popularity of these social, web-based tools is demonstrated by their design and integration into current and soon to be released consumer mobile devices. An example is the inclusion of RSS news reading capability into Nokia (Nokia Lifeblog 2.0) and Sony Ericsson cell phones, and the Sony PSP. The latest Sony Ericsson cell phones feature integrated mobile photo blogging (Gohring, 2006), and Nokia's N73 cell phone allows direct posting of captured photos to Flickr. Additionally, the two 'giants' of the Internet, Google (2006) and Yahoo (2006), are both positioning themselves for the wave of wireless mobility by developing a suite of mobile social networking tools.

The recent release of the Opera mobile and mini web browser (Opera Software, 2006) for almost every mobile phone and PDA has opened the door for viewing many standard web sites and web2 services on mobile devices without any translation. In particular, the Moodle LMS (Dougiamis, 2005) renders very nicely on a small screen device running Opera mini.

One of the more innovative free mobile tools is the kaywa reader, which allows a camera phone to scan and interpret QRcodes. QRcodes can either represent a paragraph of text, or a URL.

The following table briefly outlines some example social software options for various mobile devices. For a more in depth overview and discussion of mobile web2 applications, and a QRcode example, visit the author's wiki pages (Cochrane, 2006b, 2006c).



Table 1: Social Software examples for a range of mobile devices.

Device	Blog options	RSS	Instant Messaging	Social Book marking	Web Services – Moodle, Elgg, Wikis etc...
Cell phone	1. SMS via <a href="#">letmeparty</a> 2. mobileBlogger (Java) 3. MoJungle – (image & video via SMS) 4. Mobispline 5. Flickr via email 6. ShoZu	1. Litefeeds –set-up feeds on web, download Java reader to cell phone 2. RSSReader (Java) 3. Google reader Mobile – via Opera mini browser.	1. eMSN (Java) 2. IM+ (Java) 3. Mobispline	1. Deliciousmona.com 2. mobilicio.us – delicious formatted for mobile devices	1. Opera Mini (Java) 2. KaBlog (Java) – supports Elgg Blog via Metaweblog API
Smart phone	1. Built-in app 2. All above 3. SplashBlog	1. Built-in app 2. All above	1. All above 2. Yehba	1. mobilicio.us	1. All above 2. Opera for Symbian or PPC 3. mobile google 4. mobile yahoo
WiFi PDA Palm OS	1. uBlog 2. Vagablog 3. SplashBlog 4. MoBlog	1. LiteFeeds 2. QuickNews 3. mRSS	1. Agile Messenger 2. MunduIM 3. Verichat	1. mobilicio.us	1. Blazer 2. Opera Mini 3. Xiino
PSP	1. Built-in web browser login to Blogger.com	1. Built-in RSS reader	None yet	1. Built-in web browser & RSS reader	1. Built-in web browser

#### 4 Lessons Learnt

At Unitec, the author is in the process of implementing mobile web2 action research trials over the next two years (Cochrane, 2006c). In preparation for this, two pre-research trials were run during 2006. These trials prompted some of the thinking behind this paper, particularly regarding the importance of the role of the technology steward when introducing new technologies and pedagogies into existing courses.

- Do not assume students' technology skills. While most students will use instant messaging to communicate with peers, their knowledge of enabling technologies such as RSS can be surprisingly limited.
- Timetable ample preparation and on-going support. Weekly technology integration tutorials are suggested here.
- Lack of Tutor engagement or integration of the technology de-motivates students. Tutors must model the use of the technology and be actively engaged in the collaborative community.
- Do not assume student connectivity – a surprising number of students still have no internet access at home, and limited access to campus WiFi hotspots.
- Do not over-complicate the integration of the technology into the course delivery and assessment. Keep it simple.
- Test the LMS server external connection settings – make sure they are assigned appropriate priority on the network/firewall.

## 4.1 Challenges

When implementing mobile learning environments there are many practical and big picture issues to consider.

- Small screen size - how to view/present information in a class setting?
- Mobile device setup – who will install software and configure the devices...?
- Personal nature of the devices.
- Dealing with the variety of device models (particularly mobile phones).
- Technical support.
- Meaningful/relevant integration into the course delivery and assessment.
- Student preferences.
- Which technology to choose in an ever changing field.
- Network/security issues.
- Moving beyond repurposing content to creating collaborative mobile learning environments.

## 5 Conclusions

Wireless mobile computing facilitates the development of collaborative learning communities, enhancing student-student and student-tutor communication and interaction. Wireless Mobile Devices coupled with open-source Social Software tools potentially provide the basis for enhancing teaching and learning in virtually any discipline, providing an environment that stimulates reflection, critique, collaboration, and user generated content (i.e. a social constructivist environment). However, the crucial element in the success of implementing mobile learning is the intentional integration into the teaching and learning aspects of a course.

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# SOFTWARE ARCHITECTURES FOR MOBILE LEARNING

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Mobile learning (M-learning) systems may be built using any of a number of generic software architectures, each of which has its own benefits and limitations. This paper describes four generic software architectures that can be applied to M-learning systems and provides an overview of their comparative strengths and weaknesses in meeting the various requirements of the mobile learner.

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## **1 Introduction**

As mobile technologies have increasingly found their way into all aspects of our lives, researchers have explored how these technologies might contribute to learning. Many mobile learning (M-learning) applications have been developed that extend the electronic learning (E-learning) experience into the mobile context (e.g., Chang and Sheu 2002; Chen, Kao et al. 2002; Liu, Wang et al. 2002). M-learning is an approach to E-learning that utilises mobile devices, but should not be seen as just another channel for delivering the same content. In fact quality M-learning can only be delivered with an awareness of the special limitations and benefits of mobile devices. This is not to say that awareness of known quality issues in E-learning is not relevant to the mobile learning context, but it is also important to identify features unique to M-learning when considering how to deliver a quality education experience.

This paper examines what kinds of software architecture might be used to build M-learning systems and outlines what factors and issues should be considered in terms of the benefits and drawbacks of each generic architecture. In the following section we review some relevant literature on key aspects of M-learning systems. We then outline a number of software architectures that may be used to build M-learning applications, looking at how each approach may contribute to the requirements of M-learning while considering the practical challenges and limitations. We provide a summary of the key issues associated with each architecture and suggest some recommendations for software architectures appropriate to different types of mobile learning system.

## **2. Mobile devices and mobile learning**

Mobile technologies, and particularly mobile telephones, are as much social objects as technical ones. They impact how we organise our lives, how we work, and, perhaps, how we learn. Designing M-learning systems therefore is not simply a technical challenge but one that has to take into account the social context of using a mobile device as a learning tool.

The primary success factor of the mobile phone is its ability to support a range of individual requirements, e.g., sending and receiving telephone calls, text messages,

multimedia messages and so on. Indeed, each person uses their mobile phone in different ways. For instance, teenagers frequently use Short Message service (SMS) for their communication medium (e.g., Schiano, Chen et al. 2002), while business professionals are more likely to use their mobile device as a personal communication centre. This aspect – different user profiles and their roles in use of mobile technologies – becomes even more important in an M-learning environment. For example, the use of SMS (or picture messages) in M-learning (Seppälä, Sariola et al. 2002; Stone, Briggs et al. 2002) has been identified as an effective tool to enhance both students' learning experience and teachers instructing experience, yet the requirements from both parties were quite different.

The numerous constraints on the technology and user interface of mobile devices are an important consideration in M-learning environments. At the moment mobile devices suffer from small screens, poor input methods, and limited battery life. Therefore, M-learning services must be carefully designed to fulfill users' needs, without overloading them with unnecessary complexity and slow operation. The software architecture chosen for a given M-learning system will therefore have a major impact on the utility of the system from the user's perspective. There is, however, some positive evidence that M-learning is able to succeed even in limited technical environments. For instance, a study by Ericsson in 2002 showed that even with a simple Wireless Access Protocol (WAP) browser interface, 77% of the participants felt that M-learning actually increased their learning performance (Ericsson 2002). Stone et al. (2002) developed a simple M-learning application using SMS as an interactivity mechanism. They concluded that the lack of sophistication of the platform was not a major barrier to the quality of the learning experience, and M-learning applications can encourage active and wide participation of both the learners and the tutors, even where it might be expected that technical limitations would discourage them. It seems therefore that technological sophistication is not necessarily a measure of usefulness, so in designing the software architecture for an M-learning system we should consider not only the technical sophistication of the platform but how well that platform meets the needs of the learner. Mobile applications should not distract with unnecessarily rich media objects (e.g., Uther 2002), so the format of content has to be chosen with care. The learning context, in particular interactivity, is more significant than the media types used. Luchini et al. (2004) stress the importance of the user participating in and learning about underlying concepts and processes rather than learning by rote, and content should be up to date and highly interactive, enabling mutual feedback between education providers and learners and assisting in the identification of knowledge gaps (Lehner and Nösekabel 2002; Massy 2002). Therefore in designing a software architecture for M-learning we should consider support for collaborative learning as a priority.

### ***3 Mobile versus mobile and wireless***

One of the more obvious, but nonetheless important distinctions to be made between different implementations is whether the application is mobile, wireless or both. As Mallick (2003) indicates, wireless is usually a subset of mobile, but of course there are many applications that are mobile without being wireless, and also those that are wireless but not mobile (Figure 1)

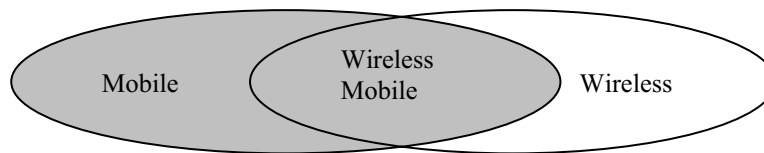


Figure 1: The relationship between wireless and mobile, with the area of interest for mobile learning highlighted (adapted from Mallick).

For the purposes of mobile learning, applications that are wireless but not mobile are not relevant to our discussion, however the distinction between mobile on the one hand, and wireless mobile on the other, is significant. Within this distinction there is another dimension, which is the level of interactivity of a solution that requires wireless connectivity. For example, mobile learning content that may be downloaded wirelessly from the Internet, whether that content is in the form of a podcast, MPEG file, Java MIDlet or some other downloadable and/or installable component, may not require further wireless connectivity after download. In contrast, an application may be downloaded that will require further contact with a wireless server while it is being used. This requirement will have a potentially negative effect on the cost and availability (i.e. being dependent on network availability) of the mobile learning content, while having the positive effect of enabling greater interactivity, breadth and currency. These are the kinds of trade-offs we examine in this paper.

#### **4 Non adaptive mark-up**

A number of mobile learning applications have been developed that use some specific form of browser mark-up for their client side presentation. This mark-up may be Wireless Markup Language (WML) or variations on the HyperText Markup Language (HTML) such as cHTML (compact HTML), XHTML (eXtensible HTML) Basic or XHTML Mobile Profile, depending on which types of mobile device are being supported. Regardless of the mark-up, the content may be served as static pages or generated dynamically on the server, using technologies such as server pages and/or eXtensible Stylesheet Language Transformations (XSLT) (Figure 2). Fowler classifies these to approaches to dynamic mark-up as the template (server page) and the transform (XSLT) approach (Fowler 2003), though in fact it is possible to combine the two, for example by using Tag libraries (such as the JSP standard tag library, the JSTL) in server pages that support transformations.

The advantage of this approach is that it is lightweight from the client device perspective requiring only the device's normal browser. The problem with non-adaptive mark-up is that using a particular mark-up language, for example WML, means that the content can only be rendered by browsers that understand that particular type of mark-up. Even though the content may be dynamically generated, it is only being generated for a specific type of client.

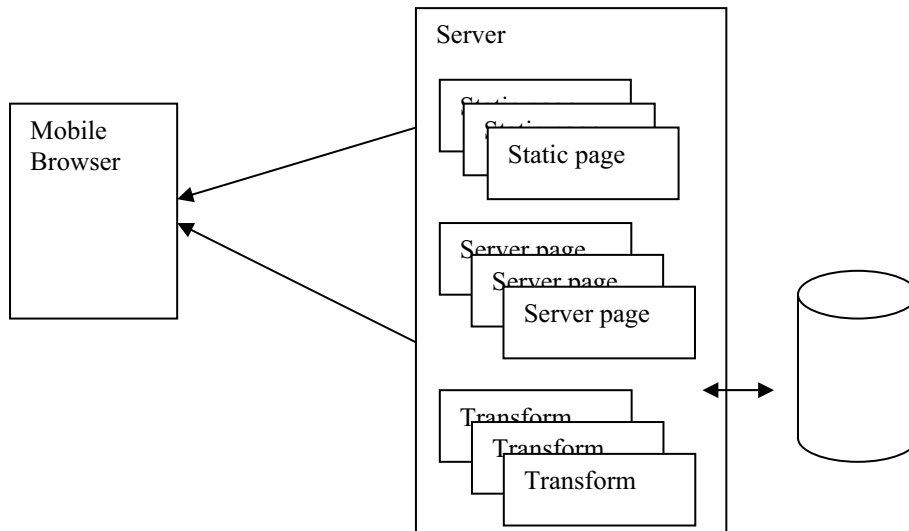


Figure 2: Non-adaptive mark-up architecture

### 5 Adaptive mark-up

Adaptive mark-up requires a server side process that is able to generate mark-up appropriate to the mobile device from a common set of contents. There are a number of approaches to this, for example an application can interrogate the HTTP (HyperText Transfer Protocol) header of the request and identify the client browser type from the 'user-agent' field, then generate client specific mark-up using various XSL transformations. An alternative approach is to use a tag library such as Wireless Abstraction Library (WALL), a JSP tag library that builds on the Wireless Universal Resource File (WURFL) (Passani and Trasatti 2002-6). WURFL is able to recognise user agent information and identify different devices, while WALL generates device specific markup. Either way, the advantage of this approach is that it enables an M-learning application to support multiple types of mobile browser (Figure 3).

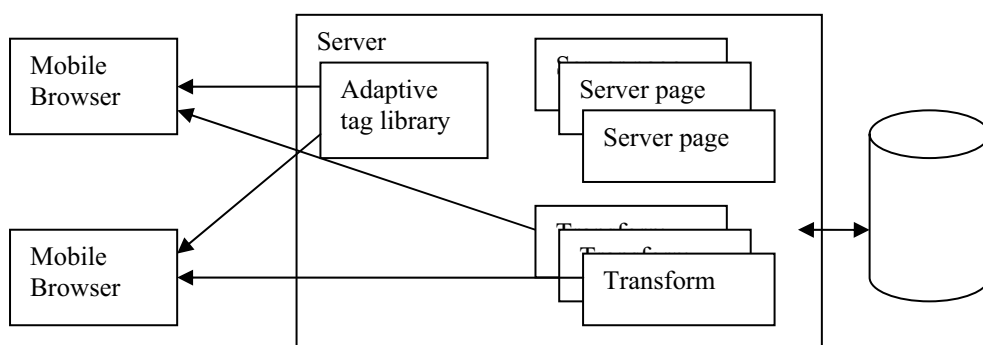


Figure 3: Adaptive mark-up architecture

### 6 Mobile client side application

While the mark-up approach to M-learning architectures can provide a good range of content across a wide range of devices, confining the learner's activity to what can be supported by a mobile browser can limit the range of learning activities that are possible on the device. For example, interactive learning games may be difficult or impossible to support. An alternative approach to using mark-up to provide content

via the mobile Internet is to provide applications that can be downloaded to the mobile device. There are three general categories of application that may be developed for mobile devices. The first approach is an application written for a specific mobile device platform, for example targeting a particular model or make of mobile phone. These applications can take advantage of the special characteristics of that particular device, which can make them, for example, highly performant, but of course these applications cannot be used on other devices. A second approach is to use Microsoft Windows based applications, for example building an application using Windows Mobile components. This approach is more generic than writing for a particular device, since there are a number of devices that support Windows Mobile. However such applications cannot run on the majority of mobile devices, since there are many other operating systems being used including Palm OS, Symbian and Linux. The third, most generic approach, is to use Java Micro Edition (Java ME)\*. Using this software platform enables us to deliver a relatively rich client experience to a wide range of devices. Although Java ME has its limitations compared to some other application platforms such as Symbian and BREW, it works across a large proportion of mobile devices, including many Windows phones (Coulton, Rashid et al. 2005). In the context of mobile phones, the specific configuration and profile typically installed is the Connected Limited Device Configuration (CLDC) supporting the Mobile Information Device Profile (MIDP). Java ME applications that run using this profile are known as MIDlets. Of course coding at the higher level of abstraction that enables interoperability has its costs in performance terms. For example Java ME applications have been shown to execute at about half the speed of equivalent C programs (Domer, Nanja et al. 2004). There are also issues regarding the version of both the CLDC and MIDlet specifications that a given phone may support. Important differences between versions include floating point number support and security management, among many others.

If a mobile client application is chosen as the software architecture, then the overall system design is simple. The application runs standalone on the client, so the only role of the server is to enable download and installation of the application (Figure 4). This may be done either wirelessly or using a cable. Wireless download of Java applications can be provided using OTA (over the air) provisioning, a standardised approach that provides a consistent client-server interaction and enables version control for application downloads. The mobile application may use the data store on the mobile device but will not require access to any server side resources.

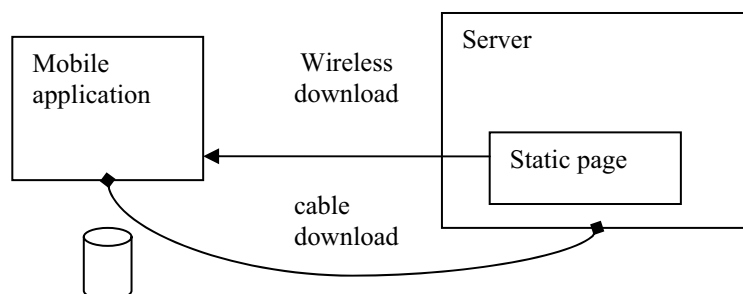


Figure 4: Client side application architecture

\* Java ME was formerly known as Java 2 Micro Edition (J2ME)



## 7 Smart client with server connectivity

So far we have considered two very different types of software architectures for mobile learning systems, one based on providing a page based mobile Internet system, the other using a downloadable application client. However there is another approach that combines features from both of these architectures, the smart client that connects to the server. In this approach, there is a client side application, but that application does not run standalone. Rather, it communicates with the server to send and receive information while the application is running (Figure 5). There are a number of advantages to this approach. First, it is possible for the mobile learning application to provide a much wider set of content than is possible with a single downloaded application, since the storage size of the mobile device limits the amount of learning content that can be downloaded. A smart client that connects to the server can access learning content on demand without having to keep it all stored in the mobile device. Similarly, we can utilise the server to store information about the clients so we can, for example, maintain a sophisticated user profile on the server. In addition, the ability of the device to communicate data with the server in both directions (upload and download) means that it is possible to build a collaborative learning system where multiple users can send and receive data to and from each other.

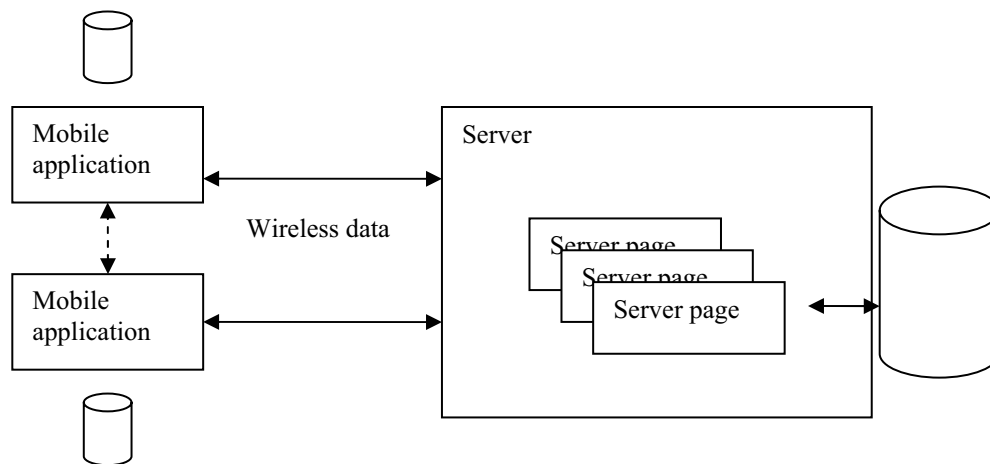


Figure 5: Smart client with server connectivity architecture

The price we must pay for this power and flexibility is complexity. For example, data management becomes a more complex issue because there may be data stored in a local data store on the client device as well as on the server. Mobile databases will need to be synchronized with central databases, and cache management has to be sophisticated to cope with the small memory size in most mobile devices. Distributed smart client applications using this architecture also need an appropriate communication protocol, such as XML over HTTP, to enable the client to access server side resources at run time.

## 8 Summary

In this paper we have provided a brief overview of four software architectures for mobile learning; non adaptive mark-up, adaptive mark-up, mobile client side application and smart client with server connectivity. All of these architectures have their own strengths and weaknesses, and in most cases we are trading flexibility against complexity. In addition there are different levels of server connectivity required for these different architectures, and successful applications depend not only

on the technical infrastructure but also the social context within which issues such as pricing come into play. Therefore deciding on a suitable software architecture for a specific M-learning system depends not only on technical factors but also an analysis of the user context. While we may see that a smart client architecture with server connectivity can provide us with the richest mobile learning environment, alternative architectures may prove easier to install, more robust in use, more easily deployed to a larger range of devices and cheaper for the learner to maintain. Therefore the most important aspect of designing an M-learning system architecture is to consider all aspects of the user context rather than just focus on the technical platform.

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## SESSION III: CASE STUDIES I

*Developing a SMS-based classroom interaction system*, by E. Scornavacca, S.L. Huff, and S. Marshall

*mLearning and the workspace learner: Integrating mlearning ePortfolios with Moodle*, by S. Chan and N. Ford

*Answering individual patient and health professional information needs utilizing a user driven innovation in M-learning*, by R. Biswas

# DEVELOPING A SMS-BASED CLASSROOM INTERACTION SYSTEM

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The rapid uptake of mobile phones among university students is providing an unprecedented platform for the development of classroom interaction systems. This paper describes the development and trial of a SMS-based classroom interaction system.

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## **1 Introduction**

Classroom interactivity has a number of significant benefits: it promotes an active learning environment, provides greater feedback for lecturers, increases student motivation, and enables a learning community (Bishop, Dinkins, & Dominick, 2003; Mazur, 1998; McConnell et al., 2006). On the other hand, interactive activities for large classes (over 100 students) have proven to be quite difficult and, often, inefficient (Freeman & Blayney, 2005).

During the past six years the rapid proliferation of mobile devices, particularly cellular phones, in the student demographic has changed the levels of student access to information and communications technology (ICT) in the classroom - presenting an extraordinary opportunity to develop interaction classroom systems and to enhance students' learning experience (Scornavacca & Marshall, 2007).

This paper aims to describe the development and trial of a short-message-services (SMS) based classroom interaction system.

The next section illustrates the theoretical background used for the development of the system. This is followed by a description of the system as well as the trial that took place. Subsequently the paper rounds off with a summary and conclusions.

## **2. Theoretical Background**

The traditional lecture theatre environment has provided universities with a cost effective and scaleable means of teaching students. However this has come at the price of making interaction difficult and inefficient, leading to reduced student engagement, motivation and learning (Freeman & Blayney, 2005).

The work of Mazur (1998) suggests the use of interactive pedagogies that are able to engage students in peer discussion and activities, guided by the lecturer, can result in effective student learning outcomes. Using interactive classroom pedagogies it is possible to promote a more active learning environment, increase the motivation of

students, inform the work of teachers and generally enable a genuine learning community in the classroom (Bishop, Dinkins, & Dominick, 2003; Mazur, 1998; McConnell et al., 2006).

The decision to engage in a more interactive pedagogy is, however, not a trivial one, and it requires effort and application on the part of the teaching staff. Large classes of more than 100 students are clearly where the most benefits of a more interactive approach can be realized but the inherent inefficiency, inaccuracy and lack or anonymity present significant problems (Freeman & Blayney, 2005).

Classroom Feedback Systems (CFS) provide one possible technological mechanism that can efficiently enable interaction in large classes. Known by various names (e.g., “clickers”) and produced commercially by a range of vendors, CFS technologies have been used since the sixties to allow students to respond to questions and have the results processed and displayed for use by the lecturer and the class as a whole (Judson & Sawada, 2002; Penuel, Roschelle, & Abrahamson, 2005). The more sophisticated CFSs provide the ability to answer a range of question types, from simple yes/no through to detailed responses, free-form questions and role-playing. Current platforms range from small infra-red units, through radio units, to the use of web systems accessed by wireless personal digital assistants (PDAs) or laptops (Bollen, Eimler, & Hoppe, 2004)

These systems are generally well regarded by students when they are used. Numerous case studies have described the use of CFS technologies in disciplines ranging from the physical sciences through mathematics, accountancy and literature (Bollen, Eimler, & Hoppe, 2004; Carnaghan & Webb, 2005; Draper & Brown, 2004; Freeman & Blayney, 2005; Hall et al., 2005; McConnell et al., 2006). A variety of positive outcomes from the use of CFS technologies have been reported including improved understanding of important concepts, increased student engagement and participation, improved quality of discussion in the classroom and improved teacher awareness of student difficulties (Mazur, 1998; Penuel, Freeman & Blayney, 2005; Roschelle, & Abrahamson, 2005). A clearer perception of their students’ current level of understanding allows instructors to adjust their teaching appropriately (Bishop, Dinkins, & Dominick, 2003; McConnell et al., 2006).

However, not all studies of CFS have been positive. Using CFS technology without specific pedagogical changes appears to have no benefit on measured student performance and learning outcomes, despite the positive perception of the technology reported by the students (Carnaghan & Webb, 2005; Judson & Sawada, 2002; Penuel, Roschelle, & Abrahamson, 2005). Further, there is also the risk that the increased student engagement will expose the limitations of the lecturer, both in terms of their own depth of understanding but also in their ability to cope with a more dynamic classroom environment (Hall et al., 2005). Penuel, Roschelle, & Abrahamson (2005) contends that the CFS technology does provide a vehicle for positive change, but that this will only occur if the actions of the teacher using the technology changes the culture of the classroom in a such a way as to support the student’s engagement and peer interaction.

As well as the pedagogical challenges, the use of CFS hardware also introduces some difficulties for students and institutions. Historically, CFS systems depended on a significant wired infrastructure that was commonly built into lecture theatres (Judson & Sawada, 2002). The introduction of wireless units has helped reduce that need, but now means that the students either have to own or rent their own units or use a unit

provided in the lecture. Either approach has problems, with students either losing or forgetting the units, or institutions needing to provide teaching assistants who hand out and collect units in class (Draper & Brown, 2004). Requiring students to purchase the hardware, even in environments where deals are made with textbook publishers to subsidize the equipment, can be problematic for student budgets and this is likely to be even more of a problem if wireless PDAs or Laptops are used.

Personal web-enabled devices such as PDAs have a number of problems of their own which can reduce their utility as CFS devices. The larger display and more flexible programming environment means that PDAs can be used to provide a rich set of student feedback but this comes at the price of significant issues such as battery life and a complicated and unreliable wireless configuration (Bishop, Dinkins, & Dominick, 2003). There is also a problem, shared with laptops, that these devices are more capable and flexible which increase the temptation for students to engage in off-task activities. This latter issue may also be a symptom of a more general issue with some students preferring the anonymity of a traditional lecture that allows them to engage in activities other than participating in the class (Duncan, 2005; Mazur, 1998).

In the New Zealand context, despite significant growth in access to computers and wireless internet access, students tend not to own portable devices such as PDAs and laptops (Barnes & Scornavacca, 2005). The preferred mobile communication device is undoubtedly the mobile phone (InfoSynch World, 2004). As with most of the world, mobile phone ownership and the use of short message service (SMS) communication has rocketed up over the past five years (Scornavacca & McKenzie, 2006). Mobile phones are regarded as essential devices by the student demographic and have the advantages of being familiar, permanently configured to work correctly, and battery lives generally measured in days rather than hours (Gopal & Tripathi, 2006; Scornavacca, Barnes, & Huff, 2006).

The potential advantages of mobile phones as educational devices enabling a form of mobile learning or m-learning outside of the physical classroom are well described in the literature (Quinn, 2000). Generally these have been aimed at the mobile professional, engaging in informal or on-demand learning but there are examples built around more formal e-learning settings such as the linking of web discussions to mobile phones via filters and triggers. In one of the few examples of classroom use of mobile phones, Markett et al. (2006) describes the use of SMS to collect text in the form of a semi-structured discussion during class that can then be continued in a more traditional web-based discussion afterwards. Sadly however, the problems caused by disruptive mobile phone use have more often led to the banning of mobile phones in classrooms and the use of jamming equipment. This can lead to unusual solutions such as that of Bollen, Eimler, & Hoppe (2004) who reported the development of an SMS-like system on PDAs in order to avoid restrictions on using mobile phones in class.

### **3. The TXT-2-LRN System**

The development of the TXT-2-LRN (text-to-learn) system is based on the assumption that nowadays most students have a SMS enabled mobile phone and that they bring it to the classroom. Therefore most of the necessary ICT infrastructure for a classroom interaction system is already in place. In order to take advantage of this opportunity it was necessary to enable the instructor to receive messages from students while lecturing. A very simple solution was developed: it comprises of a

mobile phone connected to the instructor's laptop and the installation of a SMS management tool (SMS Studio). An alternative to this set-up would be using an SMS-gateway instead of the phone. The SMS software enables the instructor to easily read incoming SMS messages on the computer screen as well as automatically analyze the results of polls. In addition, it also allows the instructor to send messages to any mobile phone. Figure 1 presents a diagram of the system's basic infrastructure:

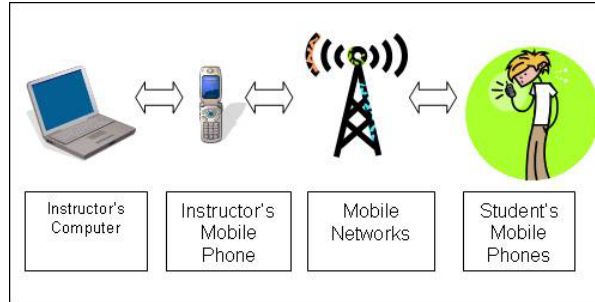


Figure 1: TXT-2-LRN Infrastructure

Based on the literature review described above, two new classroom dynamics were designed:

*Open Channel:* it allows students to send questions or comments to the instructor's laptop via SMS without interrupting the class. The instructor is able to read the messages on the laptop screen and decide whether and when to comment on the message received. Replies to questions that were not addressed during class could then be supplied by the instructor afterwards via SMS or a traditional discussion forum.

*M-quiz.* During the class, the instructor presents a slide containing a question related to the topic, with four possible responses (A, B, C, D). Students discuss the question and then use their mobile phones to select an answer. A real-time graphic display showing the aggregated results can be displayed on the main screen. This feature is used mainly for concept tests (Mazur, 1998) or to trigger class discussions.

Figure 2 presents an overview of the classroom activities using the system. Notice that in the beginning of each lecture a slide was presented reminding students that if they have a question or comment they may raise their hand or send an SMS. The instructor's mobile phone number also appeared in a corner of all remaining presentation slides. The interactive quiz (M-quiz) happened only once per lecture and students were invited to discuss their answers with the people next to them before casting their votes. In addition, students were informed that by sending a message their mobile phone number would be disclosed, however their identity would remain anonymous.



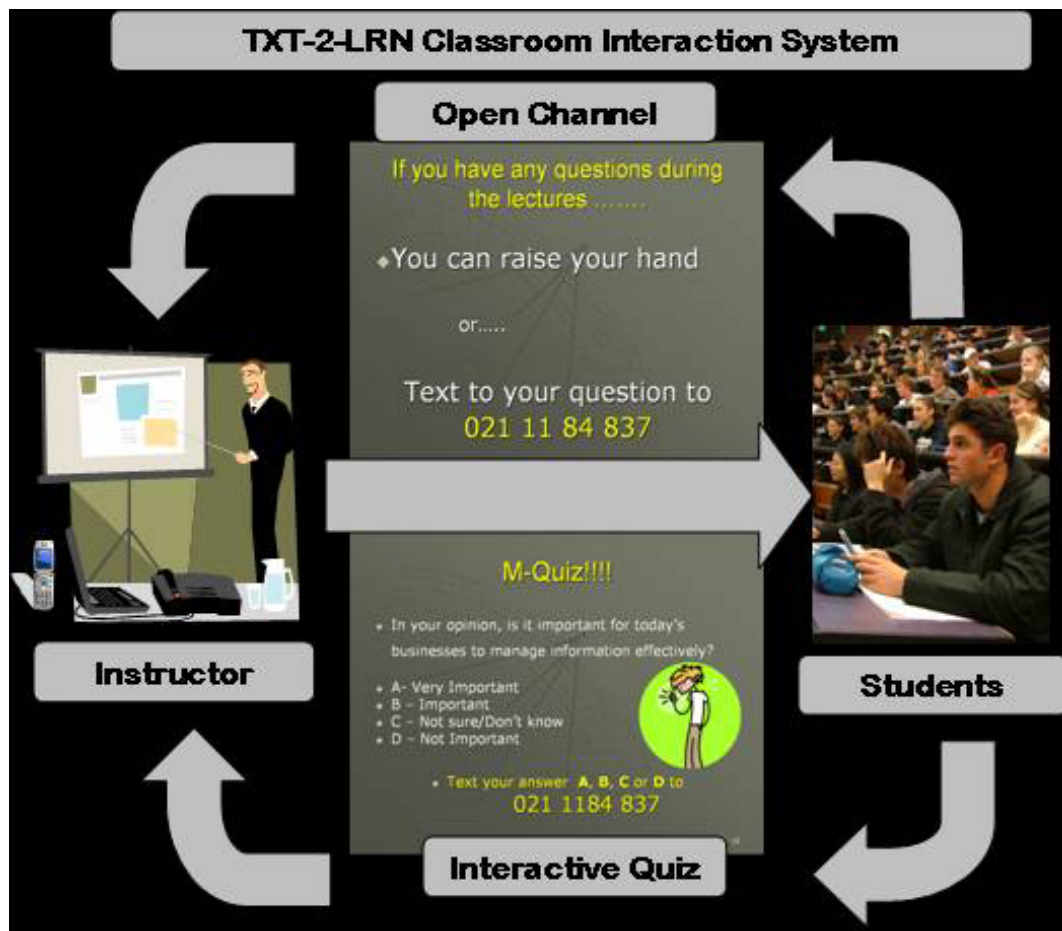


Figure 2: TXT-2-LRN Classroom Interaction

#### 4. Using TXT-2-LRN in the Classroom

FCOM110 is a mandatory course for all Bachelor of Commerce and Administration (BCA) students, which introduces them to the major areas of study of the Faculty of Commerce at Victoria University of Wellington, New Zealand. There are about 1,200 students enrolled in this course - making one of the largest cohorts in the university. One-hour lectures were delivered three times a week to four groups of approximately 300 students. During the five lectures on information technology, students were introduced to the TXT-2-LRN system and actively encouraged to use their mobile phones in class. During the trial, using the system was voluntary and students paid for their own messages.

Approximately a quarter of the students used the open channel to send a question or comment in classes. Figure 3 presents how students' messages were displayed on the instructor's laptop.

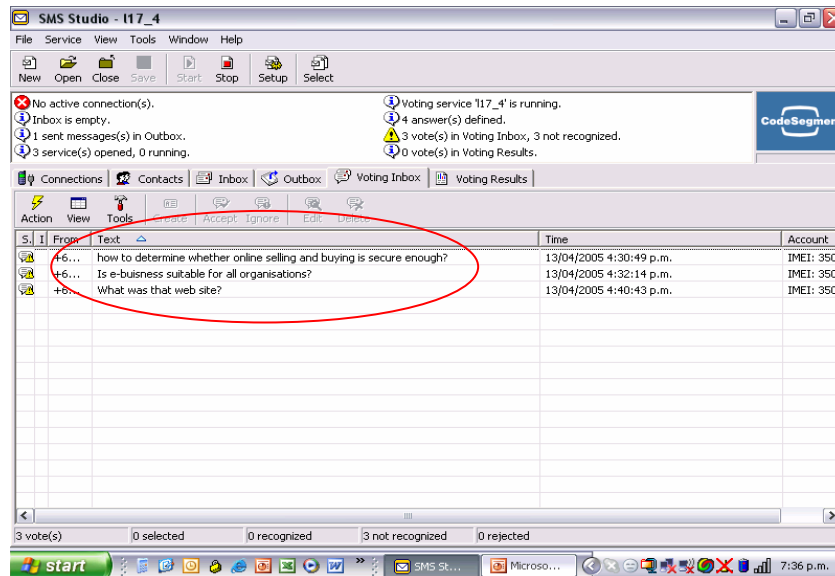


Figure 3: Screenshot - Open Channel

During the trial, approximately a quarter of the students used the open channel to send a question or comment in classes. The instructor involved in the trial had a very positive experience using the system and perceived a notable increase in quality and quantity of student feedback during class. In addition, the number of comments and questions received via the system (about 15 per class) was valuable without being disruptive. Approximately 130 students at some point during the five lectures actively contributed with comments and questions. That is a substantial improvement for this large class environment where students are normally passive listeners.

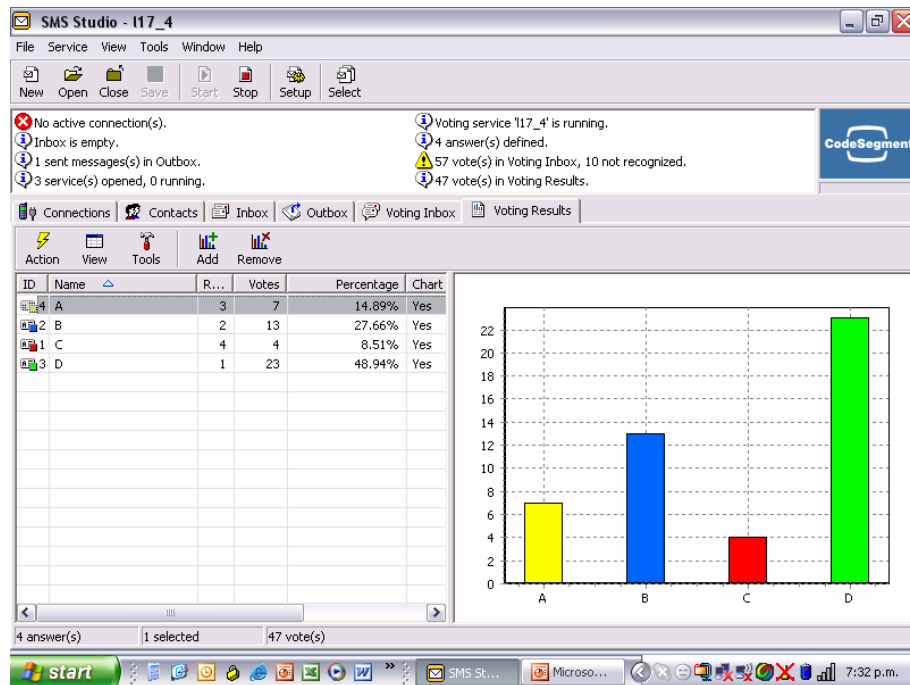


Figure 4: Screenshot – M-Quiz

Participation in m-quizzes was higher than use of the open channel: more than half of the students took part in at least one m-quiz. The instructor noticed that m-quizzes provided several benefits, including instantaneous feedback on concept tests or using m-quiz results to stimulate class discussion. It was also noticed that students seemed to be very interested in the result of polls that reflected their collective opinion on a given issue.

Figure 4 presents how the M-quiz results were displayed on the instructor's laptop – a separate screen containing only the graph was displayed to the students (using the projector). Overall, the participation levels were constant during the course of the five lecturers.

## 5. Conclusions

The rapid proliferation of mobile phones among the student population is generating a novel platform for the development of classroom interaction systems. This paper described the development of a SMS-based classroom interaction system.

The additional channel of communication in the classroom can be beneficial to students and instructors. The lecturer perceived a gain of quality and quantity of feedback from the students - making classes more interesting and interactive. The “open channel” was found to be an especially useful method of communication, in comparison to the traditional “raising hands” method of asking questions. Overall, the main inhibitor for adoption of SMS in the classroom seems to be cost of text messages. However, recent changes in the pricing structures offered for SMS services should see this barrier further reduced, increasing the usage of the system in the classroom.

Further research should be undertaken regarding students' performance and learning outcomes versus use of the system as well. It also would be interesting to use such system in different contexts and disciplines. In addition, activities outside the classroom should be investigated in order to extend the boundaries of the classroom through mobile technologies.

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# MLEARNING AND THE WORKPLACE LEARNER: INTEGRATING MLEARNING EPORTFOLIOS WITH MOODLE

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This paper reports on trials undertaken at CPIT to set up a support system for workplace based learning. A mlearning programme involves the use of a text messaging to disseminate summative and formative assessments. The use of mobile phones to take photos, videos, audio and text evidence of workplace skills being acquired to compile an eportfolio are also part of the trials. Evidence will be stored on Web 2.0 applications / personal portals and accessed by students via a course site set up using the content management system, Moodle.

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## **1 Introduction**

This paper reports on a series of trials that have taken place at CPIT in 2005 and 2006 and are still on-going. These trials are undertaken to put in place a mLearning based blended distance learning and support programme. The trials test out a range of opportunities presented by an ever growing range of Web 2.0 applications that are also accessible using mobile phones. In 2007, CPIT will pilot the mLearning programme with a cohort of baking apprentices.

The paper will first begin with a short overview of the context in which the trials are taking place. Then a literature review and discussion will be undertaken into why we are using mobile phones along with Web 2.0 applications to deliver the mLearning programme. A short introduction to ePortfolios is also included to provide background on the promise that ePortfolios can provide in recognising skills and knowledge attainment in workplace based settings. Trials undertaken to evaluate various Web 2.0 applications and how we have been able to bring them into the CPIT content management system (CMS), Moodle are then described and discussed.

## **2 Overview**

Bakery training has been taking place at CPIT since the early 1970s. In the mid 1990s, bakery qualifications moved from Trade Certificate Qualifications into the competency based National Certificates based on unit standards governed by the New Zealand Qualifications Authority (NZQA). The Industry Training Organisation (ITO) that looks after baking training is Competenz. In 2004, Competenz began a review of the National Certificates in Baking so that new National Qualifications at levels 2, 3 and 4 are now registered on the NZQA framework. One of the aspects of restructuring the qualifications was to allow providers (CPIT is one of 3 providers for off-job training to the baking industry) to provide a 'total' package to bakery apprentices so that bakers did not have to undertake workplace assessments in the workplace. This means that providers will need to assess workplace based competency of apprentices along with providing for block and correspondence course training.

CPIT is based in the South Island but the majority of apprentices who attend block courses at CPIT are from the North Island. A distance learning / assessment process needs to be put in place in order for CPIT to provide the 'total' package. Informal surveys of bakery apprentices over the last five years reveal that computer ownership and access has remained at 15%. However, all apprentices surveyed in the last three years own mobile phones. Therefore, mLearning has been chosen as the method to be used to complete the following:-

1. Course content for theory of baking courses delivered to apprentices on hard copy.
2. Theory of baking courses supported using mobile phones via voice and text messaging (SMS).
3. All formative / summative assessments for theory of baking and the written part of workplace based competencies to be delivered & answers collected via SMS.
4. Evidence gathering to form ePortfolios using mobile phone to take photos or videos and posted on photo collation applications on the web.
5. CPIT learning management system (LMS) accessed by mobile phone for students to check on their ePortfolio collection.
6. Collation and reflection on their ePortfolio to be completed when the apprentice comes to CPIT for their yearly block courses.

### **3 Literature Review**

#### **3.1 Why are we using mobile phones?**

There are an estimated 2 billion mobile phones in the world today (Dennis, T. 2005). In 2003, there were 2,825,000 (66% of the population) mobile phone subscriptions in New Zealand (Petrova, 2005). Young people have embraced mobile phone ownership and the mobile phone is seen as an essential accessory to maintaining an active social life.

Apprentice bakers are starting out on their careers, purchasing computer equipment and paying for internet access is often something that is not the most important priority in their young lives. One of our first mLearning trials (Chan, S. 2005b) was to use eTXT<sup>TM</sup>, a bulk text messaging system provided by New Zealand Telecom, to disseminate questions and archive answers to the questions. This trial revealed that response to the text messaging was 100% return within 2 hours of the questions being texted out. Therefore, CPIT has made a commitment to investigate ways in which the mobile phone could be made use of for better student support and improved learning opportunities.

The ease of contact with workplace learners is enhanced via mobile phone contact. This leads to better rapport between tutors and learners. Using mobile phones and the Web 2.0 applications available online provides workplace based learners with the opportunity to connect, create, collaborate and network. The principles outlined by the work of Brown (2002) with his treatise on how the 'web' has changed the way people work and learn and Siemens' (2005) connectivism learning theory have been pivotal in our work on blending cognitive apprenticeship models of learning (Brown,

Collins and Duguid, 1989) to distance learning contexts. (Chan, 2005a) The mobile phone is therefore another conduit that we are now making use of to enhance student / tutor interaction.

### **3.2 Why are we using Web 2.0 applications?**

O' Reilly (2005) provides a good introduction to "what is Web 2.0". Alexander (2006) presents a summary and discussion of the use of Web 2.0 in teaching and learning. Web 2.0 emphasises the use of the web as a platform for 'social software'. Users of the software generate the content that is hosted on various Web 2.0 applications. Files that are archived on Web 2.0 applications are stored on the servers of the companies that provide the applications. Access to Web 2.0 sites is therefore possible as long as there is the ability to access the internet. Accessing the web via mobile phones is now almost main stream although the cost is still considerably higher when compared to access from a networked desktop personal computer.

There are many applications that bring together aspects of blogging and WIKIs on to sites like MySpace, Bebo and Windows live that provide the options for archiving, tagging, organising and showcasing photos, videos, audio files and mp3 collections. These collections can then be shared with friends by providing them with the URL of the site with private sites being accessed via the URL and the entry of a password. Sharing of the contents within these sites is enhanced by the seamless way in which these sites also provide for internet relay chat (IRC) or email or even for SMS. These conglomerate sites are the ones most useful for use as a base for forming ePortfolios. At the moment, the use of these sites attracts no charge and this makes them an attractive option for educational purposes.

In our trials, we used Flickr and Filemobile as the sites to which photos taken on a mobile phone would be archived. Videos can be emailed using the mobile phone to YouTube or Metacafe. Springdoo provides the possibility of recording and sending voice messages to email. These applications are used as sites for evidence to be easily collected and stored. We are also using Web 2.0 applications to bring the evidence from stored at various web sites into one area, these are now discussed in the next section on ePortfolios.

### **3.3 The role of ePortfolios in workplace based learning**

Portfolios of student work to be used for assessment purposes have been around for a long time. Going back just a few hundred years, traditional craft apprentices would have to complete a 'master piece' in order to complete their apprenticeship and enter the ranks of master craftsmen. This 'masterpiece' would often be a product supported with sketches, drawings and sometimes written descriptions of how the product was designed and manufactured. Therefore the concept of using a portfolio to track a learner's journey from novice to practitioner is not a new one.

ePortfolios are a way of digitally storing the evidence of a learner's skill and knowledge acquisition. They can be used to collect evidence to support competency based assessments and can often then be used to showcase a learner's achievement. There are different levels of ePortfolios (Love, McKean and & Gathercool, 2004),

- Level 1 basically revolves around a scrapbook concept

- level 2 provides more structure to bring it up to curriculum vitae status
- The authors argue that a true web folio begins at level 3 whereby there is the ability for both the student and faculty to put together a working portfolio that showcases the student's work.
- Level 4 opens the web folio up to feedback from other parties that may include the student's families, employers (current and potential), various mentors and the faculty.
- At level 5, the web folio becomes an authentic / authoritative evidence that links the contents of the folio to standards, programmes and "other descriptors including higher order taxonomies."

It is therefore important in our ePortfolio project, to avoid becoming stuck at level 1 or 2 with a 'show and tell' ePortfolio. Instead, the construction of the ePortfolio itself should involve input from the apprentice in selecting, archiving, describing and preparing material for inclusion in their ePortfolio. The process will also require the apprentice to think about their skill / knowledge acquisition process when they link the evidence they have collected with the standards and learning outcomes expected. Apprentices will also need to be encouraged to provide backup text / audio descriptions of the photos / videos that they have selected so that meta-cognition is encouraged with regards to the ePortfolio construction process. The provision of an easy to use, fully mobile phone accessible interface to support this process is therefore an important part of this project.

Barrett (ongoing) provides a comprehensive web site that is a good resource for any educator embarking on working with ePortfolios. She has evaluated many generic (including word processors, slide display software, databases etc), off the shelf and open source software for their suitability for use as ePortfolio repositories and collators. Her work has directed us towards looking at the use of Web 2.0 applications for our work on setting up learning portfolios using mobile phones as the main evidence collection, collation and viewing tool.

We are currently in the process of trialling a number of personal portal 2.0 applications. These allow individuals to choose the type of items they would like to have on their own personal page. Many personal portals allow for the storage of photos, videos, blogs, music, address book, links, RSS feeds etc. The newer personal portals also provide links to other photo, video, blogging and music storage sites, so that an individual's page provides easy access to a range of digital media stored at various places on the net. The personal portals we have been trialling are Windows live, Pageflakes, Vox, Multiply and Freewebs.

## ***4 Description of project***

### **4.1 Trials of Web 2.0 applications and alignment with Moodle**

Virtual learning environments (VLEs) such as Moodle provide tutors and learners with a secure learning environment. They also provide tutors with a range of plug in modules like discussion boards and online chat with which to create a range of learning experiences. We are making use of Moodle as a secure 'aggregation' site so that students are able to access their evidence archives and personal portals along with



learning activities from one site. Moodle will also provide tutors with an administration site so that all students' work can be easily viewed and evaluated and learning activities can be built and distributed.

To date, a significant gap exists in the provision of learning modules that utilise the power and potential of mobile communication devices. This is largely due to the diversity of technologies that currently exist in the commercial telecom industry and the security features that VLEs and educational institutions employ.

The rise of third party services (Web 2.0) such as Flickr and YouTube which provide mobile access and can be simply integrated into VLEs such as Moodle provide a way of being able to integrate these technologies into mainstream educational use. The possibilities afforded by the combination of activity and resource modules provided with VLEs and Web 2.0 applications which are freely available on the world wide web has been an area our project has wholeheartedly embraced. The linking of Moodle with the possibilities offered by Web 2.0 applications provides a high degree of flexibility. This enhances the student learning experience by expanding the range of activities available, increasing the number of points of entry into the instructional material, enabling higher levels of student to student and tutor to student communication / collaboration and providing students and tutors with a personal space in which to collate and reflect on their learning. All of these modules and applications can be designated as publicly or privately accessible. The use of this form of 'mashing' provides a flexible & student centred learning environment at virtually no monetary cost.

We undertook searches using the search function within Moodle and with Google to see if anyone else was working on integrating Web 2.0 applications into Moodle for mLearning. We found several projects (Moodle discussion sites, 2005) but none that were working on a similar project that we were.

However, the above sites did provide us with input on how mobile accessible sites should be set out. These prompted us to work on optimising our Moodle entry page for easy download on to a mobile phone. Also, due to the cost of mobile web browsing, the page had to be kept lean and access to a student's Moodle page had to involve as few page downloads as possible.

Linking external web 2.0 applications to Moodle modules is very straightforward. The important aspect to note here is how to layout the Moodle page for ease of access via mobile phone and to ensure that mobile usability is enhanced at all times. Not all web 2.0 applications load up well for display on to a mobile phone screen. Some of the personal portal sites we have chosen to work with will only work with a Java enabled browser like Opera Mini. Allowing student access to their sites using a personal computer via Moodle, opens up better options for access. However, our long range goal is to have as much as possible of the ePortfolio evidence collection and collation completed using a mobile phone.

## **5 Discussion**

At CPIT, we have taken a pragmatic approach in making use of existing hardware and software that we have been able to source to make up our mLearning programme.

Our students all own mobile phones and we have found that SMS is an effective way of reaching out and maintaining contact with them. The web is now flooded with a range of applications that can be utilised by educators. These applications are free to use but often need some experimentation with in order to ensure that they fit in with the context and educational philosophies that they will be used within. In our evaluation of various web 2.0 applications, we have also been careful to only use sites that have a wide user base and have been accessible for some time. This ensures the longevity of these sites for sustained usage by our students. We are also continually evaluating a range of sites, so that newer, more mobile phone accessible sites can be continually sourced for our trials.

We have therefore made use of a tool that our students are familiar with using, combined it with web based applications that are available and brought these together for our students to form an ongoing ePortfolio of their workplace based competencies, skills and knowledge. All the disparate sites are hosted on a Moodle course with students being able to access their individual areas and the tutor able to see all of the students' work.

In line with our work on ePortfolios, discussion and reflections on our ongoing trials and our pilot for 2007 are archived on a [blog](#) (Chan, S. ongoing). This blog records our journey into mLearning and archives many resources, contacts and our learning about setting up ePortfolios for workplace learners using mobile phones. Our work is still in its early stages of implementation, but mLearning holds great promise in assisting workplace based / distance learners in recording their own learning journeys.

## **6 Conclusion**

Our work in aligning Moodle to our mLearning pilot project is progressing well. With the development of a 'clean' access page for mobile phones, download of Moodle on to mobile phones has become faster and less mobile phone platform dependent. We are continually on the lookout for Web 2.0 applications that are suitable for use as ePortfolio type repositories. Mobile access to many Web 2.0 applications has improved considerably over the last year or so. As both PDA / mobile phones and web 2.0 applications become more advanced, they become more accessible for use by educators. Problems with incompatibility of mobile phone models, operating systems and telecommunication providers become less pervasive. The future therefore looks very promising for the development of an easy to use mLearning / ePortfolio interface that is accessible using a mobile phone.

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# ANSWERING INDIVIDUAL PATIENT AND HEALTH PROFESSIONAL INFORMATION NEEDS UTILIZING A USER DRIVEN INNOVATION IN M- LEARNING

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The aim is to propose a learning solution to promote a user driven model of health care utilizing an M learning platform alongside the presently dominant expert driven approach. It is a qualitative proposal with description of present day expert driven medical learning structure and the need for a user driven M learning model with appropriate case illustrations. Average patient data, which occupies most of our present day information bases, is often unable to satisfy individual patient needs. In spite of the medical information base expanding unprecedented at present we still do not have that quality of information to satisfy a given individual patient to an optimal extent. We need an information base that can seamlessly integrate information needs of all categories of certain individual medical learners namely patients, medical students who are also health professionals with matching solutions offered by other individual medical learners who have already gone through the particular experience the other group needs. We need to have a medical learning database where patients and medical students/health care givers regularly key in their narrative logs into a suitable web-interfacing device. Presently PDAs (portable digital assistants) are the closest fit although in the near future it is expected to improve into something wearable with a more efficient input arrangement than the PDA stylus keyboard. This input would simulate a learning neural network with the input channeled to other individual users (with qualitative narrative analysis software to extract themes suggesting information needs from the individual users e-log input). Following this the network automatically would match each node's (individual user's) information needs through synapses (emails) and the output could be re-iterated several times via a back propagation algorithm to generate an optimal learning solution output.

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## **1 Introduction**

### **1.1. Defining the medical information user**

All humans are users of health care systems. If not the National Health Service (which is an external system) they may still be users of their own internal organ systems that have been generously provided with self-repairing capabilities.

In medicine information keeps expanding at a rate that is quite a challenge for all levels of medical learners. Information needs drive learning and we begin by identifying the various information needs of different human categories that desperately need to learn.

### **1.2. Categories of medical learners (potential users/consumers)**

*“In M-learning for E-health, there is no doctor or patient, only different categories of medical learners”.*

Category I (Patients and their relatives, primary care givers) All humans are potential physicians but only a few receive formal training.

Category II (Physicians/Health professionals, secondary care givers) they are formally trained real world healers who are generally looked upon by most humans as areas of support whenever their health systems are in trouble. In terms of learning needs they remain life long medical students (Biswas 2003).

Although a real life physician who remains a pillar of strength for any individual patient, need not be replaced as much as virtual life need not replace real life, the patient may still need to view his problem from multiple angles that his physician may not be expected to be even aware of.

The wisdom or expertise of a real world physician may be a manifestation of accumulated information input signals that have stabilized/optimized over the years. It may not be feasible for an expert physician to have an optimal solution to each and every individual patient need. At best s/he can provide an answer based on averaged patient outcome data.

There is no proof of the present top down subspecialty approach in medicine resulting in better outcome or patient satisfaction. (Loefler 2000). With rapid technological strides and shrinking tools of the trade, like an echo ultrasound scanner that may be soon incorporated into the mobile phone and the endoscope (fit for a sword swallower) getting replaced by the capsule with a videoendoscopy unit and with the advent of tele-robotic surgery it is no longer impossible for the individual physician-surgeon to learn and expand in a multidisciplinary approach rather than a small focused area.

Evidence based guidelines (that keep evolving with continued research) may continue to function as a good parameter at present to judge the validity of the information collected by the individual user driven by his needs.

Evidence based health care is a form of problem based learning applied to daily health care activities with a purported objective of meeting individual patient needs using the accumulated and growing epidemiological population based average patient outcome data. At present it fights a gradually losing battle to establish an absolute unchanging structure of medical truth that is generalized to all users on the basis of statistically averaged health outcomes from controlled trials.

*“So what is to become of us serious medical technocrats in this postmodern age where multiple versions of the truth abound?”* (Hodgkin, 1996)

Evidence based health care has brought validity to modern medicine, yet is limited by its inability to provide the whole picture. Every individual patient and health professional has multidimensional information needs that require fulfillment.

### **1.3. Present problem in M-learning in health care redefined-Why does all our information oversupply fail to satisfactorily answer the needs of a given individual patient or physician?**

Average patient data, which occupies most of our present day information bases, is often unable to satisfy individual patient needs. In spite of the medical information base expanding unprecedented at present we still do not have that quality of information to satisfy a given individual patient to an optimal extent.

To quote from an important article on information needs,

*“Thirdly, the questions are often complex and multidimensional.*

This is one of the BMJ editors addressing a similar problem almost 10 years back and we are trying to make some progress in identifying a solution to it now.

*They are often questions about both particular patients and different areas of medical knowledge--for example, "In an octogenarian with anemia, angina, and a history of transient ischemic attacks, with a normal creatinine, iron, and mean corpuscular volume, who refuses a bone marrow exam, what diagnostic and therapeutic options are there?"*

He presents in a single case, four different problems (including patient age) simply on clinical presentation alone, compounded by the fact that the patient doesn't want the kind of investigative and therapeutic options present day modern medicine has to offer.

*Fourthly, the need for information is often much more than a question about medical knowledge. Doctors are looking for guidance, psychological support, affirmation, commiseration, sympathy, judgment, and feedback. This "information need" is particularly poorly explored, and yet it may well be the most important need and the biggest stumbling block to a technical solution.*

*Fifthly, most of the questions generated in consultations go unanswered.* (Smith 1996)

#### **1.4. Seeking Solution: How then do we care for the multidimensional information needs every individual can generate? Does information technology offer a solution?**

We need an information base that can seamlessly integrate information needs of all categories of certain individual medical learners namely patients, medical students who are also health professionals with matching solutions offered by other individual medical learners who have already gone through the particular experience the other group needs.

We need to have a medical learning database where patients and medical students/health care givers regularly key in their narrative logs into a suitable web interfacing device (presently PDAs are the closest fit although in the near future it is expected to improve into something wearable with a more efficient input arrangement than the PDA stylus keyboard). The mobile phone may not only be a modern mirror that reflects our daily processes and the information needs generated from them but also a fairy tale one that answers most of our needs.

## 2 Sample M-learning environments

### 2.1 Prospective Case studies (Daily E-log samples)

These indicate narrative Informational needs as well as experiences at various levels of medical learning accumulated at various positions of the present author-physician-academic, spanning seven years and 3 teaching hospitals/institutions in 3 different countries (Nepal, India and Malaysia). The underlying theme is that the daily narrative data a patient, health care student/professional generates reflects both their information needs as well as information contribution (learning points) to the medical knowledge base.

These informational narratives may also answer the problem of complex multidimensional needs. Access to life experience information of one patient that finds a match in another patient can itself act as a sort of narrative therapy for that patient.

I shall just briefly illustrate my point with a recent example in my ward from a physician's E-log. There are many more extensive ones, which I have blogged for reference if necessary. (Biswas, 2007;5) More often they are just telegraphic information:

*5) Relooked Bed 11...student's request. 50 yr Male, Neph synd with DM, with diab foot dripping pus on the bed. No dressing since yesterday? ...Blood sugar values?*

*6) Bed 10 60 yr Male, collapsed suddenly, cirrhosis with end stage, didn't want to resuscitate but had to for protocol as we had missed out on the dnr earlier. Students had an exercise.*

This was a month back I think...can't be sure...time flies so fast on the daily ward rounds. Most of my E-logs remain unutilized. In fact I first started making e-logs on my PDA chiefly to identify my information needs as a physician before I gradually started realizing even patients had similar needs and we needed to have an integral solution for both.

### 2.2 Relevance of daily E logs to solve individual patient/health professional user needs:

*How the mobile learning environment proposed can help clinicians and patients obtain new narrative information from the new learning environment*

Around 70% of the information needs that the patient/ physician may identify from these personal logs goes unanswered due to lack of time (Smith, 1996).

The academic physician-consultant (author of these real log examples) had seen the diabetic man in slide 11, bed 11 earlier on his morning consultation rounds but he realized that this patient's blood sugar control had been overlooked only after a medical student requested him to have another re-look. He made a point in his mind to



inform this to his junior colleague, the medical officer who would remain in the wards (also at the same time making the telegraphic note about Bed 11 in his personal diary). Suddenly, at that point of time, Bed 10 collapsed and he had to participate in a CPR that was emotionally and physically draining and he was relieved to escape to the OPD for the day.

### ***3. Sharing and communicating valuable individual patient data***

If this data were on a web portal as soon as the physician entered it into his PDA, the data would have matched with his other colleague's data for the day regarding this particular patient (a kind of virtual hospital filing system). His junior colleague (Medical Officer/Senior Resident) doing just a file review on his PDA would have noticed the note and acted on the diabetic's blood sugars if it was high. Controlling it better may have benefited the wound more than the systemic antibiotics that he was already on (which had doubtful local benefit). This technology offering a convenient local solution to improving hospital communication among in house health professionals is evolving at present in many hospitals.

#### **3.1 Medical students as a vital force in E learning and improvement of patient care**

The government generally thinks that it spends a lot of money in Undergraduate Medical training perhaps as these student doctors apparently do not serve while they learn. However it is the medical student who has the time to listen in detail to their chosen individual patient (they do not have to see and are not responsible for all the ward patients unlike their overworked houseman/resident seniors). Medical student logs on their individual patients can be a vital source of detailed narrative data on individual patients which their consultant might often enjoy reading and also benefit from daily. The medical student who pulled the consultant to the bedside may as well have entered his thoughts about his patient on his PDA-elog that would have automatically been reviewed by the consultant or his Medical officer (Senior resident).

#### **3.2 Individual patient learning and communicating from global experiences**

In the present proposal we are looking at a global solution for all varieties of individual users. Perhaps a diabetic patient in another part of the world on keying his concerns about his own foot ulcer would find a match in this incident and could become aware of the need for better sugar control in his own situation and may remind his own physician about his increasing sugars (the emotional appeal in narratives may make for better patient learning?). Not that his/her physician is not knowledgeable but all physicians are erring and forgetful humans as much as all patients are potential physicians (of their own systems to begin with) and both parties can benefit continuing to learn from each other.

Most health care professionals/individual patients can generate a lot more variety of beneficial examples in shared e-logging in health care regularly maintaining their own daily process logs for which one may still have time as it is done on the job and the

information needs generated from these may be identified by web based user driven solutions.

#### **4. Manner in which proposed E health, M-learning solution may be used**

With improvement in technology these valuable data of daily processes generated by a given individual can be recorded and documented daily in web based archives. Once in the net there is technically feasible software already existing that can quickly extract themes from these individual process narratives. These themes can in turn represent individual users (patient, medical student, health professionals) information needs.

One just needs to send the above-mentioned case study narratives via gmail and notice the advertisements generated. The advertisements contain something relevant to the information needs posted in the mail and it is obvious that the software used by gmail is able to locate a few of the needs in the information content sent on the mail. Although a separate study can be done on how close gmail can itself get to successfully answer the information needs in daily elogs, we need not get into that as gmail/google obviously is far from providing it at present although one can't rule out a future possibility (Tang 2006)

Once information needs are identified another software/search engine could automatically collect the matching information available on the web from another individual patient/medical student health professional as well as any related top down evidence based information content and post it appropriately to the site/mail of the individual users concerned (with web links for detailed reading).

In this way any individual user feeding input into the net can receive automatic feedback that can grow as individual users for this web based solution grow as they keep feeding their own daily data. Growing feedback from multiple users would spur interest and learning in the identified area of need and can be strengthened by the user returning the feedback through email with more information or needs to the individuals sending him/her the initial feedback.

#### **5. Proposed solution and neural network learning**

The multidimensional learning proposed here is similar to a learning neural network not in physical-mathematical terms but in terms of qualitative analogy as you can see an attempt has been made to depict it pictorially in Fig 1.

The individual user (patient, care giver) input is automatically fed to multiple users (nodes) who may synapse with the initial user and other users (via web based matching, email) and finally the resultant learning output shall return to the initial user (by something qualitatively analogous to a back propagation algorithm for example when knowledge is shared with multiple users it keeps getting altered (which perhaps is a hidden layer process among the nodes) and this process may continue to reiterate till there is an optimal solution to the problem.

## **6. Important issues in proposed user driven M-learning**

Ethical and technical feasibility:

As the discussion on this has become extensive during the course of writing the article please follow this web link to read more: (Biswas 2007;7)

Present status of described approach

Each and every individual is the author of his own destiny (as well as his own web log) that reflects his life processes and decisions that can shape his future.

The present proposal is an attempt to help make those decisions  
*Bottom up knowledge translation and present day top down medical realities:*

How individual medical learners utilize their answered information needs would be the beginning of another process in continued bottom up development in health care positively complementing the present pedagogic top down approach that dominates current medical learning.

Let this bottom up, multidisciplinary, qualitative, web based solution at least make a beginning in helping to lessen the health care burden of present day top down, focused, quantitative, modern health care (before we can even think of more ambitious goals of a web solution changing the practice of medicine).

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## SESSION IV: CASE STUDIES II

*Podcasts as a supplement in tertiary education: An experiment with two computer science courses*, by T. Bell, A. Cockburn, A. Wingkvist, and R. Green

*M-support for nursing students in primary health care nursing*, by B. Mackay

*SmartChecker: Real time monitoring and tracking student's class attendance using wireless PDA*, by M. Mustafa, M. Yazid, and W. Aezwani

# PODCASTS AS A SUPPLEMENT IN TERTIARY EDUCATION: AN EXPERIMENT WITH TWO COMPUTER SCIENCE COURSES

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The current generation of undergraduate students are enthusiastic adopters of mobile technologies, and some of these technologies offers significant opportunities for broadening the times, places and manner that students study and learn. One of these is podcasting, which greatly eases distribution of content to portable devices, giving the students opportunity for anytime, anywhere learning. However, most educational podcasts do not take advantage of the potential of podcasting. In this paper we discuss the issues surrounding the use of podcasting for higher education. We report our experiences using podcasts to supplement two undergraduate Computer Science courses, and we provide tips for others considering the use of podcasts in education.

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## **1 Introduction**

Podcasting is an asynchronous mode of distributing multimedia files – “podcasts” – over the Internet using syndication feeds, for playback on portable devices and personal computers at the user’s convenience. It has much potential as a highly mobile learning tool, and yet almost all applications of podcasting in university education fail to exploit the potential as they simply broadcast lectures (which are visual and even kinesthetic experiences) as a podcast (which is primarily an audio experience). Some educational podcasts compensate for this by including images, video, and/or web links. However, we believe that there is value in creating audio-only podcasts that supplement the lectures, so that mobile learning can occur in a “hands-free, head-up” mobile situation to enable students to learn also during activities such as commuting.

Despite the audio-only limitation of podcasting, it is attractive for education because it potentially enables students to increase the number of hours of studying without necessarily having to remove something from their schedule such as doing household chores, or exercising. And although we advocate a supplement to lectures, the time required to prepare the extra material in such a podcast need not be too demanding on the lecturer. There are some restrictions on what is possible with mobile podcast listening: the student is not likely to be able to take notes or look up references. A related issue is that it can be difficult to elicit a response because the user may not be in a position to use email or even send a SMS message at the time they are listening, and are likely to forget to do it when they have the opportunity later.

In this paper we review the ways that audio podcasting might be used in an educational setting, particularly in a tertiary environment. We also report the results of

experimenting with podcasting as a supplement to two first-year Computer Science courses with approximately 150 and 250 students respectively.

## **2 Podcasting**

The normal process for podcasting is that a content provider (podcaster) will make the files available on the Internet via an RSS (Really Simple Syndication) feed, to which the audience subscribes using aggregation software (a podcatcher). When a new podcast is published, it can be automatically uploaded to their portable device and hence they can listen to it at their convenience. Normally subscriptions are free, and there are no direct costs for listening to podcasts. Podcasts are typically provided in a heavily compressed MP3 format and can be played on a wide variety of devices, many of which are available inexpensively. Students are likely to already own something suitable. In addition, any desktop computer with Internet access is bound to be able to play a podcast, which means that owning a portable player isn't essential.

Podcasting is a relatively recent phenomenon; the first RSS audio feeds appeared in July 2003 (Doyle 2005) and by mid-2005 there were approximately 10,000 different podcasts available on a wide range of topics. In June 2005 Apple added podcasting to their free "iTunes" program, and this provided a surge of interest – within two days Apple announced that a million podcast subscriptions had been made. In December 2005 the editors of the New Oxford American Dictionary announced "podcasting" to be the word of the year and it appeared in the dictionary in 2006. Many podcasts have irregular and/or very limited followings, but some have hundreds of thousands of downloads of each episode. Their content and frequency is diverse, from hourly 3-minute newscasts, through daily 20 minute commentaries, to weekly one-hour in-depth discussions. Free software is also available for podcast creation, and there is also a lot of material on the Internet (including in podcasts) explaining how to make your own podcast. For users with an Internet connection, a desktop computer with a soundcard, and a relatively inexpensive microphone, the main additional cost to produce a podcast will be a relatively small fee required to have the files hosted on a server with a plan designed for the large number of downloads that podcasts can get, such as "Liberated Syndication" (<http://libsyn.com>).

## **3 Using podcasts in education**

A key benefit of podcasting is that it enables students to listen to course related material while they are engaged in other activities. In the past a highly motivated student might have used such time for revision of their lecture notes, or reading literature references, but the use of digital media players provides a level of portability and ease of file transfer that has not previously been feasible. Also, the use of a feed such as RSS coupled with an aggregator such as iTunes means that the material can be pushed onto the student's portable device. By having files pushed like this, users are more likely to listen to them because they need not remember to carry out an explicit download.

The medium does have disadvantages, such as the lack of visual content, the difficulty of taking notes, and the divided attention of the listener between environmental distractions and the material on the podcast. Also, the material will be of most benefit to auditory learners, and does not appeal to all students. Despite these limitations, there are many opportunities for using podcasts as a supplement while giving a course. You can use them to give out news and updates, answering questions sent in (for example by email), and/or give general feedback to students. Another possibility

would be to highlight the key points you stated in class and have extended discussion about them, and/or conducting interviews with external people adding or reinforcing the material addressed. Podcasts is also a way of providing hands-free instructions to students conducting laboratory work or using different computer programs. In addition we can imagine letting students do project reports using podcast as they develop good oral skills and share their experience with the others. In the wider educational setting podcasting could be used for recruiting and marketing, recording meetings and conference talks, and broadcasting for specific groups such as alumni, sports teams, or cultural groups.

Despite this rich range of potential applications, currently the most common approach to podcasting at universities is to provide the students with the traditional lectures as a podcast. This does have some value, giving them a second, or first if they missed it, chance to listen to it, which is particularly appreciated by students whose first language is not English. In many cases it also means that people outside the university community can benefit from having access to the lectures. However, this does not represent a major advantage over existing lecture recording systems that publish the audio or even video on the web.

#### **4 Podcasts at other institutions**

A number of institutions have started to offer podcasts. Duke University's "Duke Digital Initiative" was one of the first institutional experiments with ubiquitous portable audio devices, when in August 2004 all of the first-year students were given a 20G iPod to use as a learning tool (Duke University 2005). The intention was to facilitate innovative use of technology on Campus. Applications that emerged included course content dissemination, classroom recordings, field recording, study support and, file storage and transfer. The students found the iPods useful for study support by using them for repeated listening, audio books, going over rehearsals (drama and music), and vocabulary lists. However, there were relatively few Podcasts (three podcasts were reported after the first year), and it appears that the major educational use was more student-driven: 60% of students reported using their iPod for recording material, and 28% for music and hard drive storage. A total of 75% reported using it to support their learning.

A number of universities have started making some of their lectures available to the general public through podcasting. For example, Harvard is into the second year of podcasting their course "Computer Science E-1, Understanding Computers and the Internet" (<http://www.fas.harvard.edu/~cscie1/>), and it has many followers – it has appeared in iTunes' top 100 Podcasts. Berkley University has among 30 faculty members who have agreed to clip on a microphone in class so that their courses' audio can be recorded and then posted online (<http://itunes.berkeley.edu/>). Princeton University's University Channel (<http://uc.princeton.edu>) let different universities contribute recordings of lectures, seminars, panels and interviews to a virtual pool of academic content under their own name.

The public podcasts of lectures allow anyone to sit in ("audit") a course, albeit without the full student experience. Access to these lectures in a mobile environment is valuable for the casual listener, and particularly for other educators who can pick up pedagogical ideas by listening to another teacher at work. This open-source ethos is to be applauded, and reinforces the idea that institutions should control qualifications, not the knowledge itself. It can also improve the quality of the education since the

teacher is exposing their teaching to such a wide audience, increasing the opportunity for feedback.

University of Southern California had two 2006 spring courses with lecture podcasts being evaluated and according to Wolff (2006) the outcome was positive in both cases. However the reasons differed as one course had a large number of students for whom English is a second language who listened to the whole lectures again, while the participants of the other course valued having the recording to replay specific explanations to understand difficult material.

From an online survey for the podcast pilot in 2005 at University of Washington, Lane (2006) reported that 70% of the students found that podcasts supported their learning and to be helpful when preparing for homework and exams. The response rate was low, 41 out of 148 enrolled students completed the voluntary survey, but can indicate the perceived value of podcasts. Interestingly, 81% of students used a desktop computer rather than a portable player to listen to their podcasts. It appears that when listening to a lecture podcast, it is valuable to sit at a desk and use notes and handouts, in which case a desktop computer provides a better interface for listening to audio than a portable device. This reinforces our contention that simply podcasting lectures does not take full advantage of the potential of podcasts to facilitate mobile learning, and for this application learning may be better facilitated by using tools such as the Audio Notebook (Stifelman *et. al.* 2001) and AudioGraph (Jesshope, 1999), which provide a richer capture of the lecture.

Furthermore, making lectures available in a flexible manner can potentially inhibit learning. Students can postpone listening to lecture material indefinitely. In an earlier experiment with video-recorded lectures, we observed exactly this behaviour: once the video-lectures were made available, attendance at lectures dwindled because the students could catch up through the video at any time, but they never realised their intention to do so (Bell *et. al.* 2001). This is not likely to be a problem for motivated students (e.g. for mature students and/or professional courses which could benefit greatly from this mode of getting lecture material), but for less mature students we suggest structuring curriculum delivery in a way that encourages them to keep up with the class schedule.

## **5 Podcasting experiment**

To evaluate the potential of podcasts as supplementing lectures, we ran a podcasting experiment for two first-year Computer Science courses, COSC122 (algorithms) and COSC110 (“Working in a digital world”), at the University of Canterbury, New Zealand. Approximately 150 and 250 students were enrolled in the courses respectively. We released weekly podcasts that *supplemented* the lectures rather than record them in their entirety. We did, however, also provide three recorded lectures for each course, without announcing our intention to do so, to see whether students would take the opportunity to review the material.

At the start of the COSC110 we surveyed students to determine what sort of access they had to digital audio players, and if they had any experience with podcasts. We found that 64% of the students had a portable device, and that 82% regularly listen to audio on a computer. Those that had portable devices estimated that they spent an average of 7.6 hours per week listening to them, and 16% reported listening to them for 10 or more hours per week. The most popular situation for listening to them was while walking (33%), but other activities are popular too, including on the bus and in



the car (21% each), while exercising (15%) and on a bike (10%). Only 13% of the students had listened to a podcast before, and only 3 students in the class reported listening to podcasts daily. This is likely a reflection of the lack of adoption of podcasting in New Zealand due to relatively high charges for Internet use. Despite the lack of experience with podcasts, 87% of the students reported that they intended to listen to the first podcast.

The initial survey also asked students to report their level of interest (5-point Likert scale from 1 for not interested to 5 for very interested) for three types of material in the podcast. The number of students showing an interest level of 4 or 5 (i.e. more than neutral) was 50% for recordings of lectures, 72% for summaries and extra information, and 65% for topical issues relating to the course, indicating a student preference for the supplements, although the inevitable demand for re-runs of lectures.

Both courses were given weekly podcasts. The COSC122 podcasts were about 20 minutes long, with one presenter, while the COSC110 podcasts used two presenters, and ranged from 15 minutes to almost one hour. The entire fourth podcast of COSC122 is accessible as an example at [www.cosc.canterbury.ac.nz/tim.bell/podcastExample.mp3](http://www.cosc.canterbury.ac.nz/tim.bell/podcastExample.mp3). The COSC110 podcast was made available to the public through <http://uccsse.libsyn.com/>. For both podcasts, the general format was to review the material from the past week, discuss topics coming up later in the course, remind students about any deadlines and provide discussion about current topics, especially if they related to current events. Each COSC122 podcast had a competition with a small prize to encourage students to email in their comments. In one of the COSC122 podcasts a section of the course text book was read aloud (with some additional commentary).

The podcasts were recorded using digital audio editing software, with a studio microphone. Off-site interviews were recorded with a portable digital audio recorder, although there are many other devices including mobile phones, laptops and digital cameras that could be used for this. A theme tune was used to add interest, provide context, and give personality to the podcast. It was also useful for covering background noises such as pages being shuffled. Interviews were edited into the podcast – in fact, many of the COSC110 interviews were recorded as one of the authors traveled around the world, which demonstrated truly mobile teaching with several interviews recorded on a conference on a ship on the Yangtze river, as well as commentaries recorded while waiting at airports. Although intricate editing is possible with the software we were using, the podcast genre typically has a “live” style, with minor glitches left in the recording. Recording in one take makes creating the podcast much less effort, and gives a personal and dynamic feel to the episode. Podcast recording software such as “Castblaster” and “PodProducer” assume this one-take mode of operation, whereas editing systems such as “Audacity” and “Garageband” encourage the podcaster to edit the content. We found that interviewees were often a little nervous as it was a new experience, and in these cases the offer to edit out any hiccups was greatly appreciated. Generally very little editing was needed once the interview got underway.

For COSC122 we were able to compare actual downloads with the students’ expectations in their survey. Unfortunately in the first week of term a major server crash occurred that made access to the podcasts very difficult for students. However, in the second week when the system was working properly, the second podcast was downloaded 69 times, which compares favourably to the 87 students who said they

intended to download it, although it represents just under a half of the class, and we were unable to count unique downloads. The three lectures were downloaded 37, 33 and 33 times each, which is under half the download counts for the first five podcasts (50, 76, 35 (missing data in the logs), 79 and 73).

The COSC110 podcast was made available to the outside world through iTunes, and the number of downloads often exceeded the number of students in the class. Feedback from outside listeners included one ex-student who was using the podcast to catch up with developments since they took the course.

**Feedback and Summary Questionnaire:** We were keen to receive feedback from the students to gauge the podcasts' effectiveness and to help us tailor future podcasts to better suit their needs and desires. We tried a variety of techniques to encourage feedback, including a draw for free coffee for students who emailed or text-messaged us to say they had listened. Response rates to the draw were very low, with only two to five responses per week, but low response rates are a known phenomenon for podcasts, even when they are heavily downloaded. One explanation for the low response rates is that listeners are often occupied with other activities (such as walking, cycling and driving) making it inconvenient to respond on impulse. The few responses we did receive were generally positive. Giving answers to student questions in the podcast was well received, and the summaries and extra information seemed to be the most valuable. Reading from the text book drew one unfavourable comment despite it representing a genuine time-saving for students who intended to read the text anyway. Some students asked for all lectures to be made available, although we chose not to for the reasons given earlier. Some students worried about the cost of downloads, although in fact we had set it up so that it would be free.

After five weeks of podcasting COSC122 (including the three sample recorded lectures), we administered a questionnaire in a regular lecture to gain insights into the extent of use of the podcasts, the students' on-going intentions, and their perceptions of the podcasts they had listened to. 56 completed surveys were returned --- approximately 38% of the class. Of those, 37 (66%) reported that they had not downloaded any of the podcasts. The most common reason given for not downloading the material was that they "still plan to" (16), and that they had problems accessing the podcasts from home (13). Four stated that they "were not interested", five stated that they forgot, and six stated they had "technical problems". This suggests that if we overcame technical problems and made it easier for students to remember to download then the number who used the podcasts could more than double, and the majority of the class would be listening to podcasts. This is likely to be the case as the technology matures.

Nineteen participants (34% of responses) stated that they had downloaded some or all of the podcasts. Of the five podcasts, most people listened to all of the material, except for podcast 2, which had a higher 'switch off' rate. This is unsurprising as podcast 2 included the relatively long (8 minutes) reading from the text book; but it shows that students' tolerance for "dull" podcast material is relatively low.

We asked five questions regarding the problems that they had encountered with the podcasts, again rated on a five-point Likert scale from 1 (major problem) to 5 (no problem): remembering to download, remembering to listen, quality of audio, finding a device and getting distracted. Of these, remembering to download was the biggest problem (mean 3.5, s.d. 1.5), followed by getting distracted (mean 3.7, s.d. 1.2) and remembering to listen (mean 3.9, s.d. 1.0). Neither quality of the audio (mean 4.7, s.d.

0.6) nor finding a device (mean 4.4, s.d. 1.2) appeared to be a major problem for these respondents who had successfully accessed the recordings. The relatively high problem rating for getting distracted is a concern, particularly because students may be listening to the lectures while carrying out activities such as cycling and driving.

The COSC110 class used a different format, with a 2-person discussion which usually went for 30 to 60 minutes. Informal feedback from students indicated that this is too long for many, and that the podcast should be kept short and to the point.

It was clear from the feedback that there is a small but significant group of students who have almost no interest in this mode of learning, but those that regularly used the podcasts the feedback was extremely positive, including comments such as “Great — keep it up!” and “Nice addition to study kit”.

## **6 Conclusions**

These experiments with podcasting indicate that it can be a low-effort and effective supplement, but not substitute, for traditional lecture-based courses. The students who used our podcasts greatly appreciated them, and many of those who had not yet accessed the recordings indicated that they thought it was potentially useful and interesting, and that they intended to access them “later”.

A number of suggestions for podcasts content are given earlier in the paper. In the light of our experience we offer the following tips for those considering using podcasts to supplement introductory undergraduate courses:

- Keep podcasts short and to the point – 15 minutes per week is probably about right for most students unless the podcast is expected as part of the contact time for the course.
- Use a system such as RSS to push the information out to students; this is likely to result in a higher uptake than if they students have to manually download the files.
- Be aggressive in overcoming technical problems at the start, such as making sure files are easy to download both on-campus and at home.
- Include motivating material in the podcasts such as interviews and topical news articles.
- Maintain a live feel to the podcasts, and inject personality. Recording the podcast with minimal editing dramatically reduces the work for the producer and creates a dynamic mood for the episode. Apart from the initial overhead of setting up the recording system and background music, the time taken to produce a podcast will not be much longer than the podcast itself.
- Do not be surprised or concerned about low response-rates to requests for feedback in the podcasts. This is a known phenomenon for the podcast medium. Based on our experience, podcasts seem to be an attractive tool to help engage students, build a class “culture”, and disseminate the important and fascinating problems that the discipline addresses.

If you are podcasting recordings of lectures, students are more likely to be listening to them in a non-mobile situation because of the length and to avoid the distractions of a mobile environment, in which case you should consider posting other course materials

online as most students will be at a personal computer and can make use of links to other references.

We hope that we will see more podcasts that supplement courses rather than just take audio content from lectures, as we believe that this adds considerable value, and need not be onerous to produce. This could range from a cognitively demanding podcast such as teaching a language, through to lighter material such as interviews with practitioners that can be followed despite the distractions present in a mobile environment, giving a good return to the student for a relatively small investment of time and effort.

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# M-SUPPORT FOR NURSING STUDENTS IN PRIMARY HEALTH CARE NURSING

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An M-Support Project was carried out by the Nursing Department at North Tec in Whangarei, New Zealand. The findings from the associated research indicate that m-support is an acceptable, cost-effective form of support to motivate, encourage and communicate with nursing students in primary health care clinical placements.

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## **1 Introduction**

The use of electronic and mobile technologies to support students in education settings is increasing. This paper describes a pilot project using short message service (SMS) to m-support nursing students in clinical placements. The associated research is also presented. According to James and Bailey (2002) m-support is the provision of support for the mobile student.

## **2 Background**

### **2.1 M-Support by SMS**

The use of SMS via cell phones is now an accepted part of everyday social communication. In New Zealand the ownership of cell phones is on the increase, especially in younger people. Census at School New Zealand (2005) states that 84% of 14 year old children who took part in their 2005 online survey owned their own cell phone. This was an increase of 25% from 2003. It is likely that this upward trend will continue.

In education mobile technology incorporating SMS is being used as a form of asynchronous communication with students. Some field experience demonstrates success in this area. Horstmanshof (2004) was successful in using SMS to develop a sense of connection and community with first year university students. Although there are limits to using SMS as a key form of support for students, research does suggest its importance in some situations (Gaskell & Mills, 2004). Nursing students in primary health care clinical are placed in a unique situation. It was anticipated that m-support through SMS would be beneficial to students; therefore a pilot was undertaken by the Nursing Department at North Tec during 2006.

### **2.2 North Tec**

North Tec (NT) is a rural polytechnic. Characteristics of the region served by NT include a higher percentage of Maori than the national average; a high level of socio-economic deprivation; a dispersed rural population with accessibility to services negatively influenced by geography and poor transport infrastructure. A key objective for North Tec is to reduce these barriers and increase access to education for students across Northland by promoting flexible learning development.

The use of technologies is also being increasingly used in nursing education to support student learning. The Nursing Department at North Tec is actively developing modules to promote flexibility (Institute of Technology and Polytechnics of New Zealand, 2005).

### **3 Primary Health Care Nursing**

The Primary Health Care Nursing Module was seen as a key target for m-support because of the nature of the clinical module. This module is offered to second year Bachelor of Nursing students. Student nurses are placed in a variety of clinical placements including General Practice; Public Health, Maori Health Provider, District Nurse and others. Students are mentored by nurses working for those organizations but are also supported by a North Tec nursing lecturer.

There are barriers to effective support of students in these placements. Geographical dispersion make it difficult to support students placed in rural areas. For example, it takes around 3 hours to travel from North Tec (Whangarei) to Kaitia one way. The nature of primary health care nursing also means that students are often out and about in the community. This makes communication and meetings between the lecturer and student difficult to arrange. In addition many placements such as medical centres are very busy and contacting the student by land line places extra pressures on staff and may interrupt patient care.

During the five week clinical block the lecturer facilitates student learning by supporting students in their formative work. This process is assisted by tutorials, formative activities including reflective work and one to one communication between lecturer and student. A student's summative assessment is on meeting clinical standards. The inclusion of e-learning promotes flexibility for students and the lecturer. An example of this is the student's ability to post reflective logs and complete reflective exercises on-line. These are then marked and comments posted for students to view. This process works very well.

### **4 The M-support Project**

The goal of the M-Support Project was to introduce a system which provided m-support for students enrolled in primary health care nursing through the SMS facility on cell phones. M-support introduces technology into the clinical environment to support nursing students which promotes flexibility beyond that offered through current e-learning resources.

#### **4.1 Considerations for the M-Support Project**

Several factors and assumptions were considered before this m-support project commenced:

- The personal nature of a cell phone means that it is usually close to the owner on a continuing basis and is not reliant on the location of the user.

- The SMS function can be utilized as an asynchronous form of communication with a student. The assumption based on previous experience (Horstmanhof, 2004) was that this could foster a sense of connectivity between the lecturer and student and facilitate a supportive learning environment.
- A key aspect of SMS in comparison to other uses of a cell phone is the cost. Currently this is 20cents or less per message.
- SMS can promote flexibility in communication for both students and their lecturer in time and place.
- Incorporating this technology into education moves what has essentially been a private and informal form of communication into a more public and formal context. The assumption was made that this might be a concern for students.
- Software has become available to support the SMS function on cell phones. The utilization of eTXT telecommunication technology provides an interface between institutional and personal technologies. ETXT and the SMS Composer software utilized for this project were those provided by Telecom (information on this technology is available at <http://www.telecom.co.nz>).

## **4.2 Project Details.**

This M-Support Project was piloted during 2006. M-support was provided through SMS to motivate, support and communicate with student nurses placed in a range of primary health care placements across Northland. Forty-one students took part in this project. Ages ranged from 18 to 56 years; the average age was 31 years.

The use of telecommunication technology facilitated this project. The software utilized is SMS composer. ETXT allows SMS communication from a personal computer to the student's cell phone. It combines email and text, to send messages to individuals or groups. A key advantage of eTXT is the ability to type on a computer key board without resorting to cumbersome texting on a phone keyboard. A student's response to an SMS message sent via eTXT, returns in email via Outlook. After loading the software an SMS function appears on the Outlook toolbar. If students are preloaded as a distribution list it is an easy matter to select this list through SMS composer, type a message and send out to students via eTXT. Messages of up to 160 characters are possible.

## **4.3 M-Support Criteria**

The value of the project was assessed by the extent to which 'm-support' criteria were achieved. For the purpose of this pilot and the associated research 'm-support' was defined and assessed through the following criteria:

1. Students reporting that it helped them to feel supported and that it motivated them in completing assigned work in their workbook.
2. Communication between lecturer and student was enhanced, including the scheduling of meetings.
3. Flexibility in communication (regardless of time and place) between lecturer and student was enhanced.
4. Students' acceptance of personal technology for communication between lecturer and student.
5. Cost was not prohibitive (within the resources of students and North Tec).

## **5. Research**

### **5.1 Methodology**

This study was informed by evaluation research in which the purpose is to assess the value of a program or service to its recipients (Casswell, 2003). A mixed method of survey research, quantitative data from eTXT and cell phone message history, and qualitative data from a lecturer's field notes was used to assess the value of the project.

### **5.2 Research Findings**

#### **Student Survey**

Thirty-one students returned questionnaires (76%). Likert scales were used to find out student perceptions of eight statements related to the M-Support Project (see Table 1.).

#### *Support, Motivation and Communication*

Five statements were around support, motivation and communication. It appeared that students did feel supported in their placement (strongly agree, 77%; agree, 20%). Slightly less strong agreement was obtained for the question about feeling motivated to complete assigned work as a result of m-support (strongly agree, 53%; agree 37%). There was strong agreement for statements around communication. Statements were about scheduling meetings (strongly agree, 71%; agree 29%), flexibility of communication (strongly agree, 77%; agree 23%) and communication in general (strongly agree, 68%; agree 29%) (see Table 1.).

#### *Student Comfort, Affordability for Students and Standard Support.*

The remaining statements posed to students were around comfort, affordability in future and the use of SMS as a standard form of support. One statement asked for students' perceptions of utilising personal technology (cell phones) in education. Students had to respond to a statement about feeling comfortable receiving texts on their personal cell phone. This statement obtained one of the most positive responses with most students in strong agreement (strongly agree, 77%; agree, 23%) (see Table 1.). This was a surprising result in view of the assumption that this could be an issue for students.



Table 1: Student perceptions of m-support.

Statements	Strongly Agree		Agree		Not Sure		Disagree		Strongly Disagree	
	N	%	n	%	n	%	n	%	n	%
Text messages from my lecturer helped me to feel supported by the lecturer during my clinical placement. n=30	23	77%	6	20%	1	3%	0	0	0	0
Text messages from my lecturer helped to motivate me to complete the assigned work in my workbook. n=30	16	53%	11	37%	2	7%	1	3%	0	0
Text messages between my lecturer and myself helped with scheduling face to face or phone interviews. n=31	22	71%	9	29%	0	0	0	0	0	0
Text messages helped the communication between my lecturer and myself. n=31	21	68%	9	29%	0	0	1	3%	0	0
Text messages promoted flexibility by enabling communication with my lecturer regardless of time and place. n=31	24	77%	7	23%	0	0	0	0	0	0
I feel comfortable receiving text messages from my lecturer on my personal cell phone. n=30	23	77%	7	23%	0	0	0	0	0	0
Text messaging should be introduced as a standard form of support for nurses in primary health care nursing placements. n=30	24	80%	3	10%	2	7%	0	0	1	3%
I could afford the financial cost of text message communication in other clinical placements. n=31	12	39%	8	26%	5	16%	1	3%	5	16%
<b>Total</b>	165	66%	60	26%	10	4%	3	1%	6	3%

It was perceived that the cost of texting could be an issue for students in future. Students were asked to respond to a statement about being able to afford the cost of text messaging. This statement obtained the most varied responses, although the majority of students were in agreement (strongly agree, 39%; agree 26%). In contrast to student perceptions, later analysis of messages demonstrated that the cost per student per clinical block is very low; less than two dollars per student.

A further statement elicited the students' perceptions of the usefulness of text messaging in future clinical placements. Students were asked to respond to a statement about introducing this type of support as standard practice. Ninety percent strongly agreed or agreed (see Table 1.). Overall, when all responses from students were considered it was apparent that they were very positive about the m-support project (strongly agree, 66%; agree 26%).

### Text Message History

Microsoft Outlook enabled text messages to be saved and later counted and analysed to determine the use, the nature and the cost of the SMS Messages. These included messages sent and received via eTXT or the clinical cell phone.

#### *Sent Messages to Students*

During the two clinical blocks in total 541 messages were sent out to students. The majority of messages were sent via eTXT from Outlook. The messages were often sent with text language to ensure messages remained within 160 characters. Three hundred and ninety-four (73%) were original messages. The remaining 147 (27%) were responses to student texts. Of the originals sent out to students 277 (70%) were sent as part of a group SMS message. Messages were counted and sorted into themes. The predominant themes in sent group messages were on motivating students to complete the formative work set out in their workbook (36%) or to attend and prepare for tutorial discussion (37%) (see Table 2.). However there were mixed themes in many messages.

Table 2: Sent SMS messages

Sent SMS Messages							
Originals to students		N=394 (73%)		Responses to students		N=147 (27%)	
Break down of originals to students							
Individual		n=117 (30%)		Group		n=277 (70%)	
Meet	Motivate	Support	Other	Motivate	Tutorial	Support	Other
100 (86%)	5 (4%)	7 (6%)	5 (4%)	100 (36%)	102 (37%)	16 (6%)	59 (21%)

The following are examples of a group message sent to students under the theme motivate but is also a mixed message. “R U settling in OK? This wk get to know routine & people. Do learning obj. Show wkbook 2 staff. Reply 2 this txt tell me how u r doing. ☺”. The predominant theme in individual messages was on arranging face to face meetings (86%) (see Table 2.). An example of an individual sent message under the theme of ‘meeting’ was “Got your care-plan, looks good. Can I come and see u tom Wed at 1230pm? ☺”.

#### *Received Messages from Students*

In total 236 messages were received from students. Eighty-eight percent of messages were in response to messages sent to them. These responses came through Microsoft Outlook via eTXT. The only original messages came via the clinical cell phone. The majority of messages received related to responses to messages regarding meetings (51%) with students or on their progress (22%) (see Table 3.).

Table 3: Received SMS messages

<b>Received SMS Messages N=236</b>				
<b>Clarify</b>	<b>Tutorial</b>	<b>Meeting</b>	<b>Progress</b>	<b>Other</b>
29 (12%)	18 (8%)	120 (51%)	53 (22%)	16 (7%)

Examples of student texts were “Just saw yr message, yea that sounds great I’ll c u at 3.30pm on Monday with my work.” Another example was “Thanks 4 ur inquiry. Am loving it. Wonderful. Removed stitches on 2 pts already n done dressings 2!”

#### *Costs of the SMS Project*

A costing exercise estimated the potential costs for future students and for North Tec. For the purpose of this costing exercise an assumption was made that students pay 20cents per text message. The average cost of participating in m-support was \$1.40 per student per clinical block. For NorthTec, a SMS message sent via eTXT costs 10 or 17 cents a message depending on the telephone carrier company. A breakdown of messages sent per student and eTXT fees (12 months) estimated the average cost for m-support at \$4.66 cents per student per clinical block. The costs of m-support appear to be within the resources of students and North Tec.

#### **Field Notes**

Ease of communication, flexibility and connectivity with students were the major themes arising from field notes. The major perception from the lecturer’s perspective was that of ‘ease of communication’. Messages sent via eTXT enabled contact to be initiated with students with ease via Microsoft Outlook using a preloaded list of students and a keyboard. Connectivity to students was enhanced. There was a feeling that each student felt like they were being contacted directly. There were also no qualms about contacting students knowing that there would be less interruption to the workplace or students work with clients”. The system also enabled flexible and efficient use of time. Work email could also be accessed and SMS messages sent from a home computer. The lecturer’s experience of m-support was very positive.

## **6 Discussion and Implications**

The findings of the research indicated a high level of success of the M-Support Project. There are indicators that it will continue to be acceptable for students and affordable for both students and North Tec despite students having concerns about cost.

Students did feel supported by the SMS messages and motivated to complete assigned work in the workbook. This supports the initial confidence in m-support from the field (Horstmanshof, 2004) and the literature (Gaskell & Mills, 2004). Communication with students was enhanced by the messages, especially regarding the scheduling of meetings. Flexibility in communication (regardless of time and place) for the lecturer and student was enhanced. Student acceptance of personal technology to aid communication was very high and cost was not a prohibitive factor. It was within the resources of both students and the polytechnic.

Within the context of the clinical module (primary health care nursing) offered at North Tec it is recommended that the SMS project be continued as standard practice for future clinical modules. This pilot and associated research may also have lessons for nurse educators nationally and internationally, especially in supporting students in the field. The use of SMS and eTXT as a form of student support could also be investigated for use in other areas such as at the start of tertiary education experience to aid retention. Further research is required to investigate future applications in educational settings.

The goal of the M-support project was to introduce a system which provided m-support for students enrolled in primary health care nursing through the SMS facility on cell phones. The research results indicated that this pilot was very successful in achieving this goal. M-support offers a complementary, cost effective and acceptable form of support for students in the field.

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# SMARTCHECKER: REAL TIME MONITORING AND TRACKING STUDENT'S CLASS ATTENDANCE USING WIRELESS PDA

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Personal Digital Assistants, Handhelds, Palmtops and Palm Pilots are all terms referring to pocket sized computer devices that make computing tasks more portable and flexible by being small enough to fit into one's pocket and mobile to be used anywhere. This paper describes the innovative platform, called SmartChecker that integrates mobile technologies into teaching and learning environment for the particularly tracking and monitoring of student's class attendance. SmartChecker, exploits the use of personal digital assistance (PDA) to provide mobile and instant graphical display. It also furnishes reports and progress tracks for determining student class attendance baselines, and improves the quality of monitoring and data captured technique, data-driven decision making and school accountability. SmartChecker is a new application was developed for data entry and retrieving all the student information using PDA. The software was developed and stored in server could be access using wireless PDA by teachers. The system automatically keeps the student's record for that class and also will calculate all the attendance for those particular days. SmartChecker serves both the school administrators and teachers. We have also highlighted and proposed solutions on specific technical and design issues relating to hand held devices, such as information display on small screen, information security, and the overall system architecture.

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## 1 Introduction

This paper presents the design and development of a mobile platform called SmartChecker that enables mobile access to a large database of student's class attendance data as well as tracking and monitoring their academic and behavioral developments in both summative and formative modes. We first illustrate two scenarios where SmartChecker can be deployed to provide an impact on school-based assessment and student management. These scenarios also form the basis for highlighting the design and technical issues of developing such a mobile monitoring platform in the subsequent sections.

## 2. Scenario: What can SmartChecker do?

When Kamri, the head-teacher of class 5 AMANAH in Kompleks Gong Badak Primary School just finishes the morning session and is rushing to have a meeting

with the headmaster, he suddenly sees Aminah, Asri's student in 5 SIDIQ, is crying in the corner. "What's up?" But Aminah refuses to say a single word. Kamri is in a hurry to the meeting, so she quickly takes out the SmartCheker. "Aminah is crying in the 3<sup>rd</sup> floor corner", she marks down the message and then transfers it to Asri.

SmartChecker retrieves all recent information relating to Aminah from the school database, such as her formative and summative assessment results in the recent past, as well as her in-school performance. Together with the coming message, SmartChecker starts to analyze if Aminah has been behaving atypically for a period of time, or this is just an isolated event, the result would then generate different alerts on Asri's PDA immediately.

Now Kamri has arrived at the president's office, where the school master is evaluating his performance. "Let us discuss about the student attendance", says the headmaster. Meanwhile, a series of bar-charts are shown on their respective PDAs. "Comparing to the form average, the scores of all your classes' attendance in the past few months are always very good. Great, I will give you some special award at the conference next week," smiles the headmaster, "but we should not only focus on the average scores, we should also look at individual students to see who may need special attention." He turns his attention back to the PDA screen that is now showing a system generated alert together with the ranking variation graph of a student. "I think we should pay more attention to him", says the headmaster, "he was our best student, but now I am a little disappointed about his performance in the past two months based on his attendance. SmartChecker alerted me last night, telling me his overall performance is atypical these two months, and we should find out what is wrong with him. You should have received the same alert, and let us look into this right away."

When Kamri leaves the office, she sees Asri coming over. He expresses thanks to Kamri, and says he has checked the performance box of the student Aminah, and notices that Aminah has been seen by various teachers crying 4 times in the past 5 days. "SmarChecker tells me she needs instant care, showing me she never been in class for 3 times this week, and had lower than average scores in her monthly test in Bahasa Melayu. She was a very good student, smart and happy in the past. Recent event are unusual behavior for her, and I will arrange a meeting with her parents tomorrow. Luckily I have been alerted by SmartChecker when this unusual behavior is just emerging and not when she has done more damages to herself."

### **3. Why Mobile Technology Useful in School Environment?**

SmartChecker is designed with regard to the objectives. And by using PDA, it will have the added advantage of portability - anytime and anywhere access to learning data. SmartChecker is a mobile student performance monitoring system using wireless mobile handheld devices like PDAs that facilitates real-time access and analysis of the formative and summative performance data of students graphically. At the same time it supports performance prediction based on the heuristic information, and facilitates the improvement of the quality of teaching, learning, data-driven decision-making, monitoring and school accountability. In our work, the Data source of SmartChecker the *SMM (Sistem Maklumat Murid)* system, which is an online school management system and a city-wide learning data archive for all school

students in Malaysia maintained by the Education Ministry. *SMM* maintain the student learning data for all the primary and secondary schools, storing the learning records and personal information for about all students in primary, secondary schools, as well as teaching staff. By utilizing the massive amount of records of learning data of every single student in Malaysia, SmartChecker could potentially provide to each school mobile access to these data as well as the tools to visualize and analyze the performance of their students' academic as well as extra-curricula activities. It also provides the opportunity to discover, for example, hidden associations of learning and demographic patterns through data mining techniques.

#### **4. Why PDA?**

Many computer-based learning systems have been developed to help educators to deploy information technology (IT) in the classroom, to help network administrators manage the technology, and to help School District computer support staff provide the best possible support for hardware and software solutions for schools. It provides curriculum software, classroom management, and a set of tools helping teachers to create electronic documents. While desktop computers have already provided a huge impact on education, the emergence of small computing devices, such as personal digital assistant (PDA) are beginning to make their presence known in many schools. PDA is a handheld computer that people can take to school, home, or any place where a PC must come in handy. The portability of such a device helps to provide effective training anywhere and anytime.

However, functions relating to administrative and analysis of student's class attendance and performance for teachers have not been addressed in previous work on mobile learning. Hofstetter (2002) points out that, educators need software that enables them to identify students' problems immediately when they encounter difficulty, and provide scaffolding to help students to overcome these difficulties. Tsantis and Castellani (2001) show that, in many cases of education aiding systems, the data exists, the tools to translate the data exist, but the time for practicing educators to organize even descriptive statistics remains limited, while, in the mean time, the amount of student performance data continue to grow and update. Thus, front-line urgently teachers need a computer-assisted way to reap the benefit of such massive as well as time sensitive student monitoring data. By using such a continuous monitoring and alert system, teachers can target students who need immediate attention rather than waiting until a more serious situation has presented itself. The same scenario could be imagined for students who have received consistently high grades, perfect attendance, and no discipline referrals or other combinations of student indicators. PDA, with its high portability and mobility, is an ideal platform to provide such learning support and monitoring functions.

Since mobile learning is an emergent and yet fast growing area of computers in education, some of the pros and cons of using mobile devices in learning have been observed in. Some of these advantages are: they can operate anytime anywhere, In primary and secondary schools, teaching staff spend more than 60% time outside their office, either teaching in the classrooms or in the playground or conducting other co-curricula activities and mobile devices can help them to retrieve pre-stored documents or getting distributed information when they are away from their desktop, while the prices of such devices are rapidly dropping they are also easy to integrate into a

child's world, and can become part of the children's culture and mobile devices are ideal platforms for collaborative learning.

## **5 Framework for SmartChecker: Real Time Monitoring and Tracking Student's Class Attendance Using Wireless PDA Device**

The pilot project will help determine and confirm the following issues before developing full scale data collection software around the PDA: 1.*Real-time or Batch data exchange*: Is real-time sending of information to the main server really needed? How much traffic in Kilobytes will be generated? How much will that cost? Will real time information exchange help in data collection monitoring? Will daily batch information interchange suffice, or should the enumerator in the field be connected to the main database all the time and perform all information update on it directly? 2.*Synchronization with main database*: Will the main database be MySQL? How will the mechanism of integration between received data from PDA, if in batch mode, occur with the main database? 3.*How well will the adopted PDA perform in the field*: Will the battery be enough? How will recharging happen? Is the PDA easy to use? What will be the optimum procedure to follow for its use in data collection? Will the PDA memory be enough to handle the client-side application and data storage (if batch mode is used)?

Three major technical issues needed to be addressed in any PDA system development: (a) Multiple user environment - how to categorize users into different groups with different information needs. (b) Data privacy control - how to ensure data can only be seen by the right person, and prevent from the man in the middle attack. (c) Interface designs how to show a large amount of graphs and information efficiently and ergonomically on a very small screen.

### **5.1. Multipurpose functionality for school and teachers**

In a school environment, there are two distinct user groups: school administrator and teachers. SmartChecker is composed of two distinct parts to serve the needs of the different groups. SmartChecker provides global views and analyses of the school performance for this group of users. The main focus is to enhance the school accountability, and to access the school continuous improvement data. Based on the quantitative analytical results, SmartChecker helps to develop teacher professional programs that would have a quick effect in the classroom and in student monitoring. Basically, two levels of analysis results can be presented for the administrator level users. The analysis for this group is focused on the attendances scores. There are form level analysis and class level analysis. At the form level, the mean, standard deviation, and other statistical factors of the attendance results can be shown graphically and compared across years. The trends of the attendances scores of a form or the whole school can also be visualized graphically. At the class level, statistical factors of each subject within each class will be presented, which helps to facilitate the performance assessment of the students.



## 5.2. Data privacy control

Due to the inherent data privacy concern, it is important to protect the data in SmartChecker at three levels. (a) Physical security: Protecting the device from loss or theft, and preventing access to the device operating system (OS) and the SmartChecker application if the device does fall into the wrong hands. (b) Data security: Ensuring that if the device does fall into the wrong hands and the OS is accessed, the data stored in the device cannot be accessed. (c) Network security: Preventing eavesdropping during data transmission between the device and the system server. RSA is the most widely used algorithm for public key encryption, and is believed to be secure given sufficiently long keys. Here we modify the classical protocol as shown in (Figure 1) to take into account of the limitations of hand held devices.

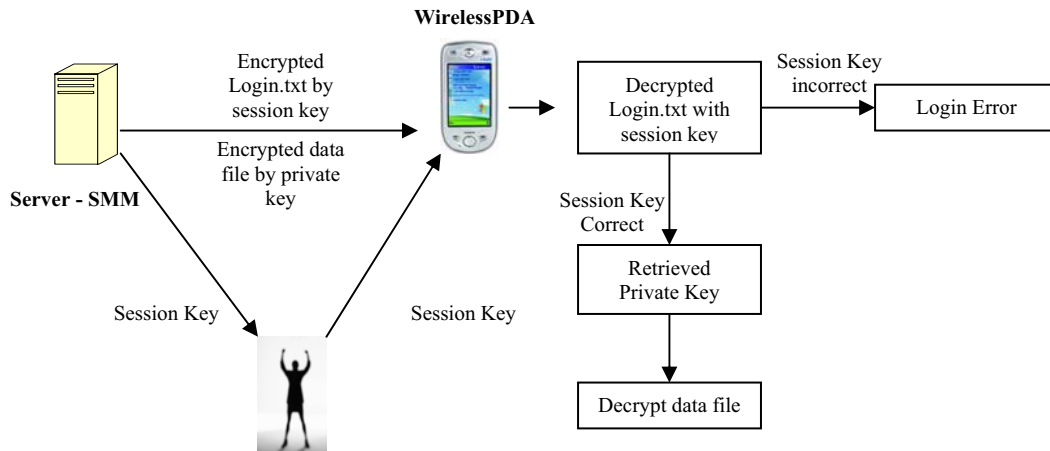


Figure 1: Data encryption protocol for SmartChecker

The idea of this protocol is to use public key encrypting data files on server before transformation, and to decrypt by the private key stored on the PDA. Different from the classical RSA, our private key is further encrypted by a session key, keeping it from being disclosed. The session key is divided into two parts: user-partial-session-key and system-partial-session-key. The former one is set once by user when the system is launched, this alleviates the burden on the users having to keep changing keys. Every time the user log in, the user partial session key is needed; the system will then combine the two partial session keys together to retrieve the private key. If the decryption of private key fails, which implies the impropriety of the user, an error message will be shown and an alert signal will be transferred to the server.

## 5.3 System Architecture and Implementation

This system was developed using three tier architecture, as depicted in figure 2, has been chosen for monitoring of system using Internet technology. This architecture provides greater application scalability, high flexibility, high efficiency, lower maintenance, and reusability of components. In this design, each tier can be run either on a separate machine or on the single machine. It improves system processing performance. These tiers do not necessarily communicate to physical locations on different computers or networks. A typical three layer architecture is divided into Client or presentation tier, Application tier and Data tier.

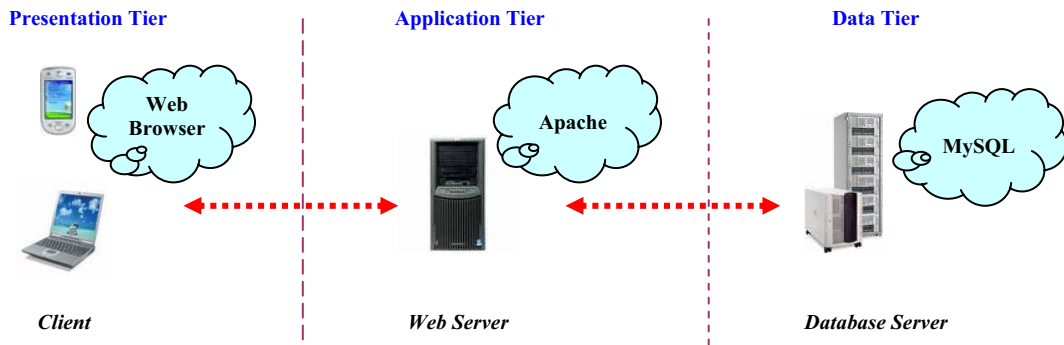


Figure 2: Three-tier architecture

### 5.3.1 Client or Presentation tier

This tier enables user to interact with the database through the web browser in a user friendly manner from remote location or using wireless device like PDA. It is also called user services layer refer to figure 3. It provides user to access the application. This layer optionally permits to feed and manipulate data.

### 5.3.2 Application tier

Application tier consists of web server and application logic for data monitoring. This tier is also called application service layer. The logics and rules are separately stored in the files using Web scripts. This architecture has proven ideal for developing Hypertext Preprocessor (PHP), Extensible Markup Language (XML) based applications because all PHP and XML processing is carried out on the middle tier of the system, without affecting client and/or database tier manipulation/development. These logics and rules are properly interfaced with the main Web server in this tier. In the current development of monitoring system, Apache Server has been used as Web server. This provides management services that are shared by multiple applications.



Figure 3: Interface Design

### 5.3.4 Data tier

This tier is also called data service layer. It concerns with persistent data usually stored in a database or in permanent storage. We are using MySQL database to store the entire student's class attendance data collection by wireless PDA via online application. It can be accessed either through the application services layer or on event created by the user services layer. The major benefits of three tier architecture are reusability, flexibility, manageability, maintainability, and scalability.

## 5.4. SmartChecker System Design : Main functions, report and alert System

SmartChecker consists of the following main functions: Querying of data in a city-wise learning data management and archive system such as the Malaysia SMM system, and facilitating comparison of data scattered across multiple databases, generate and display the results of formative assessment and summative assessment in different graphical formats, like bar-chart and scattered diagram. Users can simply navigate and hyper linking through different graphs and data points to gain a thorough understanding of each student's class attendances, from the detailed scores, comparison to the average to the overall ranking, perform trend analysis by a set of pre-determined rules. The prediction modeling is conducted according to the trend analysis, and instant alert will be pop up. The alert consists of the detailed information of an atypical student who may need special care, on-site input of additional formative assessment data by teachers. Here, formative assessment data consists progress check and classroom performance. Teachers are able to input them anytime and anywhere, and at the same time, the data will be transferred to the school database securely when there is a network connection, assign appropriate levels of access and security for different groups of users. The large database on the server side is separated into many small tables, and then configured to different XML files for transformation.

## 6. Conclusion

SmartChecker is an instantaneous and mobile student performance monitoring and checking system, and in addition to predicting student's class attendance or potential problems, it can also help to evaluate the students' performance based on their attendance. The implementation on PDA with wireless network greatly enhances its portability and usability. Particularly we have highlighted and proposed solutions on the specific design issues relating to hand held devices system architecture. For future development, we will focus on the analysis of student performance and real-time prediction. Prediction rules will be defined based on the following three factors: *formative assessment results, summative assessment results, and merits*. An approach will be designed based on a set of pattern classifiers, not only showing the atypical students, but listing out possible reasons for their changes. The expertise of teaching staff will be utilized as the heuristic knowledge in design of these rules and also fully utilized the wireless technology devices like PDA.

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